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RESEARCH ARTICLE

Dietary and Eating Habit of Overweight/Obese Adolescents of Peri-Urban Areas of Ludhiana Districts

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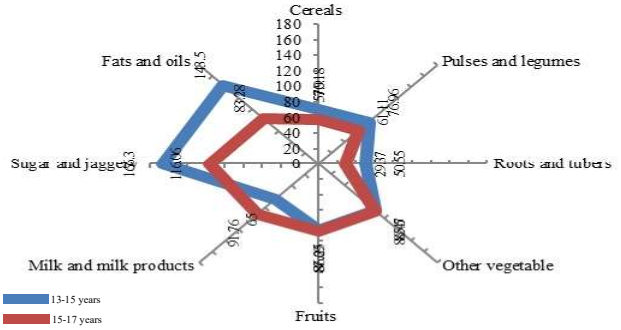
HIGHLIGHTS

- Determine obesity prevalence among adolescents (13-17 years) in peri-urban areas of Ludhiana district. Overweight is found 23.4% and Obesity is 1.20% among adolescents
- Adequate intake of energy, protein, fat, thiamine, vitamin C, and folic acid. Inadequate intake of ß carotene, retinol, riboflavin, niacin, calcium, and iron. Zinc intake marginally adequate in boys, marginally inadequate in girls. 47.5% of adolescents
- Low level of physical activity and performances observed among selected adolescents.

GRAPHICAL ABSTRACT

Average daily intake of food by adolescents



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ABSTRACT

Context: The study investigates the high prevalence of overweight and obesity among adolescents in peri-urban Ludhiana, Punjab, examining dietary habits, nutrient intake, and associated health risks to inform targeted interventions for promoting healthier lifestyles and mitigating obesity-related health issues.

Objective: The aim of the study was to find the prevalence of obesity among adolescents (13-17 years) in peri-urban areas of Ludhiana district.

Methods: In the study a sample of 80 adolescents (40 boys and 40 girls) in the age group of 13-17 years was selected from the peri-urban areas (Hambran and Mullanpur).

Results and discussion: Among adolescents, 23.4% were overweight and 1.2% were obese, with higher pre-obesity rates among girls aged 15-17 and obesity rates higher in boys. Meal skipping was prevalent at 47.5%, especially breakfast, despite 63.75% consuming three meals daily. Nutrient intake was mostly adequate, except for deficits in ß carotene, retinol, riboflavin, niacin, calcium, and iron. Zinc intake was barely adequate for boys and inadequate for girls. The low level of physical activity and performances was observed among the selected adolescents. These findings underscore significant health risks, including diabetes, hypertension, and heart disease, compounded by psychological issues like body image dissatisfaction.

Significance: The study suggests targeted interventions including comprehensive nutrition education, increased physical activity, and improved dietary practices, emphasizing parental involvement to foster healthier food choices. Addressing these issues holistically can mitigate the adverse health impacts of adolescent obesity and promote long-term well-being.

Overweight and obesity among adolescents have become globally prevalent, both in industrialized and developing countries. The prevalence of obesity among adolescents is considered as a global epidemic. It has serious public health consequences (WHO 2014). Bad food choices, lack of nutritional knowledge and awareness, faulty eating habits like eating food while watching television, inactivity due to excessive and unnecessary use of mobile phones and computers, long hours of playing video games and usage of other electronic devices and no involvement in outdoor games etc. all contribute to the incidence of obesity among adolescents (Rosen 2014). Changes in the behavior of adolescents such as aggression and other undesirable impact directly associated with excessive use of mobile phones and other electronic devices leading to inactivity (Bansal 2018). Overweight and obesity in adolescence tends to track into adulthood and becomes difficult to treat (Park 2012). Adolescents are facing serious health problems such as diabetes, high blood pressure and heart disease. All these are outcome of lifestyle and food choices. Vegetables essential for food and nutritional security (Noopur *et al.,* 2023) have been overlooked in the diet plan, compromising the availability even of bioactive molecules vital for various disease prevention (Panwar *et al.,* 2024). However, a number of constraints hinder the production and consumption of vegetables (Noopur *et al.,* 2023) than fast food and hence fast food leading to obesity which affect the eating behavior especially obese girls who are more prone to eating disorders such as binge eating and experience greater body image dissatisfaction compared to obese boys (Phul, 2007).

METHODOLOGY

Locale of research: The study was carried out in peri-urban agers of Ludhiana district of Punjab (The latitude of Ludhiana is 30.900965, and the longitude is 75.857277).

Research design: A questionnaire cum interview schedule was used. BMI was calculated from the height and weight of the subject by using the formula stated by Garrow (1981). Information regarding food habits and meal pattern of 80 sub-subjects was recorded. To obtain data regarding dietary intake of the subjects, 24-hour recall method was used for three consecutive days. The average daily food and nutrient intake was assessed by using Diet Cal software (Kaur, 2017). The food and nutrient intake were compared with suggested dietary intakes for balanced diet and Recommended Dietary Allowances (ICMR, 2010).

Sampling design: Total 80 adolescents in the age group of 13-17 years of both genders were selected.

Measurement Techniques: Use Likert scales to assess dietary habits and physical activity. Create an index by combining scores of dietary adequacy and physical activity levels. Calculate scores for nutrient intake adequacy.

Statistical and other tools: Per centage, frequency, adequacy, mean values, standard deviation and correlations were employed to analyze associations between dietary patterns, physical activity, and weight status among adolescents. The per cent nutrient adequacy was calculated using following formula:

$$\% \text{ Nutrient adequacy} = \frac{\text{Intake of nutrient}}{\text{Recommended intake nutrient}} \times 100$$

Per cent Nutrient Adequacy using a classification given by Jood et al (1999)

Category	%
Adequate	100% and above
Marginally adequate	75% and above
Marginally inadequate	50 to 74.9%
Inadequate	Below 50%

RESULTS

Classification of subjects based on BMI : The table delineates the distribution of subjects based on their Body Mass Index (BMI) as per the World Health Organization (WHO) 2004 guidelines. It classifies subjects into overweight, pre-obese, and obese groups, further subdividing the obese category into Grade I, II, and III based on specific cut-off points. The study encompasses two groups: Group A (boys, n=40) and Group B (girls, n=40), further segmented into age subgroups of 13-15 years and 15-17 years.

In the overweight category (BMI ≥25.00), the majority of subjects are included: 95.65 per cent of boys aged 13-15 years, 82.35 per cent of boys aged 15-17 years, 100 per cent of girls aged 13-15 years, and 92 per cent of girls aged 15-17 years, resulting in an overall overweight prevalence of 92.5 per cent.

In the pre-obese category (BMI 25.00-27.49), 6.75 per cent of boys aged 13-15 years, 8.10 per cent of boys aged 15-17 years, 2.70 per cent of girls aged 13-15 years, and no girls aged 15-17 years fall into this classification, accounting for 17.56 per cent of pre-obese subjects.

Within the BMI range of 27.50-29.99, a subcategory of pre-obese, 22.97 per cent of boys aged

Table 1. Distribution of the subjects based on BMI as recommended by WHO 2004

Categories of Body Mass Index (BMI)	Principle cut-off point	Group A (Boys) n=40		Group B (Girls) n=40		Total N=80
		13-15 years n=23	15-17 years n=17	13-15 years n=15	15-17 years n=25	
Overweight	≥25.00	22(95.65)	14(82.35)	15(100)	23(92)	74(92.5)
Pre-obese	25.00-27.49	5(6.75)	6(8.10)	2(2.70)	-	13(17.56)
	27.50-29.99	17(22.97)	8(10.81)	13(17.56)	23(31.08)	61(82.43)
Obese	≥30.00	1(4.34)	3(17.64)	-	2(8)	6(7.5)
Obese Grade I	30.00-34.99	1(16.66)	3(50)	-	2(33.33)	6(100)
Obese Grade II	35.00-39.99	-	-	-	-	-
Obese Grade III	≥40.00	-	-	-	-	-

Figures in parenthesis are in per centage

Table 2. Dietary and eating habits of selected subjects

Variables	Group A (Boys) (n=40)		Group B (Girls) (n=40)		Total N-80
	13-15 years (n=23)	15-17 years (n=17)	13-15 years (n=23)	15-17 years (n=17)	
Type of diet					
Vegetarian	13(56.52)	7(41.17)	11(73.33)	16(64)	47(58.75)
Non vegetarian	8(34.78)	7(41.17)	3(20)	7(28)	25(31.25)
Ova vegetarian	2(8.69)	3(17.64)	1(6.66)	2(8)	8(10)
Frequency of major meal consumption					
Twice a day	7(30.43)	5(29.41)	2(13.33)	7(28)	21(26.25)
Thrice a day	14(60.86)	10(58.82)	10(66.66)	17(68)	51(63.75)
4 times a day	2(8.69)	1(5.88)	3(20)	1(4)	7(8.75)
More than 4 times	0	1(5.88)	0(0)	0(0)	1(1.25)
Habit of meals skipping					
Yes	15(65.21)	8(47.05)	6(40)	13(52)	38(47.5)
No	8(34.78)	9(52.94)	9(60)	12(48)	42(52.5)
Frequency of skipping meals (days/week)					
Daily	8(34.78)	4(23.52)	0(0)	6(24)	18(22.5)
Thrice (week)	0(0)	0(0)	5(33.33)	0(0)	5(6.25)
Twice (week)	3(13.04)	0(0)	0(0)	0(0)	3(3.75)
Fortnightly	1(4.34)	1(5.88)	0(0)	4(16)	6(7.5)
Rarely	3(13.04)	1(5.88)	1(6.66)	3(12)	8(10)
Frequency of snacks consumption					
Once in a day	1(4.34)	2(11.76)	0(0)	1(4)	4(5)
Twice a day	20(86.95)	11(64.70)	13(86.66)	19(76)	63(78.75)
Thrice a day	2(8.69)	3(17.64)	2(13.33)	5(20)	12(15)
More than 3 times	0(0)	1(5.88)	0(0)	0(0)	1(1.25)
Do you bring water bottle to school					
Yes	7(30.43)	3(17.64)	8(53.33)	13(52)	31(38.75)
No	16(69.56)	14(82.35)	7(46.66)	12(48)	49(61.25)
Water intake per day					
>2 liter	6(26.08)	0(0)	2(13.33)	4(16)	12(15)
<2 liter	17(73.91)	17(100)	13(86.66)	21(84)	68(85)
Frequency of fruits intake					
< 1 time	14(60.86)	10(58.82)	8(53.33)	8(32)	40(50)
1 time	8(34.78)	5(29.41)	5(33.33)	11(44)	29(36.25)
2 times	1(4.34)	2(11.76)	2(13.33)	6(24)	11(13.75)

Time of fruit consumption in a day					
Before meal	6(26.08)	1(5.88)	2(13.33)	7(28)	16(20)
With meal	3(13.04)	4(23.52)	3(20)	2(8)	12(15)
After meal	2(8.69)	1(5.88)	2(13.33)	3(12)	8(10)
Anytime	12(52.17)	11(64.70)	8(53.33)	13(52)	44(55)
Frequency of salad intake					
< 1 time	9(39.13)	6(35.29)	4(26.66)	8(32)	27(33.75)
1 time	10(43.47)	10(58.82)	7(46.66)	12(48)	39(48.75)
2 times	4(17.39)	1(5.88)	4(26.66)	5(20)	14(17.5)
Time of salad consumption in a day					
Before meal	0(0)	0(0)	0(0)	3(12)	3(3.75)
With meal	20(86.95)	15(88.23)	14(93.33)	20(80)	69(86.25)
Anytime	3(13.04)	2(11.76)	1(6.66)	2(2	8(10)
Do you wash your fruit before eating					
Always	17(73.91)	14(82.35)	13(86.66)	20(80)	64(80)
Very often	4(17.39)	1(5.88)	1(6.66)	2(8)	8(10)
Sometimes	1(4.34)	1(5.88)	1(6.66)	3(12)	6(7.5)
Never	1(4.34)	1(5.88)	0(0)	0(0)	2(2.5)
How many times you chew a bite					
< 10 times	1(4.34)	0(0)	1(6.66)	3(12)	5(6.25)
10-20 times	0(0)	0(0)	0(0)	0(0)	0(0)
20-30 times	3(13.04)	4(23.52)	0(0)	2(8)	9(11.25)
Never counted	19(82.60)	13(76.47)	14(93.33)	20(80)	66(82.5)
Do you have your breakfast daily					
Always	18(78.26)	11(64.70)	10(66.66)	15(60)	54(67.5)
Very often	3(13.04)	1(5.88)	3(20)	5(20)	12(15)
Sometimes	2(8.69)	2(11.76)	2(13.33)	2(8)	8(10)
Never	0(0)	3(17.64)	0(0)	3(12)	6(7.5)
Do you wash your hands before taking meals					
Always	23(100)	15(88.23)	14(93.33)	22(88)	74(92.5)
Very often	0(0)	1(5.88)	0(0)	1(4)	2(2.5)
Sometimes	0(0)	1(5.88)	0(0)	1(4)	2(2.5)
Never	0(0)	0(0)	1(6.66)	1(4)	2(2.5)
Lunch options					
Bring your lunch from home	11(47.82)	5(29.41)	8(53.33)	13(52)	37(46.25)
Mid-day meal	10(43.47)	3(17.64)	6(40)	5(20)	24(30)
Buy a snack/meal from canteen/vender also	1(4.34)	4(23.52)	1(6.66)	5(20)	11(13.75)
Skip a lunch	1(4.34)	5(29.41)	0(0)	2(8)	8(10)

Figures in parenthesis are in per centage

13-15 years, 10.81 per cent of boys aged 15-17 years, 17.56 per cent of girls aged 13-15 years, and 31.08 per cent of girls aged 15-17 years are categorized, making up 82.43 per cent of the subjects in this range.

In the obese category (BMI ≥30.00), 4.34 per cent of boys aged 13-15 years, 17.64 per cent of boys aged 15-17 years, no girls aged 13-15 years, and 8 per cent of girls aged 15-17 years fall into this classification, leading to an overall obesity prevalence of 7.5 per cent.

Specifically, in the Obese Grade I category (BMI 30.00-34.99), 16.66 per cent of boys aged 13-15 years, 50 per cent of boys aged 15-17 years, no girls aged 13-15 years, and 33.33 per cent of girls aged 15-17 years are classified, constituting 100 per cent of the subjects in this category. No subjects fall into the Obese Grade II (BMI 35.00-39.99) or Obese Grade III (BMI ≥40.00) categories.

This distribution underscores a significant prevalence of overweight and obesity among the adolescent subjects, emphasizing the need for targeted interventions to manage and mitigate BMI within healthy ranges. Additionally, findings by Ghosh et al.

(2020) reported that 12 per cent of adolescents were overweight, followed by 3.5 per cent classified as obese, further corroborating the necessity for strategic health interventions.

The distribution reveals that among boys, 65 per cent are classified as overweight, 20 per cent as pre-obese, 7.5 per cent as obese, and 7.5 per cent as Obese Grade I. In contrast, the distribution among girls indicates 77.5 per cent are overweight, 5 per cent are pre-obese, 5 per cent are obese, and 5 per cent fall into the Obese Grade I category. These charts highlight a higher prevalence of overweight status among girls compared to boys, while boys exhibit higher percentages in the pre-obese and obese categories.

Dietary habits of selected subjects: The dietary habits of the selected subjects are presented in the Table 2. Most of the subjects 47(58.75%) were vegetarian, among them 13(56.52%) and 7(41.17%) were boys and 11(73.33%) and 16(64%) were girls in the age group 13-15and 15-17 years, respectively. Further, 25(31.25%) of selected subjects were non-vegetarian (34.78 % and 41.17 % boys and 20 % and 28 % girls aged 13-15 and 15-17 years, respectively). Eight (10%) selected subjects were ova-vegetarian. In a study by Fatima *et al* (2019) more of the overweight and obese children were non vegetarian (63 subjects) and 7 subjects was vegetarian (7 subjects).

Further, the present study revealed that more than half 51(63.75%) of the subjects use to consume three major meals per day followed by 26.25, 8.75 and 1.25 percent of adolescents consuming two, four and more than four meals per day, respectively. The practice of skipping meals was prevalent among half (47.5%) of the adolescents. Twenty two percent selected subjects skipped meals on the daily basis. The frequency of skipping meals fortnightly by selected subjects was by 6(7.5%), rarely 8(10%), thrice a week 5(6.25%) and twice a week 3(3.75%) whereas 18(22.5%) of subjects reported skipping of meals (any) on daily basis.

Maximum number of selected subjects (78.75%) consumed snacks twice a day. Fifteen percent subjects ate snacks thrice a day followed by 5 per cent and 1.25 percent adolescents who consumed snacks once times a day and more them three times a day, respectively. Thirty nine percent selected subjects use to bring their own water bottle to school. The water intake of the 15 percent subjects was more than the 2 liters per day and 85 percent subjects use to drink less than 2 liters water per day. Only 36.25 percent (34.78 and 29.41 per cent boys and 33.33 and 44 per cent girls aged 13-15 and 15-17 years, respectively) ate fruit daily. Thirteen percent selected subjects ate fruit 2 times per day. There are half of the selected subjects (50%) who did not consume fruits even once a day. Fifty five percent of the adolescents take fruit anytime in a day (in between) and 16(20%), 12(15%), 8(10%) adolescents take fruit before meal, with meal, or after meal, respectively. Less than half of the subjects 39(48.75%) take salad once in daily diet, 10(43.47%) and 10(58.82%) boys and 7(46.66%) and 12(48%) girls from the age group 13-15 and 15-17 years, were practicing this. respectively. Only 17.5 percent selected subjects use to consume salad 2 times in a day. Eighty six percent subjects consumed salad with meals (86.95 and 88.23 percent boys and 93.33 and 80 percent girls aged 13-15 and 15-17 years, respectively) and 8(10%) and 3(3.75%) subjects consumed anytime and before meal in a day. Majority of the selected subjects 66(82.5%) never counted that how many times they chew a bite. Very few (11.25%) stated that they chew a bite 20-30 times and 5 (6.25%) subjects said that they chew a bite less than 10 times. Further results showed that 54(67.5%) adolescents always consumed breakfast followed by 15 percent who consumed breakfast very often, 10 percent sometimes and 7.5 percent who never ate breakfast. The 13-15 years boys (78.26%) and girls (66.66%) use to skip breakfast as compare to15-17 years boys (64.70%) and girls (60%). Similarly, In the study by Fatima *et al* (2019) it was revealed that 26 percent adolescents generally skip their breakfast.

Majority of the adolescents 74(92.5%) use to practice washing hand before meals. Whereas 2.5 per cent subjects used to wash their hands sometimes, 2.5 per cent adolescents use to wash their hand very often and 2.5 percent reported that they never bothered to wash their hands before taking meal. Less than half of the subjects i.e. 37(46.25%) use to bring lunch from home, girls of age group 15-17 years 13 (52%) were more likely to bring their lunch from homemade lunch as compare to the girls of 13-15 years 8 (53.33%) age group. Majority of boys from age group 13-15 years (47.82%) use to bring their lunch from home in comparison to the boys of 15-17 years (29.41%). Mid-day meal was preferred by 24(30%) adolescents followed by canteen meal/snack consumers 11 (13.75%) and those who skipped their lunch were 8(10%) subjects. Boys (47.82%) and girls (52%) aged

Table 3. Meal timing of the selected subjects

Particulars	Group A (Boys)		Group B (Girls)		Total
	13-15 years n=23	15-17 years n=17	13-15 years n=15	15-17 years n=25	N=80
Meal timings					
Breakfast					
Before 8 am	18(78.26)	11(64.70)	11(73.33)	13(52)	53(66.25)
8:00-9:00 am	5(21.73)	3(17.64)	3(20)	8(32)	19(23.75)
9:00-10:00 am	0(0)	3(17.64)	1(6.66)	0(0)	4(5)
After 10 am	0(0)	2(11.76)	0(0)	2(8)	4(5)
Lunch					
Before 1 pm	14(60.86)	0	9(60)	14(56)	44(55)
1:00-2:00 pm	6(26.08)	2(11.76)	2(13.33)	3(12)	13(16.25)
2:00-3:00 pm	2(8.69)	6(35.29)	4(26.66)	8(32)	20(25)
After 3 pm	1(4.34)	1(5.88)	0(0)	1(4)	3(3.75)
Dinner					
Before 8 pm	2(8.69)	3(17.64)	1(6.66)	3(12)	9(11.25)
8:00-9:00 pm	12(52.27)	8(47.05)	9(60)	10(40)	39(48.75)
9:00-10:00 pm	8(34.78)	4(23.52)	4(26.66)	11(44)	27(33.75)
After 10 pm	1(4.34)	2(11.76)	1(6.66)	1(4)	5(6.25)
Snacks					
Mid-morning	7(30.43)	3(17.64)	4(26.66)	5(20)	19(23.75)
Evening time	2(8.69)	2(11.76)	1(6.66)	6(24)	11(13.75)
Two times	5(21.73)	4(23.52)	1(6.66)	3(12)	13(16.25)
Any time	9(39.13)	8(47.05)	9(60)	11(44)	37(46.25)

Figures in parenthesis are in per centage

13-15 years use to bring lunch from home.

Meal timings of selected subjects: The meal timings of the selected subjects are shown in the Table 3. Almost 53(66.25%) of the subjects ate their breakfast before 8am. While 23.75, 5 and 5 percent subjects ate their meal in between 8-9 am, 9-10 am and after 10 am, respectively. Further majority of the subjects (55%) preferred to ate lunch in the recess time i.e. before 1 pm. Sixteen percent subjects had their lunch from 1-2 pm, 13(16.25%) from 2-3 pm and 3.75 per cent ate lunch after 3 pm. Only 9(11.25%) of the subjects consumed dinner before 8 pm. Almost 39(48.75%) and 27(4.2%) subjects ate dinner between 8-9 pm and 9-10 pm, respectively and 5(6.25%) subjects ate dinner around 10 pm. Further results revealed that there was no exact timing for having snacks. Generally, adolescents ate snacks any time (46.25%) and 13.75 and 16.25 per cent ate snacks in the evening and morning, respectively. Only 13(16.25%) subjects prefer to have snack two times in a day i.e. in the morning and evening. Vidmar *et al* (2020) revealed that more than 60 per cent of calories, carbohydrates and added sugar were consumed between 11:00 am and 19:00 pm, by the adolescents (n=13 year).

Food Intake : The average intake of food and its percent adequacy is presented in Table 4 and 5.

Cereals and millets : It was found that the mean consumption of cereals and millets was 294.78±48.69g and 260.58±64.17g and 227.66±32.00 g and 191.2±45.12 by the boys and girls aged 13-15 years and 15-17 years, respectively. There was marginally inadequate percent adequacy of cereals among the adolescents of all age groups i.e.13-15-year boys (70.18%) and girls (68.78%) and for 15-17 years boys (57.60%) and girls (57.93%).

Pulses and legumes : The mean consumption of pulses and legumes was 57.72±36.44 g and 55±35.83 g and 58.57±37.64 g and 62.2±44.58 g by boys and girls of age group 13-15 years and 15-17 years, respectively. The percent adequacy of energy among the adolescents 13–15-year boys (76.96%) and girls (97.61%), 15-17 years girls (82.93%) and among 15-17 years boys (61.11%) was marginally inadequate.

Roots and tubers : It was noticed that the mean intake of roots and tubers was 75.83±56.96 g and 58.75±8.34 g for boys and 62.5±22.61 g and 103.84±51.88 g for the both age groups (13-15 and 15-17 years). The percent adequacy of roots and tubers was marginally

Table 4. Average daily intake of food groups (g) of selected subjects (N=80)

Food Group	Age (years)							
	13-15 years Boys (n= 23)		15-17 years Boys (n=17)		13-15 years Girls (n=15)		15-17 years Girls (n=25)	
	SDI*	Observed Value	SDI	Observed Value	SDI	Observed Value	SDI	Observed Value
Cereals	420	294.78±48.69	450	260.58±64.17	330	227.66±32.00	330	191.2±45.12
Pulses and Legumes	75	57.72±36.44	90	55±35.83	60	58.57±37.64	75	62.2±44.58
Roots and tubers	150	75.83±56.96	200	58.75±8.34	100	62.5±22.61	200	103.84±51.88
Other vegetables	200	171±68.10	200	172.94±98.98	200	161.66±61.86	200	122.22±36.32
Fruits	100	86.25±9.57	100	87.69±10.12	100	96.66±8.16	100	86.11±10.36
Milk and milk products	500	325±104.36	500	458.82±207.08	500	326.66±75.27	500	324±98.02
Sugar and jaggery	20	33.26±10.83	30	34.82±8.50	25	32.93±11.42	25	35.76±9.52
Fats and oils	45	64.78±37.03	50	41.64±16.04	40	41.66±13.84	35	45.2±18.56

Values are Mean ± SD; * Suggested dietary intake (ICMR 2010)

inadequate among the adolescents of age group 13-15 years' girls (62.5%) and boys (50.55%) and 15-17 years girls (51.92%) and among 15-17 years boys (29.37%) percent adequacy was marginally adequate.

Other vegetables : Average mean intake of other vegetables among the adolescents' boys and girls was 171±68.10 g and 172.94±98.98 g and 161.66±61.86 g and 122.22±36.32 g in the age group 13-15 and 15-17 years, respectively. There was marginally adequate percent adequacy of other vegetables among the adolescents of age groups i.e.13-15-year boys (85.5%) and girls (80.83%) and for 15-17 years boys (86.47%) and among girls (61.11%) of age group 15-17 years percent adequacy was marginally inadequate.

Fruits : The mean intake of fruits by the boys of age group 13-15 and 15-17 years was 86.25±9.57 g and 87.69±10.12 g and for girls 96.66±8.16 g and 86.11±10.36 g, respectively. The percent adequacy of fruits by the adolescents of all age groups i.e.13-15-year boys (86.25%) and girls (96.66%) and for 15-17 years boys (87.69%) and girls (86.11%) were inadequate.

Milk and milk products : Among adolescents the mean intake of milk and milk products was 325±104.36 and 458.82±207.08 g and 326.66±75.27 and 324±98.02 g for boys and girls of the age group 13-15 and 15-17 years, respectively. The percent adequacy of milk and milk products was marginally inadequate among the adolescents of age group 13-15 years' girls (65.33%) and boys (65%) and 15-17 years girls (64.8%) and among 15-17 years boys (91.76%).

Sugar and jaggery: It was observed that the mean intake of sugar and jaggery was 33.26±10.83 g and 34.82±8.50 g by boys and 32.93±11.42 g and 35.76±9.52 g by girls for the both age groups (13-15 and 15-17 years). The percent adequacy of the sugar and jaggery consumption was higher than the recommendation i.e. 13–15-year boys (166.3%) and girls (116.06%) and by 15-17 years boys (131.72%) and girls (143.04%).

Fats and oils : The results further revealed that the mean consumption of fats and oils was 64.78±37.03 g and 41.64±16.04 g among the boys aged 13-15 years and 15-17 years, respectively. The mean consumption of fats and oils by girls of age group 13-15 and 15-17 years was 41.66±13.84 g and 45.2±18.56 g. The percent adequacy of energy was higher among 13-15 years old adolescents' boys (143.95%) and girls (104.15%), followed by 15-17 years girls (129.14%) and 15-17 years boys (83.28%).

Nutrient intake : The average daily macronutrient and micronutrient intake and its per cent adequacy is presented in Table 4 and 5.

Macronutrient intake :

Energy : The mean daily intake of energy was 2681.75±240.21 Kcal and 2174.47±364.13 Kcal and 2016.64±241.96 Kcal and 2052.29±286.26 Kcal by boys and girls of age group 13-15 years and 15-17 years, respectively. The percent adequacy of energy was marginally adequate by the adolescents aged 13-15 years (boys 97.51% and girls 86.55%), 15-17 years (boys 72% and girls 84.11%).

Protein : The average daily intake of protein among 13-15-years and 15-17-years boys was 61.42±5.93 and 59.20±7.94 Kcal. Among adolescents age group 13-15 years it was slightly higher than the recommended protein intake. Among girl's intake was 47.16±6.11 and 46.91±6.06 Kcal of age group 13-15 and 15-17 years.

Table 5. Average daily intake of nutrients of selected subjects

Nutrients	Age (years)							
	13-15 years Boys n= 23		15-17 years Boys n=17		13-15 years Girls n=15		15-17 years Girls n=25	
	RDA*	Observed Value	RDA	Observed Value	RDA	Observed Value	RDA	Observed Value
Energy (Kcal)	2750	2681.75±240.21	3020	2174.47±364.13	2330	2016.64±241.96	2440	2052.29±286.26
Protein (g)	54.3	61.42±5.93	61.5	59.20±7.94	51.9	47.16±6.11	55.5	46.91±6.06
Carbohydrates (g)	-	355.51±31.24	-	310.96±34.85	-	266.06±37.27	-	267.41±33.39
Total Fat (g)	45	108.80±29.03	50	73.57±23.03	40	82.42±17.53	35	85.78±16.50
β-carotene (µg)	4800	964.67±429.29	4800	1011.44±531.94	4800	679.35±258.97	4800	663.35±388.43
Retinol (µg)	600	165.65±44.34	600	132.05±63.45	600	159.58±79.42	600	152.59±33.45
Thiamine (mg)	1.4	1.51±0.23	1.5	1.55±0.07	1.2	1.04±0.05	1.0	1.04±0.19
Riboflavin (mg)	1.6	0.96±0.14	1.8	0.98±0.22	1.4	0.74±0.13	1.2	0.74±0.16
Niacin (mg)	16	9.88±1.45	17	9.81±0.74	14	6.68±0.78	14	6.91±1.08
Vitamin C (mg)	40	105.06±77.05	40	84.32±60.73	40	51.47±18.80	40	53.57±33.11
Calcium (mg)	800	593.36±186.51	800	682.10±243.97	800	563.55±119.20	800	540.83±136.60
Iron (mg)	32	16.72±1.92	28	17.11±1.62	27	11.32±1.01	26	11.49±2.32
Folic acid (µg)	150	266.87±61.78	200	293.08±99.69	150	180.17±44.82	200	179.66±67.07
Zinc (mg)	11	10.91±1.18	12	10.83±0.70	11	7.28±0.52	12	7.46±1.14

Values are Mean ± SD ; *RDA-Recommended dietary allowance (ICMR 2010)

Protein consumption was adequate among 13-15 years boys (113.11%) and marginally adequate among 13-15 years girls (90.86%) and 16-17 years boys (86.55%) and girls (84.52%).

Carbohydrates : Carbohydrates are the source of energy. The data represents that the mean intake of carbohydrate was by boys aged 13-15 and 15-17 years was 310.96±34.85 Kcal and 310.96±34.85 Kcal and by girls of aged 13-15 and 15-17 years was 266.06±37.27 Kcal and 267.41±33.39 Kcal.

Total fat : The mean consumption of total fat (visible and invisible) by boys and aged 13-15 years was 108.80±29.03 and 82.42±17.53 Kcal. Whereas mean consumption of total fat by girls aged 13-15 years and 15-17 years was 73.57±23.03 and 85.78±16.50 Kcal. Mean values of fat intake was higher as compare to the recommended value by both boys and girls of different age groups. There was higher percent adequacy of fat among the adolescents of all age groups i.e.13-15-year boys (241.77%) and girls (206.05%) and 15-17 years boys (147.14%) and girls (245.08%).

Micronutrients :

ß-carotene : The mean intake of Beta-carotene was 964.67±429.29 µg and 1011.44±531.94 µg for boys, 679.35±258.97 µg and 663.35±388.43 µg for girls among the age group of 13-15 and 15-17 years, respectively. The percent adequacy of Beta-carotene was inadequate among the adolescents 13-15 years' boys (20.09%) and girls (14.15%), 15-17 years boys (21.07%) and girls (13.81%).

Retinol : Average intake of retinol 165.65±44.34 µg and 132.05±63.45 µg and 159.58±79.42 µg and 152.59±33.45 µg among boys and girls aged 13-15 and 15-17 years, respectively. There was an inadequate percent adequacy of retinol among the adolescents of all age groups i.e.13-15-year boys (27.60%) and girls (26.59%) and for 15-17 years boys (22%) and girls (25.43%).

Thiamine : It was observed that mean daily intake of thiamine was 1.51±0.23 mg and 1.55±0.07 mg by boys and by girls it was 1.04±0.05 mg and 1.04±0.19 mg for the both age groups 13-15 and 15-17 years, respectively. The percent adequacy of the thiamine among the adolescent girls aged 13-15 years (86.66%) was marginally adequate and among 13–15-year boys (107.85%) and 15-17 years boys (103.33%) and girls (104%) was adequate.

Riboflavin : The mean intake of riboflavin for boys and girls of age group 13-15 and 15-17 years was 0.96±0.14 mg and 0.98±0.22 mg and 0.74±0.13 mg and 0.74±0.16 mg, respectively. There was marginally inadequate percent adequacy of riboflavin among the adolescents of all age groups i.e.13-15 year boys (60%) and girls (54.44%) and for 15-17 years boys (52.85%) and girls (61.66%). The mean daily intake of riboflavin was noticed 0.42 ± 0.17 mg with percent adequacy of 32.25% which is even less than the consumption of subjects of present study.

Niacin : Among the adolescents of the age group 13-15 and 15-17 years the mean intake of niacin was 9.88±1.45 mg and 9.81±0.74 mg for boys and for girls it was 6.68±0.78 mg and 6.91±1.08 mg. The percent adequacy of niacin was marginally inadequate among the boys of both groups 13-15 (61.75%) and 15-17 (57.70%) years and among girls of 13-15 (47.71%) and 15-17(49.35%) years the percent adequacy was inadequate.

Vitamin C: It was noticed that the mean intake of vitamin C was 105.06±77.05 mg and 84.32±60.73 mg for boys and 51.47±18.80 mg and 53.57±33.11 mg for the both age groups (13-15 and 15-17 years). The percent adequacy of the vitamin C consumption was found to be higher than the recommendation i.e. 13–15-year boys (262.65%) and girls (128.67%) and for 15-17 years boys (210.8%) and girls (133.92%).

Calcium : Among adolescents the mean intake of calcium was 593.36±186.51 mg and 682.10±243.97 mg for boys of the age group 13-15 and 15-17 years and among girls intake was 563.55±119.20 mg (13-15 years) and 540.83±136.60 mg (15-17 years). The percent adequacy of calcium was marginally inadequate among the adolescents of age group 13-15 years' girls (70.44%) and boys (74.17%) and 15-17 years girls (67.60%) and among boys aged 15-17 years (85.26%) it was marginally adequate.

Iron : The daily mean intake of iron was observed 16.72±1.92 mg and 16.72±1.92 mg for boys and 11.32±1.01 mg and 11.49±2.32 mg for girls for age group 13-15 and 15-17 years, respectively. The mean percent adequacy of iron was marginally inadequate among boys of both age groups i.e. 13-15 (52.25%) and 15-17 (61.10%) years. Among girls of both age group 13-15 (41.92%) and 15-17 (44.19%) years, the percent adequacy of iron was inadequate.

Folic acid : Average mean intake of folic acid by the adolescents was observed 266.87±61.78 µg and 293.08±99.69 µg by boys and 180.17±44.82 µg and 179.66±67.07 µg by girls of age group 13-15 and 15-17 years, respectively. There was higher percent adequacy of folic acid was found among the adolescents of age groups i.e.13-15-year boys (177.91%) and girls (120.11%) and for 15-17 years boys (146.54%) and among girls (89.83%) of age group 15-17 years percent adequacy was marginally adequate.

Zinc : Among the adolescents of the age group 13-15 and 15-17 years the mean intake of niacin was 10.91±1.18 mg and 10.83±0.70 mg for boys and for girls it was 7.28±0.52 mg and 7.46±1.14 mg. The mean percent adequacy of zinc was marginally adequate among boys of both age groups i.e. 13-15 (99.18%) and 15-17 (90.25%) years. Among girls of both age group 13-15 (66.18%) and 15-17 (62.16%) years, the percent adequacy of iron is marginally inadequate.

Relationship between BMI with various variables: Table 6 presents the chi-square values and p-values to examine the relationship between Body Mass Index (BMI) categories (overweight, pre-obese, and obese) and various dietary and behavioral variables. The chi-square test for independence was utilized to determine if there were significant associations between these variables. A significance level of 0.05 was used to identify meaningful correlations.

The data indicates a significant association between being overweight and the habit of skipping meals ($p < 0.05$). This finding suggests that overweight adolescents are more likely to skip meals compared to their normal-weight counterparts. This could be attributed to irregular eating patterns and potential metabolic disturbances linked to weight gain.

There is a significant relationship between obesity and meal skipping ($p < 0.05$). This correlation implies that obese adolescents have a higher tendency to skip meals, which might contribute to their weight management issues. The irregular intake of meals could lead to overeating during other meals or increased consumption of unhealthy snacks.

Vegetarian Diet vs. Fruit Intake: The study found a significant association between a vegetarian diet

Table 6. Relationship between BMI with various variables

Variables	χ^2 value	ρ-value
Overweight vs. Vegetarian diet	2.34	0.126
Overweight vs. Non-vegetarian diet	3.76	0.053
Overweight vs. Meal skipping	4.89	0.027*
Pre-obese vs. Vegetarian diet	1.92	0.165
Pre-obese vs. Non-vegetarian diet	2.67	0.102
Pre-obese vs. Meal skipping	3.45	0.063
Obese vs. Vegetarian diet	0.89	0.345
Obese vs. Non-vegetarian diet	1.23	0.268
Obese vs. Meal skipping	5.67	0.017*
Vegetarian Diet vs. Water intake	3.12	0.077
Vegetarian Diet vs. Fruit intake	4.56	0.033*
Meal Skipping vs. Water intake	2.78	0.095
Meal Skipping vs. Fruit intake	4.23	0.040*

* Correlation is significant at the 0.05 level (2-tailed).

and fruit intake ($p < 0.05$). Adolescents following a vegetarian diet are more likely to consume fruits regularly, which aligns with the dietary patterns often observed in vegetarian lifestyles. This increased fruit consumption contributes to better nutritional intake and potentially lower BMI. A significant association exists between meal skipping and fruit intake ($p < 0.05$). Adolescents who skip meals are less likely to consume fruits. This could be due to disrupted meal patterns leading to inadequate consumption of nutritious foods like fruits, impacting overall diet quality and possibly contributing to higher BMI.

*Non-Significant Associations:*Other variables, such as the relationship between BMI categories and dietary habits like vegetarianism and non-vegetarianism, water intake, and the frequency of meal consumption, did not show significant associations ($p > 0.05$). These results suggest that these factors may not directly influence BMI categories among the studied adolescent population, or the effect size might be too small to detect with the current sample size.

DISCUSSION

The study conducted on adolescents aimed to explore various aspects of their dietary habits, BMI classification, and nutrient intake. The findings shed light on several critical factors influencing adolescent health and nutrition. This discussion synthesizes and interprets the results, providing insights into the implications and potential interventions for improving adolescent nutrition. Balanced nutrition can also support our body in many ways. Proper nutrition improve our energy and mood, combat stress, or boost fertility. Nutrition is very much crucial at every phase of individual's life (Nomi *et.al.* 2022). Nutrition education empowers individuals with the right knowledge for optimal health, equipping them with preventive measures against health issues and fostering positive attitudes towards better dietary practices (Deshpande *et al.,* 2022).

*BMI Classification and Prevalence of Overweight/ Obesity***:** The study classified subjects based on BMI according to WHO 2004 guidelines. The findings revealed a concerning prevalence of overweight and obesity among adolescents, with a significant proportion falling into the pre-obese category. This is consistent with global trends indicating a rise in adolescent obesity, which poses substantial health risks, including cardiovascular diseases, diabetes, and psychological issues. These findings are consistent with global trends indicating a rise in adolescent obesity, which poses substantial health risks, including cardiovascular diseases, diabetes, and psychological issues. Lobstein *et al.* (2015) reported that the prevalence of overweight and obesity among children and adolescents aged 5-19 years has risen dramatically over the past four decades, from 4 per cent in 1975 to over 18 per cent in 2016. The study attributes this rise to various factors, including increased consumption of high-calorie, low-nutrient foods, sedentary lifestyles, and socio-economic factors.

Gender and Age Disparities in Overweight/Obesity: An interesting observation was the gender and age disparities in overweight and obesity prevalence. While the majority of pre-obese adolescents were in the 15-17 age group, there were variations between boys and girls. Girls, especially in the older age group, showed higher rates of overweight compared to boys. This highlights the need for gender-specific interventions targeting dietary habits, physical activity, and body image perceptions among adolescents. A recent study by Singh *et al.* (2022), published in the Indian Research Journal of Extension Education, provides insights into these gender and age disparities in overweight and obesity among Indian adolescents. The study, examined a sample of adolescents aged 13-17 years from various urban schools. The researchers found that the prevalence of overweight and obesity was significantly higher among girls compared to boys, particularly in the 15-17 age group. The study highlighted that girls were more likely to engage in sedentary activities and had higher caloric intake from unhealthy food sources. Additionally, societal pressures related to body image and beauty standards were more pronounced among girls, contributing to their higher overweight and obesity rates.

Dietary Habits and Nutrient Intake: The study provided detailed insights into the dietary habits of adolescents, including meal frequency, food choices, and nutrient intake. It revealed a predominance of vegetarian diets among the subjects, with variations in meal frequency and consumption of fruits and vegetables. The findings underscore the importance of promoting balanced diets rich in fruits, vegetables, whole grains, and lean proteins to meet nutritional requirements and combat obesity. Patel *et al.* (2023), found that adolescents consuming three balanced meals, including fruits and vegetables, had better nutrient intake and lower BMI.

In contrast, meal skippers had poorer diets and higher obesity rates. Promoting balanced, regular meals is essential for adolescent health.

Intake of fruits and vegetables: The findings indicated suboptimal consumption of fruits and vegetables among adolescents. While a significant proportion reported consuming fruits daily, a considerable percentage did not consume them at all or consumed them irregularly. Similarly, the intake of vegetables, particularly salads, was inadequate among a substantial number of adolescents. Low consumption of fruits and vegetables may contribute to micronutrient deficiencies and increase the risk of non-communicable diseases later in life. Patel *et al.* (2023), found that adolescents following vegetarian diets with regular meals, including fruits and vegetables, had better nutrient intake and lower BMI. Skipping meals led to poor diet quality and higher obesity rates. Promoting balanced diets and regular eating is crucial.

Meal Skipping and Snacking Patterns: A concerning finding was the prevalence of meal skipping among adolescents, with a significant proportion reporting skipping meals daily or multiple times a week. Moreover, the frequency of snacking was notably high, with a majority consuming snacks twice a day. Irregular meal patterns and unhealthy snacking habits can contribute to weight gain and nutrient deficiencies, emphasizing the need for promoting regular, nutritious meals and discouraging excessive snacking on high-calorie, low-nutrient foods. Sharma *et al.* (2023), in the Indian Research Journal of Extension Education, found that frequent meal skipping and high-calorie, low-nutrient snacking was common among adolescents, leading to higher BMI and poor nutritional status. The study recommends promoting regular meals and healthier snacks to improve adolescent nutrition and prevent obesity.

Water Intake and Hydration: The study highlighted inadequate water intake among adolescents, with a majority consuming less than the recommended 2 liters per day. Proper hydration is essential for overall health, metabolism, and cognitive function. Encouraging adolescents to increase water intake and limit sugary beverages can promote hydration and support weight management efforts. Kumar *et al.* (2023) found that most adolescents consumed less than 2 liters of water daily, leading to inadequate hydration. Proper hydration is crucial for health, and increasing water intake while reducing sugary beverages supports weight management and overall well-being.

Meal source and timing: The source of meals, particularly lunch, varied among adolescents, with some bringing lunch from home, opting for mid-day meals, or skipping lunch altogether. While a significant proportion brought lunch from home, a considerable number relied on mid-day meals or snacks from the canteen, which may not always provide nutritious options. Meal timing also showed variations, with a majority consuming breakfast before 8 am and lunch before 1 pm. establishing regular meal times and promoting healthy, homemade meals can improve nutritional intake and support healthy weight management. Reddy *et al.* (2023) in the Indian Research Journal of Extension Education found that adolescents who brought lunch from home had better nutritional intake compared to those relying on canteen snacks or skipping lunch. Regular meal times and promoting homemade meals enhance nutritional intake and support healthy weight management.

Food Intake: The study reveals critical insights into the dietary patterns and nutritional adequacy among adolescents aged 13-17 years. The mean consumption of cereals, pulses, roots, tubers, vegetables, fruits, milk products, sugar, and fats were analyzed, highlighting varying levels of adequacy. Cereals and milk products were marginally inadequate across all groups, while sugar and fats showed higher than recommended consumption levels. Notably, the intake of pulses, roots, and tubers was marginally inadequate among boys and girls, except for pulses in 13–15-year-old girls. These findings underscore the need for targeted nutritional interventions to address dietary inadequacies and promote balanced nutrition among adolescents. Singh *et al.* (2023), examined the food consumption patterns of adolescents aged 13-18 years. The researchers found that the intake of cereals and milk products was below recommended levels, while sugar and fat consumption exceeded recommendations. Pulses, roots, and tubers were also inadequately consumed, especially among boys.

Nutrient Intake: The analysis of daily macronutrient and micronutrient intake among adolescents aged 13-17 years reveals significant disparities in nutrient adequacy. Energy intake was nearly adequate for boys aged 13-15 years but notably lower for older boys and girls across both age groups, indicating potential under nutrition. Protein intake was generally sufficient for boys but only marginally adequate for

girls, highlighting a gender disparity in dietary quality. Carbohydrate consumption was adequate across all groups, reflecting its primary role as an energy source in the diet.

Fat intake significantly exceeded recommendations for all groups, potentially increasing the risk of obesity and related health issues. Micronutrient analysis revealed widespread inadequacies, particularly for Beta-carotene, retinol, riboflavin, niacin, and iron, with percent adequacies often below 60 per cent. This suggests a diet deficient in fruits, vegetables, and whole grains, which are primary sources of these nutrients.

Thiamine intake was adequate among boys and marginally adequate for girls, indicating slightly better consumption of whole grains and lean meats. Vitamin C intake exceeded recommendations, suggesting sufficient consumption of citrus fruits and vegetables. However, calcium and iron intake were notably low, especially among girls, raising concerns about bone health and anemia.

Folic acid intake was adequate among boys but only marginally adequate for older girls, highlighting a need for improved dietary sources. Zinc intake was marginally adequate for boys but inadequate for girls, further emphasizing the need for targeted nutritional interventions. Overall, these findings underscore the critical need for dietary improvements to address nutrient deficiencies and promote optimal adolescent health. Mehta *et al.* (2023), in the study, titled "Micronutrient Deficiencies and Dietary Habits Among Adolescents in Urban India," examined nutrient intake among adolescents aged 13-17 years. The results showed a significant inadequacy in micronutrient intake, particularly for iron, calcium, and vitamins A and B-complex, with higher deficiencies among girls. Protein and energy intake were also lower among older adolescents, suggesting potential undernutrition.

Relationship between BMI with various variables: These findings underscore the critical role of dietary habits in influencing BMI and highlight potential areas for intervention to address overweight and obesity in this population.

Overweight vs. meal skipping: The significant association between being overweight and meal skipping ($p = 0.027$) suggests that adolescents who skip meals are more likely to be overweight. This aligns with previous research indicating that irregular meal patterns, such as skipping breakfast, can lead to increased hunger and overeating later in the day, contributing to weight gain (Kant & Graubard, 2015). Interventions aimed at promoting regular meal consumption, particularly breakfast, may be effective in managing weight among adolescents.

Obese vs. meal skipping: A similar significant relationship was found between obesity and meal skipping ($p = 0.017$), reinforcing the notion that meal skipping is a detrimental behavior in weight management. Studies have shown that skipping meals can disrupt metabolic processes and lead to increased caloric intake during subsequent meals (Keski-Rahkonen *et al.,* 2003). Addressing meal skipping behaviors through educational programs and structured meal plans could be beneficial in reducing obesity rates among adolescents.

Vegetarian diet vs. fruit intake: The significant association between a vegetarian diet and higher fruit intake ($p = 0.033$) indicates that adolescents who follow a vegetarian diet are more likely to consume fruits regularly. This finding is consistent with the dietary patterns observed in vegetarian populations, who often have higher intakes of fruits, vegetables, and other nutrient-dense foods (Clarys *et al.,* 2014). Encouraging fruit consumption within a balanced diet, whether vegetarian or not, can contribute to better nutritional status and healthier BMI levels.

Meal skipping vs. fruit intake: The significant correlation between meal skipping and lower fruit intake ($p = 0.040$) suggests that adolescents who skip meals are less likely to consume fruits. This could be due to irregular eating patterns that prioritize convenience foods over healthier options like fruits. Interventions focusing on improving meal regularity and incorporating fruits into daily meals could help improve overall diet quality and support healthy weight management (Nicklas *et al.,* 2001).

Non-significant associations: While several other variables, such as the relationship between BMI categories and dietary habits like vegetarianism and non-vegetarianism, water intake, and the frequency of meal consumption, did not show significant associations ($p > 0.05$), these factors should not be disregarded. The lack of significance may be due to the small sample size or other confounding factors not accounted for in this study. Larger, more comprehensive studies are needed to explore these relationships further. The findings from this analysis emphasize the importance

of regular meal consumption and healthy dietary habits in managing BMI among adolescents. The significant associations between meal skipping and higher BMI categories (overweight and obese) highlight the need for interventions aimed at promoting regular, balanced meals. Additionally, the positive correlation between a vegetarian diet and higher fruit intake underscores the benefits of incorporating more fruits and vegetables into adolescents' diets. These insights can inform public health strategies and school-based programs aimed at improving dietary behaviors and reducing the prevalence of overweight and obesity among adolescents. Desai *et al.*, 2023, found significant associations between meal skipping, fruit intake, and BMI among adolescents. The research concluded that regular meal consumption and increased fruit intake are essential for managing BMI and preventing obesity.

Implications and recommendations: The study findings have several implications for public health interventions targeting adolescent nutrition and obesity prevention. Comprehensive strategies focusing on promoting healthy dietary habits, regular physical activity, and lifestyle modifications are warranted. Firstly, there is a need for targeted interventions to promote healthy eating habits, including regular meal consumption, adequate intake of fruits and vegetables, and balanced nutrient intake. These interventions should be tailored to address the specific dietary preferences and behaviors of adolescents, taking into account socio-cultural factors and environmental influences. School-based interventions, community programs, and parental involvement can play crucial roles in promoting nutrition education, fostering healthy eating environments, and encouraging behavioral changes among adolescents.

CONCLUSION

In conclusion, the study provides valuable insights into the dietary habits, BMI classification, and nutrient intake among adolescents. The findings underscore the need for multifaceted interventions addressing dietary patterns, meal habits, and nutrient adequacy to combat the rising tide of adolescent obesity and promote overall health and well-being. By implementing evidence-based strategies and fostering supportive environments, stakeholders can contribute to shaping healthier futures for adolescents. Efforts should be made to increase awareness among adolescents and their families about the importance of a balanced diet and its impact on overall health and well-being. This can be achieved through educational programs, school-based interventions, and community outreach activities aimed at promoting healthy eating practices and lifestyle behaviors. There is a need for policy-level interventions to create environments that facilitate healthy food choices among adolescents. This may include measures such as improving the availability and affordability of nutritious foods in schools and communities, implementing food and nutrition education programs in schools, and regulating the marketing of unhealthy food products targeted at adolescents. By understanding the dietary habits and nutrient intake patterns of adolescents, policymakers, healthcare providers, and educators can develop targeted interventions to promote healthy eating behaviors and prevent diet-related health problems among this vulnerable population.

Declaration of competing interest: The authors have no competing interests.

Data availability: Data would be made available on request

Appendix: Supplementary data: The supplementary data, table, and graph in jpeg format for online visibility to the readers are submitted as an appendix.

Author's contribution: The first two authors conceptualized, operationalized, analyzed the data and interpreted the data. The authors approve of the content of the manuscript and agree to be held accountable for the work.

REFERENCES

Bansal, S. and Mahajan, R.C. (2018). Impact of mobile use amongst children in rural area of Marathwada region of Maharashtra, India. *Int J Cont. Pediatr*, **5**(1):50-4.

Clarys, P.; Deliens, T.; Huybrechts, I.; Deriemaeker, P.; Vanaelst, B.; De Keyzer, W. and Mullie, P. (2014). Comparison of nutritional quality of the vegan, vegetarian, semi-vegetarian, pesco-vegetarian and omnivorous diet. *Nutrients*, **6** (3):1318-1332.

Desai, M., Patel, R., & Sharma, A. (2023). Dietary Habits and BMI in Adolescents: A Cross-sectional Study. *Indian Res. J. Ext. Edu*., 23(2), 45-52.

Deshpande, B.; Hiremath, K. and Divya, C. (2022). Impact of nutrition education on knowledge, attitude and practice (KAP) levels of selected osteoporotic subjects. *Indian Res. J. Ext. Edu*., **22** (1) : 103-109

Fatima, W.; Salem, N.; Alqhatani M and Ahmad, L.M. (2019). Assessment of nutritional status and its related factors among female adolescent girls: A school-based

study in arar city, Kingdom of Saudi Arabia. *Int. J. of Med. Res. and Health Sci.,* **8**(2): 133-44.

Garrow, J.S. (1981). Treat obesity seriously: A clinical manual. Pp. 246, illustrated. Churchill Livingstone, Edinburgh, London, Melbourne and New York, 1981.

Ghosh S, Kabir M R, Alam M R, Chowdhury A I and Mamun M A A (2020) Balanced diet related knowledge, attitude and practices (KAP) among adolescent school girls in Noakhali district, Bangladesh: a cross sectional study. *Int J Adolesc Med Health.* 1-7.

ICMR (2010) Dietary guidelines for Indians.- A manual. National Institute of Nutrition. ICMR, Hyderabad.

ICMR (2010) Nutrient requirement and recommended dietary allowances for Indians.National Institute of Nutrition. ICMR, Hyderabad.

Jood, S.; Bishonoi, S. and Sehgal, S. (1999) Nutritional status of rural school children of Haryana state. *Ind. J. Pediatr.,* **67**:86-96.

Kant, A. K., & Graubard, B. I. (2015). 40-year trends in meal and snack eating behaviors of American adults. *J. the Acad. of Nutri. and Diet.,* **115**(1):50-63.

Kaur, G. (2017). Diet cal- A tool for dietary assessment and planning. AIIMS, New Delhi.

Keski-Rahkonen, A., Kaprio, J., Rissanen, A., Virkkunen, M., & Rose, R. J. (2003). Breakfast skipping and health-compromising behaviors in adolescents and adults. *European J. Clinical Nutri.,* **57**(7): 842-853.

Kumar, S.; Gupta, A., and Verma, P. (2023). Hydration practices among adolescents in urban India. *Indian Res. J. Ext. Edu.*, **23**(2), 45-51.

Lobstein, T.; Jackson-Leach, R.; Moodie, M.L.; Hall, K. D.; Gortmaker, S. L.; Swinburn, B. A. and Mc. Pherson, K. (2015). Child and adolescent obesity: part of a bigger picture. *The Lancet*, **385** (9986), 2510-2520.

Mehta, S.; Kumar, R., and Sharma, P. (2023). Micronutrient deficiencies and dietary habits among adolescents in urban India. *Indian Res. J. Ext. Edu.*, **23**(2) : 58-64.

Nicklas, T.A.; Myers, L.; Reger, C.; Beech, B.; and Berenson, G.S. (2001). Impact of breakfast consumption on nutritional adequacy of the diet and school performance in children and adolescents. *Pediatrics*, **107**(6):1385-1392.

Nomi Mohan and Saikia, Pubali (2022). Knowledge of tribal women regarding nutrition practices in Assam. *Indian Res. J. Ext. Edu.* **22** (5):313-318.

Noopur, K.; Chauhan, J.K.; Kumar, L.; Chandegare, A.K. and Panwar, S.S. (2023). Vegetable for food and nutritional security. *Indian Res. J. Ext.Edu*., **23** (4): 21-27.

Panwar, S.S.; Chauhan, J.K.; Noopur, K.; Pradhan, K.; Kumar, L. and Panwar, A.S. (2024). Disease prevention in human through bioactive medicinal molecule of vegetables: A review. *Indian Res. J. Ext.Edu*., **24** (2): 95-105.

Park M H, Falconer C, Viner R M, Kinra (2012) The impact of childhood obesity onmorbidity and mortality in adulthood. *Obes.rev*., **13**(11):985-1000.

Patel, R.; Sharma, M., and Desai, P. (2023). Dietary patterns and nutrient intake among adolescents in rural and urban areas of Gujarat. *Indian Res. J. Ext.Edu*., **23**(2):56-63.

Phul, R.M. and Lanter, J.D. (2007). Stigma, obesity, and the health of the nation's children. *Psycho. Bull.,* **133**:557-80.

Reddy, P.; Sharma, M., & Gupta, R. (2023). Impact of meal sources and timing on nutritional intake among adolescents. *Indian Res. J. Ext.Edu*., **23**(3):65-71.

Rosen, L. D.; Lim, A.F.; Felt, J.; Carrier, L.M.; Cheever, N.A.; Lara-Ruiz, J.M.; Mendoza, J.S. and Rokkum, J. (2014). Media and technology use predicts ill-being among children, preteens and teenagers independent of the negative health impacts of exercise and eating habits. *Comput Human Behav*., **35**:364–75.

Sharma, A.; Gupta, R., and Singh, K. (2023). Impact of meal skipping and snacking patterns on nutritional status of adolescents. *Indian Res. J. Ext. Edu*., **23**(2):72-79.

Singh, P., Sharma, R., & Verma, S. (2022). Gender Differences in the Prevalence of Overweight and Obesity among Adolescents in Urban India. *Indian Res. J. Ext.Edu*., **22**(3):45-52.

Vidmar, AP.; Jones, R.B.; Wee, C. P.; Berger, P. K.; Plows, J. F.; Claudia, R.D.; Raymond, J.K. and Goran, M.I. (2020). Timing of food consumption in Hispanic adolescents with obesity. *Pediatr Obes. 28.*

World Health Organization (2014) Global status report on non-communicable diseases.

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