Journal of Ayurveda & Holistic Medicine

https://jahm.co.in

eISSN-2321-1563

Case Control Study

IMPACT OF EATING HABITS ON ADOLESCENT OBESITY- A CASE CONTROL STUDY.

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ABSTRACT :

Introduction: Obesity refers to increased adiposity in the body. Obesity in children has gained the status of epidemics in recent years. It is an issue of concern even in developing countries like India owing to swift economic transition, lifestyle changes and globalization of food. Obesity children and adolescents may persist in later life and can be mapped to childhood onset metabolic syndromes and non-communicable disorders. This study aimed at assessing impact of eating habits in adolescents on obesity. Thus, early identification of obesity in children and interventions can pave way for healthier community. **Methods:** A case control study was conducted in 111 obese and 488 non-obese adolescent high school children aged between 14 to 17 years. Body mass index (BMI) was used as an assessment parameter and children with BMI >30 was considered as obese (WHO). The data was collected using a structured case report form (CRF) incorporating food frequency index and the data set was analysed using MS office Excel and SPSS software version 20. **Results:** Prevalence of obesity was 18.5% in high school children. The prevalence was more in higher grade students, upper middle class and females were more affected. Butter was major dietary risk factor. Higher intake of calorie dense, fatty, sugar foods like laddu ($p<0.019$), jalebi ($p< 0.011$), and kajukatli ($p<0.013$) and Ice cream ($p< 0.00003$) was associated with obesity. **Conclusion:** obesity prevalence alarmingly increased. There is an urgent need to educate parents and children on dietary habits and impact of adolescent obesity on health through intensive community health campaigns using all effective media with an emphasis on preventive strategies.

KEYWORDS: adolescent, BMI, food frequency index, obesity, school children

RECEIVED ON: 24-05-2025

REVISED ON: 07-06-2025

ACCEPTED ON: 12-06-2025

Access This Article Online:

Quick Response Code:

Website Link: https://jahm.co.in

DOI Link: https://doi.org/10.70066/jahm.v13i5.1971

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CITE THIS ARTICLE AS

Tejaswini N K, Reena K, Raghavendra Rao. Impact of eating habits on adolescent obesity- A case control study. *J of Ayurveda and Hol Med (JAHM).* 2025;13(5):52-61.

1. INTRODUCTION

Adolescence is the age of 10–19 years, the transitional phase between childhood and adulthood. Obesity is defined as abnormal growth of adipose tissue. Obesity is a preventable risk factor whose prevalence is rising in children and adolescents. [1] India accounts for highest adolescent population globally. Several studies among Indian adolescents have reported the concerns on rising overweight and obesity. [2,3] The prevalence of obesity is increased eight folds among 5-19 years. [4] A study from Karnataka, South India, reports 10.8% and 6.2% prevalence of overweight and obesity respectively and a male dominance. [5] According to study done by UNICEF, world obesity atlas for 2022 a more than 27 million obese children have been identified. India representing 1 in 10 children globally by 2030. Several factors have been attributed to the increased prevalence of over-weight and obesity. The prime factor contributing could be the imbalance between calorie intake and calorie expenditure. However, there could be the role of genetic factors in the development of obesity, but it could be as less than 5%.[6] The intake of high calorie despite poor calorie utilization, calorie exhausted, and insufficient physical activity forms a base for obesity. [7] Obesity acts as a precursor to several Non communicable diseases (NCD), mental disorders, respiratory disorders which can continue to adulthood. Obesity can also impact on child's physical health, emotional wellbeing and social interaction resulting in low academic performances and avoidant behaviour among social groups.[8] Obese children could develop co-morbidities like type 2 diabetes, Bronchial asthma, hypertension, non-alcoholic fatty liver syndrome, menstrual disorders, sleep apnea. [7] Adolescent obesity often tracks to adulthood. High screen time associated with sedentary lifestyle adds up to obesity. [7] due to post pandemic, rapid urbanization, blind dietary habits obesity and over-weight has become a growing topic of concern.

Body mass index (BMI) is an important sensitive parameter to assess obesity. Based on this people are classified as underweight (< 18point 5 kg/m2), healthy weight (18point 5–24point 9 kg/m2), pre-obese (25–29point 9 kg/m2), class I (30 to<35point kg/m2), class II (35 to <40 point kg/m2) and class III (>40 point kg/m2). [9] Further, standardized food frequency index was used identify type of food preferred to eat and their frequency. [10]

This study aimed at assessing impact of eating habits in adolescents on obesity with BMI as key assessment parameter. Thus, early identification of obesity in children and interventions can pave way for healthier community.

Objectives

Primary objective:

To identify the eating habits in adolescent high school children and their relationship with obesity

Secondary objective:

To identify the dietary risk factors for adolescent obesity and their relation with obesity in high school going children based on food frequency index

To evaluate the influence of socioeconomic status and Gender on adolescent obesity

Hypothesis:

H1 (Alternative Hypothesis): Eating habits in adolescence predispose obesity in high school-going children.

H0 (Null Hypothesis): Eating habits in adolescence have no relation with obesity in high school children

2. MATERIAL AND METHODS

Study design: Case-Control Study

Cases: Adolescents with BMI ≥ 30 (classified as obese)

Controls: Adolescents with BMI < 30 (not obese)

Sample size: Sample size was determined considering proportion exposure of cases and controls based on previous studies using formula, ($N = [Z1-a/2+Z1-\beta]^2$ P q [r+1] / [P1-P2])

Inclusion criteria:

Apparently healthy children aged between 14-17 years attending high schools in and around Kumbalagodu.

Exclusion criteria:

Children with chronic systemic disorders.

Children with physical disabilities.

Children with endocrine diseases.

Parents of children not consciously willing to participate in the trial

Variables: The dataset includes various demographic variables (gender, type of school, level of school, area of school, mother tongue, parental education and occupation, socio economic status and pocket money), Anthropometric variables (BMI categories based on WHO guidelines, height (cm), and weight (kg)), dietary intake variables based on standardized food frequency index) and detailed food consumption patterns for each adolescent, physical activities and screen time as behavioral variables. The analysis focuses on the relationship between various eating habits and obesity status as assessed by BMI categories.

Methodology of Data collection:

Recruitment: Apparently healthy children studying in nearby six schools of Anchepalya and Kumbalgodu, Bengaluru urban district, fulfilling the inclusion criteria consciously willing to participate in the study, with a consent were recorded with findings of general physical examination such as height, weight, head circumference and BMI.

Method of data collection: The central idea of the study is to explore the eating habits in adolescent high school and its relationship with obesity. With a prior permission from the school authorities and an oral/written assent/ consent, all the eligible students were recruited for the study from six various randomly selected schools in the region of Anchepalya and Kumbalgodu till the required sample size was met. The children were distributed a predesigned questionnaire consisting of basic information, socioeconomic status, eating habits based on food frequency index, family history of obesity, physical activities, watching TV and screen time. Information regarding meal frequency, frequency of consumption of fruits and vegetables, patterns of meal skipping, frequency of eating at restaurants, liberty to buy snacks, watching TV while eating will be recorded. Anthropometric data were collected by direct examination. Weight was recorded using electronic weighing scale; height was recorded using height scale. BMI was calculated by weight (kg)/height (m) 2. BMI with score 25 is considered as

overweight. While BMI of >30 is considered as obesity. The study was conducted between February to May 2025.

Instruments used: A pre designed questionnaire with essential information, socio-demographic history, eating behaviors based on Food frequency index for qualitative analysis will be adapted.

Ethical considerations: Prior approval and clearance were obtained from Institutional ethics committee (IEC NO: SDMIAH/IEC/43/2023). Throughout the research, data collection and analysis adherence to ethical guidelines were maintained. Anonymity and confidentiality were maintained and no personal identifiers were collected. The data was securely stored and used solely for research purpose and not shared with others.

Quality control: The quality control measures span from the sampling frame till the final analysis of the data obtained. Thus, sampling was decided based on the prevalence from previous studies. A convenient sampling was used to attain the required number of participants. Previously validated standard survey format is adapted with addition of relevant details was used to ensure the quality of the data. The team of well-trained researchers lead by principal investigator visited the field to collect the data.

Confidentiality: Throughout the study all information about participants would be kept confidential but and these medical records can be inspected by the concerned authority the purpose of analyzing the results. They could also be looked at by Institutional Ethics Committee members and by Regulatory authorities / Court to check originality of research work. However, the identity and any sensitive matter on state of health would be confidential.

Statistical analysis: Categorical and quantitative variables would be expressed as frequency (percentage) and mean ± SD respectively. Mann-Whitney U Test will be used to compare ordinal parameters between groups. Chi-square test was used to find association between categorical variables. For all statistical interpretations, $p<0.05$ at 95% confidence interval was considered the threshold for statistical significance. Statistical analyses were performed by using a statistical software package SPSS, version 20.0.

3. RESULTS:

A total of 700 questionnaires were distributed to the eligible school children and 610 questionnaires were filled and received back with a response rate of 96.8%. Amongst them 11 questionnaires were removed due to incomplete information while rests 599 were analyzed. 70 empty questionnaires were returned as the school was not willing to participate. Major reason for not receiving questionnaires were children being absent on the day due to various reasons.

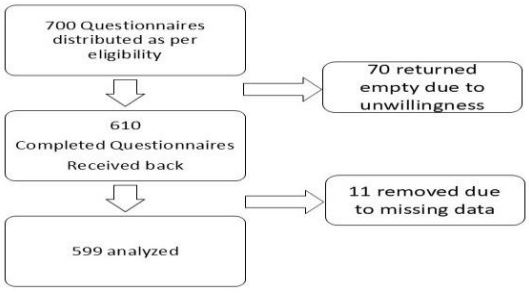

Figure 1: Participants flow chart

Analysis of back ground characteristics of 599 adolescent school going children are summarized in table 1.

Table1: Comparison of sample based on socio demographic background

		Non Obese		Obese		χ^2	p
		Count	Percent	Count	Percent		
Area	Rural	350	80.5	85	19.5	1.07	0.300
	Urban	138	84.1	26	15.9		
Grade	8 – 9	325	85.8	54	14.2	12.54	p<0.01
	10 – 11	163	74.1	57	25.9		
Status of school	Boarding	42	75.0	14	25.0	1.71	0.191
	Day school	446	82.1	97	17.9		
Parents / guardians highest education level	Class 1 to 12	178	80.5	43	19.5	1.56	0.459
	Diploma	268	83.0	55	17.0		
	Non formal education	42	76.4	13	23.6		
Occupation of parents	Farmer	146	82.5	31	17.5	1.48	0.477
	Govt./Corp./ Pvt. Employee	118	78.1	33	21.9		
	Business/Trade	224	82.7	47	17.3		
Pocket money	Yes	70	76.1	22	23.9	2.09	0.149
	No	418	82.4	89	17.6		
Screen time (hours)	1	98	81.0	23	19.0	0.03	0.985
	2	233	81.5	53	18.5		
	>2	157	81.8	35	18.2		

Over all observation of BMI categories in the data set indicates 18.5% prevalence of obesity in adolescents. Additionally persistent prevalence of underweight in community (46.1%) noted along with 6.5% prevalence of overweight. (table 2)

Table 2: Distribution of the sample based on BMI

BMI	Count	Percent
Under weight	276	46.1
Normal	173	28.9
Over Weight	39	6.5
Obese	111	18.5
Mean ± SD	21.2 ± 6.7	

BMI- Body mass index, SD: standard deviation

Table 3: Distribution of Study Participants based on Anthropometry

Characteristic	Obese (Mean ± SD)	Non-Obese (Mean ± SD)	p-value
Weight	74.66 ± 11.26	46.20 ± 11.19	0.00000
Height	151.29 ± 13.52	157.37 ± 9.40	0.00000
Bmi	33.05 ± 3.67	18.47 ± 3.65	0.00000

SD: standard deviation

The comparison of anthropometric measurements showed highly significant differences between obese and non-obese adolescents (Table 3). Obese adolescents weigh substantially more than their non-obese peers and interestingly, obese students are on

average shorter than non-obese students. The difference in BMI is stark, with obese students having values well above the standard obesity threshold, while non-obese students remain within the healthy range.

Eating Habit Analysis

Average consumption frequencies were compared between obese and non-obese groups were analyzed using Chi square test. Initial findings showed sweets such as laddu, jalebi, and kajukatli had higher average consumption among obese students. Mann-Whitney U tests were used to assess whether the differences in consumption were statistically significant. Significant association was noted with eating sweets like Jalebi ($p<0.011$), Kajukatli ($p<0.013$), burfi ($p<0.003$), doodhpeda ($p<0.040$) and Laddu ($p<0.019$). So also, association was significant with pasta ($p<0.032$) and dry fruits ($p<0.001$). Junk food such as sandwich. Pizza, burger, waffles, pastry, donut, cream bun, and Honey cake have no significant association with obesity, whereas soft drink ice cream cheese, chocolate Chai biscuit, Choco biscuit, have borderline Association. On correlation analysis, moderate positive correlations are observed with the consumption of butter three to four times a week (0.233) and nutritional drinks like Complain one to three times a month (0.229), suggesting that these foods are somewhat associated with higher BMI. Most other food items, such as grilled fish, kova, paneer, jamun, poori, and sweets like jalebi and laddu, show weak positive correlations (ranging from 0.11 to 0.17), indicating only a slight association with increased BMI. Interestingly, seldom consumption of vegetables also shows a small positive correlation (0.133), possibly implying that lower intake of vegetables might be linked to higher BMI. Even foods like chips, which are marked as "never" consumed, show a small positive correlation (0.119), hinting at the complexity of dietary patterns and possible compensatory eating habits. Overall, while individual foods have relatively weak correlations with BMI, the data supports the general notion that higher intake of calorie-dense, fatty, or sugary foods may be mildly associated with increased BMI.

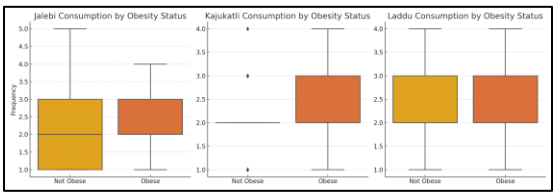

Fig. 1: consumption patterns by obesity status for the three significant foods

Apart from sweet consumption, several other factors that are found to be significantly associated with obesity in adolescents are fewer vegetables consumption ($p < 0.000001$), Ice cream consumption ($p \approx 0.00003$) and Butter consumption. ($p<0.05$).

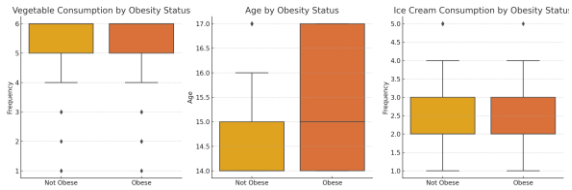

Fig. 2:

4. DISCUSSION:

599 children aged 14 to 17 years studying in higher secondary level from private schools in and around Anchepalya and Kumbalgodu were assessed to note the impact of eating habits on adolescent obesity. Over all prevalence of obesity in adolescent high school children

aged 14 to 17 years was found to be 18.5%. This emphasizes on rising trends of early onset obesity and was consistent with recent other studies. [11-17[1] the prevalence was more among students in higher grades, particularly Grade 11. This suggests that as adolescents age and advance academically, they may become more prone to obesity, possibly due to increased academic stress, reduced physical activity, or greater autonomy over food choices. Students from rural areas were more obese compared to those from urban settings. This finding could be influenced by factors such as limited access to nutrition education, recreational facilities, or healthcare support in rural regions. More over the study setting included sub urban and rural areas. Obesity was more prevalent among students whose parents have no formal education. This underscores the influence of parental knowledge and behaviour on adolescent lifestyle and nutrition. This is in consistence with studies by Grace GA et al, [18] Giugliano et al, [19] Mozaffari et al, [20] and Bhuiyan et al. [21] This could be due to the fact that less education could be associated with poor awareness on healthy food choices. Significant differences in weight, height, and BMI noted and all were affirming the validity of the obesity classification and highlighting the physiological growth. Average shorter height in obese children could be with the fact that obesity develops without corresponding linear growth, possibly pointing to early-onset adiposity or nutritional imbalance.

The diverse eating patterns were noted amongst children. Like in previous other researches higher intake of traditional sweets like jalebi, kajukatli, and laddu was significantly associated with obesity among adolescents. So also, the association was significant with Milk powder, Panner, Ice cream and butter. Interestingly less consumption vegetables and fruits also showed significant association with obesity. This indicates that, beyond sweet consumption, many others with obesity in adolescents. These results reinforce the broader dietary patterns that contribute to obesity, with lower intake of nutritious foods like fruits and vegetables along with higher intake of energy-dense foods like ice cream and butter. Previous results in researches by Chaudhari et al and Niemeier HM et al. Support the fact that eating energy dense food and fast food are associated with increased prevalence of obesity among children and adolescents. [22, 23] Further low vegetable intake was also identified as risk factor associated in a study by Rathi N. [24] The study data can be used as basis for planning large community base studies on adolescence obesity and awareness campaign. Additionally regulatory organisations can use a data to promote and regulate healthy life style and policy making.

Limitations:

Major limitation of this study was regarding collecting data genetic causes, antenatal and postnatal events owing to recall bias. Laboratory investigations were not done. Study was limited single geographical area, Bengaluru. It was time consuming to collect data individually.

5. CONCLUSION:

This case control study assessed adolescent eating behaviors with that of obesity. Overall, the data

supports the general notion that higher intake of calorie-dense, fatty, or sugary foods and less fruit and vegetable consumption have mild association with adolescent obesity. Prevalence of obesity in adolescent is increased alarmingly. Preventive strategies should be effectively implemented at school level, community level and to parents along with nutritional education. Longitudinal studies on the same topic could contribute more. Further research should be focusing on effectiveness of preventive strategies on adolescent obesity.

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Acknowledgements: The authors express gratitude and acknowledge Rajiv Gandhi university of health sciences, Bengaluru, Karnataka, India for research grant under UG projects for the year 2024 with project name 'Eating habits in adolescent obesity-A Case control Study (project code: UG24AYU0232). Sincere thanks to all the children, parents and school authority for active participation in the project. Also grateful to Dr. Jagadeesh K, Principal, SDM Institute of Ayurveda and Hospital, Bengaluru for constant guidance and support.

Conflict of Interest: None

Source of Support: Funded by RGUHS (PROJECT CODE:UG24AYU0232)

Informed consent – Written informed consent from the patients was taken for the conduct of the study and for any scientific publication.

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