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Original Research Article

Study of prevalence of overweight and obesity among school going adolescents in north Karnataka and its association with life style changes

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ABSTRACT

Background: Overweight and obesity in adolescence have become major public health concerns worldwide, including in India, with prevalence rates doubling over the past two decades. Childhood obesity is strongly linked to adult obesity and increases the risk of chronic diseases such as type 2 diabetes, hypertension, cardiovascular disease, and certain cancers. It also negatively impacts bone health, reproductive health, and overall quality of life. This cross-sectional study was conducted to determine the prevalence of overweight and obesity among school-going adolescents and to assess their association with lifestyle factors.
Methods: This cross-sectional study was conducted to determine the prevalence of overweight and obesity among school-going adolescents and to assess their association with lifestyle factors. A total of 800 adolescents aged 13–17 years from various private schools in Kalaburagi were included. Data were collected using a semi-structured questionnaire. Anthropometric measurements were taken using standardized methods, and overweight/obesity was classified based on the 2015 Indian academy of paediatrics (IAP) growth chart. Statistical analysis was performed using IBM SPSS version 25.0, with the Chi-square test applied for significance ($p<0.05$).
Results: The study found that 34.3% of participants were either overweight or obese. A significant association was observed between overweight/obesity and various lifestyle factors including diet, screen time, physical activity, and family history. High intake of calorie-dense, processed, and fast food emerged as a major contributor.
Conclusions: Despite improvements in health education and recreational opportunities in schools, obesity remains prevalent, highlighting the need for greater awareness and behaviour change at both individual and community levels.

Keywords: Adolescents, Obesity, Overweight, Lifestyle, Prevalence, Risk factors

INTRODUCTION

Obesity, a leading cause of preventable mortality, has emerged as one of the most critical public health concerns of the 21st century, as recognized by the World Health Organization. It is closely linked to a wide range of health complications, including type 2 diabetes mellitus, cardiovascular diseases, obstructive sleep disorders, early onset of puberty, and endothelial dysfunction.[1] In the context of public health, particularly in low- and middle-income countries, the term "double burden of disease" has gained prominence. It describes the simultaneous presence of undernutrition and increasing rates of overweight and obesity, both of which negatively impact health outcomes. Although infectious diseases and undernutrition continue to pose major challenges, non-communicable disease risk factors such as overweight and obesity are becoming increasingly

prevalent, particularly in urban settings.[2] Obesity, a preventable and modifiable risk factor, is becoming increasingly common among children, especially adolescents. In 2016, an estimated 340 million children and adolescents worldwide were categorized as overweight or obese. Alarmingly, the prevalence of obesity in this age group has increased more than fourfold between 1975 and 2016.[3]

Children in low- and middle-income countries like India face heightened vulnerability to poor antenatal and early childhood nutrition. At the same time, they are being exposed more frequently to energy-dense, high-fat, high-salt foods that lack essential micronutrients. When coupled with sedentary lifestyles and insufficient physical activity, these dietary patterns are key drivers of the growing epidemic of childhood obesity.[3]

Overweight is defined by the presence of excess body fat, whereas obesity is a chronic, multifactorial condition marked by substantial fat accumulation that can adversely affect health. Obesity is associated with impaired bone health, altered reproductive function, and an elevated risk of certain cancers. Moreover, it can diminish quality of life by contributing to reduced mobility and disrupted sleep. When overweight and obesity develop during adolescence, they can result in immediate health problems that often continue into adulthood, heightening the risk of long-term complications.[4]

Although obesity has existed for centuries, it was relatively uncommon in ancient populations. In historical periods such as the Middle Ages and the Renaissance, a larger body size was often perceived as a symbol of wealth and social status, as reflected in art from those eras. In contrast, public concern over childhood obesity is a more recent development, gaining attention only over the past four decades, as its once stable prevalence began to rise sharply.[6]

Despite the increasing rates and severity of obesity, there remain substantial gaps in understanding its root causes, and the development of effective management approaches continues to be a challenge. A key area of debate is whether obesity in most individuals arises primarily from a dysfunction in energy storage mechanisms-potentially influenced by hormonal and endocrine factors-or from an imbalance between caloric intake and energy expenditure, largely driven by dietary and lifestyle factors.[6]

Overweight is generally described as excessive fat accumulation or body weight exceeding the healthy range for a particular age. In contrast, obesity is a chronic and multifactorial condition characterized by substantial fat deposits that pose risks to health. It is linked to an elevated risk of type 2 diabetes mellitus, cardiovascular disease, bone and reproductive health complications, certain cancers, metabolic syndrome, obstructive sleep apnoea, and psychological difficulties. In addition to these health risks, obesity can negatively impact overall quality of life by impairing mobility and disrupting sleep patterns.[4] The assessment of overweight and obesity in children is typically conducted using weight and height measurements to calculate the body mass index (BMI), defined as weight in kilograms divided by the square of height in meters (kg/m^2). BMI is a simple, low-cost, and non-invasive anthropometric tool that serves as a surrogate indicator of body fat. Additional measurements, such as waist circumference, may further aid in diagnosing obesity.[4]

For children under the age of five, overweight is classified as a weight-for-height measurement greater than 2 standard deviations above the median of the WHO child growth standards, while obesity is defined as exceeding 3 standard deviations above this median.[4] Among children and adolescents aged 5 to 19 years, BMI is plotted on age- and sex-specific growth charts to determine nutritional status.[4]

BMI falling <-2SD from median is classified as underweight. BMI between >-2 SD to < +1 SD from median is normal weight. BMI falling >+1 SD from median is overweight. BMI falling >+2 SD from median is considered as obese. IAP 2015 charts defined; overweight as BMI ≥23 kg/m^2 of adult equivalent (more than 71st and 75th percentile in boys and girls, respectively) and obesity as ≥27 kg/m^2 of adult equivalent (more than 90th and 95th percentile in boys and girls, respectively).[5]

Implementing effective strategies to prevent and manage childhood obesity is crucial to reducing its persistence into adulthood and lowering the risks of associated morbidity and mortality. Many obesity-related comorbidities develop early in life, increasing long-term healthcare costs. In addition to physical health risks, childhood obesity can severely impact emotional and psychological well-being, often leading to depression, body dissatisfaction, unhealthy weight control behaviors, social stigmatization, and diminished self-esteem[3].

In 2022, it was reported that 43% of adults aged 18 years and older were classified as overweight, with 16% affected by obesity. That same year, approximately 37 million children under the age of five were overweight. Among children and adolescents aged 5 to 19 years, more than 390 million were overweight, including 160 million classified as obese. As of 2016, the global prevalence of overweight and obesity in this age group had risen to nearly 18%.[3,4]

The prevalence of obesity among children and adolescents continues to climb in low- and middle-income countries, while remaining persistently high in many high-income nations. Of particular concern is abdominal or central obesity, which is strongly associated with increased risks of cardiovascular and metabolic disorders in this age group. A waist-to-height ratio

greater than 0.5 is frequently used as a simple and effective indicator of abdominal adiposity, requiring no age-based reference values. The international obesity task force defines morbid obesity as an age- and sex-adjusted BMI of 35 kg/m² or higher by 18 years of age.[7] Globally, the prevalence of paediatric obesity has increased markedly over the past five decades.[8] Between 1975 and 2016, the age-standardized prevalence of obesity among children and adolescents aged 5 to 19 years rose from 0.7% to 5.6% in girls and from 0.9% to 7.8% in boys.[9]

Projections from the world obesity federation in 2019 estimated that by 2025, approximately 206 million children and adolescents aged 5 to 19 years would be living with obesity, with this number expected to reach 254 million by 2030. Among the 42 countries projected to have over one million children with obesity by 2030, China ranks first, followed by India, the United States, Indonesia, and Brazil. Notably, only seven of these countries are classified as high-income. Although overall obesity prevalence appears to have stabilized in many high-income countries, the incidence of severe obesity among children and adolescents continues to rise.[10,11]

Furthermore, the COVID-19 pandemic contributed to an accelerated rate of weight gain among children and adolescents compared to pre-pandemic trends. This surge has been attributed to a combination of factors, including decreased physical activity, increased screen time, dietary changes, food insecurity, and elevated levels of family and individual stress.[12,13]

Objectives of the study

To study the prevalence of overweight among school going adolescents. To determine the association between overweight and obesity with life style changes.

METHODS

Source of data

The data will be collected from school going adolescents of age 13 to 17 years from different schools of Kalaburagi.

Study design

It was a cross-sectional study.

Place of study

Department of paediatrics, Basaweshwar teaching and general hospital, attached to Mahadevappa Rampure medical college, Kalaburagi. Ethical approval given by regional ethical committee from Mahadevappa Rampure Medical College.

Sample size

The sample size was 800. Sample size was calculated using the formula.

Sample size (n) = (Z)2 PQ/ L2

Prevalence rate of overweight among adolescent school going children aged 13 to 17 years=11.3%.

Prevalence rate p=11.3

Q=100-P =88.7

L=Permissible error 20% of P, L=2.2

Power of study was 80.0

Sample size (n) = 1.96×1.96×11.3×88.7/2.2×2.2 n
= 3.845×1002.31/4.84 n
= 3853.88/4.84 n
= 796

Sample size n = Round figure 800 case

Sampling procedure

Study subjects will be selected after applying inclusion exclusion criteria. Information is collected through prepared proforma from each student in the study.

Study duration

The study duration was from 1st may 2023 to 31st October 2024 (18 months).

Statistical analysis

The statistical data collected will be analysed statistically using IBM SPSS software 20.0 version. For qualitative data analysis Chi square test will be applied for test of significance. P value of<0.05 is considered as significant.

Inclusion criteria

Adolescents aged 13-17 years of all sex. Students with overweight as BMI ≥23kg/m2 of adult equivalent (more than 71st and 75th percentile in boys and girls, respectively). Students with obesity as BMI ≥27 kg/m^2 of adult equivalent (more than 90th and 95th percentile in boys and girls, respectively).

Exclusion criteria

Students who have any physical deformities. Students who are suffering from chronic illness and who are on chronic medications.

Study method

It is a community based cross sectional study in high schools and higher secondary schools of Kalaburagi city from May 1st 2023 to October 31st 2024. Consent will take from the head of the institution. The data's will be collected by using semi structured questionnaire. The weight of the student will be measured by using a weighing machine, with a precision of 0.5 kg. For measuring the height, the student has to stand on a level surface without shoes, then height in cm will be taken. Overweight and obesity among the study population will be estimated by using 2015 IAP growth chart.

RESULTS

The study included a total of 800 school-going adolescents from North Karnataka, comprising 471 males (58.9%) and 329 females (41.1%). The mean age of the participants was 14.40±1.11 years (Table 1). The age distribution revealed the highest number of children were aged 13 years (27.5%), followed by those aged 15 years (25.5%). The youngest participant was 13 years old, and the oldest was 16. No statistically significant difference in mean age was found between genders (p=0.824).

Most participants belonged to joint families (75.7%), while 24.3% were from nuclear families (Table 2). Regarding dietary habits, 53% followed a mixed diet, while 47% were vegetarians (Table 3).

Anthropometric measurements showed an average height of 153.47±6.45 cm and mean weight of 48.90±7.17 kg (Table 4). Based on BMI classification, 14.1% were underweight, 51.6% had normal weight, 28.8% were overweight, and 5.5% were obese. The overall prevalence of overweight and obesity combined was 34.3%, with a mean BMI of 21.43 ± 3.09 kg/m^2 (Table 5).

Associations between obesity and lifestyle factors

Family history

A statistically significant association was found between overweight/obesity and a family history of both diabetes and obesity (p<0.001). Among those with a diabetic family history, 42.2% were overweight or obese compared to 15.1% among those without such history. Similarly, 44.2% of children with a family history of obesity were overweight or obese, in contrast to 10.0% in those without.

Diet type

Overweight and obesity were significantly higher in children with a mixed diet (36.7%) compared to vegetarians (20.7%) (p<0.001).

Meal consumption time

Children who spent less than 5 minutes eating meals had the lowest prevalence of overweight/obesity (12.1%), whereas those who took 5–10 minutes had the highest (38.4%). This association was statistically significant (p<0.001).

Screen time

Overweight and obesity prevalence increased with screen time. Among those spending more than 3 hours daily on screens, 60% were overweight or obese. Only 5.4% of those with 1-hour screen time were overweight or obese. This relationship was highly significant (p<0.001).

Physical activity (rate of play)

Children who never engaged in play had the highest prevalence of overweight/obesity (77.8%), while those playing more than seven times a week had the lowest (9.6%). The relationship was statistically significant (p<0.001) (Table 6).

Butter/ghee consumption

High-frequency consumers of butter/ghee (> once a week) had a higher rate of overweight/obesity (38.0%), followed by those consuming once a month (20.5%), and rarely (3.6%) (p<0.001) (Table 7).

Fried local foods

Intake frequency of fried local foods showed a strong association with weight status. Half of the children consuming these foods more than once a week were overweight or obese, whereas only 2.4% of those consuming them rarely were affected (p<0.001) (Table 8).

Red meat consumption

Overweight and obesity were significantly associated with red meat intake. Children consuming red meat more than once a week showed a prevalence of 51.2%, while only 15% of non-consumers were overweight or obese (p<0.001) (Table 9).

Fast food (pizza/burgers)

A significant link was observed between fast food consumption and obesity. Among children who consumed pizza or burgers more than once a week, 58.7% were overweight or obese. In contrast, only 7.2% of those who rarely consumed such foods were overweight or obese (p<0.001) (Table 10).

Soft drink intake

Daily soft drink consumers had an overweight/obesity prevalence of 51.2%, whereas it was only 9.4% among those who consumed less than once a week. The association was highly significant (p<0.001).

Chocolate consumption

Chocolate habits were significantly linked with weight status. Children consuming chocolates more than once per day had an overweight/obesity prevalence of 43.7%, compared to 10.5% among those consuming 1–3 times per month (p<0.001).

Summary

The results clearly indicate a high prevalence of overweight and obesity among adolescents in North Karnataka, affecting more than one-third of the population studied. Several lifestyle and dietary habits were significantly associated with higher BMI, including family history of metabolic conditions, poor dietary choices (frequent intake of fast food, soft drinks, chocolates), sedentary behaviour (high screen time, low physical activity), and rapid eating habits. These findings emphasize the urgent need for targeted interventions focusing on health education, lifestyle modification, and dietary awareness among school-aged children to curb the growing trend of adolescent obesity.

Table 1: Age and gender wise distribution of children.

Age (in years)	Males		Females		Total	
13	115	24.4	105	31.9	220	27.5
14	153	32.5	49	14.9	202	25.2
15	89	18.9	115	35.0	204	25.5
16	114	24.2	60	18.2	174	21.8
Total	471	100.0	329	100.0	800	100.0
Mean±SD	14.41±1.10		14.39±1.12		14.40±1.11	
P value	t=0.223 P=0.824, NS					

NS: non significant

Table 2: Type of family wise distribution of children.

Type of family	Number of children	Percentage
Nuclear family	194	24.3
Joint Family	606	75.7
Extended family	0	0.0
Total	800	100.0

Table 3: Diet wise distribution of children.

Diet	Number of children	Percentage
Veg	376	47.0
Mixed	424	53.0
Total	800	100.0

Table 4: Height and weight wise distribution of children.

Parameters	Minimum	Maximum/No	Mean	SD
Weight (in kg)	23.1 kg	92.5 kg	48.90 kg	7.17
Height (in cm)	127.5	180.0	153.47 cm	6.45

Table 5: BMI wise distribution of children.

BMI kg/m^2	Categories	No. of respondents	Percentage
< 18.5	Under weight	113	14.1
18.5–23.0	Normal weight	413	51.6
23.1—27.0	Over weight	230	28.8
≥ 27.1	Obese	44	5.5
Total	---	800	100.0
Mean ± SD	21.43±3.09		

Table 6: Association of children's over-weight and obesity with rate of play.

Rate of play	Categories	No	Over-weight & obese	Normal weight & under wt	X^2 –Test value, P value
			No (%)	No (%)	
Time	Never	9	7 (77.8%)	2 (22.2%)	X^2= 156.3, P=0.000, HS
	<7 times	342	174 (50.9%)	168 (49.1%)	
	7 times	251	34 (13.5%)	217 (86.5%)	
	>7 times	198	19 (9.6%)	179 (90.4%)	
Total	---	800	234	566	---

Table 7: Association of children's over-weight and obesity with intake of Butter/ghee.

Intake of Butter/ghee	Categories	No	Over-weight & obese	Normal weight & under wt	X^2 Test value, P value
			No (%)	No (%)	
Period	>Once in a week	481	183 (38.0%)	298 (62.0%)	X^2= 105.10, P=0.000, HS
	Once in a month	236	48 (20.5%)	270 (79.5%)	
	Rarely	83	3 (3.6%)	151 (96.4%)	
Total	---	800	234	566	---

Table 8: Association of children's over-weight and obesity with intake of fried local food.

Intake of fried local food	Categories	No	Over-weight & obese	Normal weight & under wt	X^2 Test value, P value
			No (%)	No (%)	
Period	>Once in a week	305	152 (50.0%)	153 (50.0%)	X^2=136.05, P=0.000, HS
	Once in a month	286	77 (26.9%)	209 (73.1%)	
	Rarely	209	5 (2.4%)	204 (97.6%)	
Total	---	800	234	566	---

Table 9: Association of children's over-weight and obesity with intake of red meat.

intake of red meat	Categories	No	Over-weight & obese	Normal weight & under wt	X^2 –Test value, P value
			No (%)	No (%)	
Time period	No/NA	447	67 (15.0%)	380 (85.0%)	X^2= 119.03, P =0.000, HS
	Rarely	77	21 (27.3%)	56 (72.7%)	
	Once a month	147	80 (54.4%)	67 (45.6%)	
	>Once a week	129	66 (51.2%)	63 (48.8%)	
Total	---	800	234	566	---

Table 10: Association of children's over-weight and obesity with intake of pizza/burgers or any fast food.

Intake of pizza/burgers or any fast food	Categories	No	Over-weight & obese	Normal weight & under wt	X^2 Test value, P value
			No (%)	No (%)	
Time period	>Once in a week	218	128 (58.7%)	90 (41.3%)	X^2= 167.93, P=0.000, HS
	Once in a month	261	83 (31.8%)	178 (68.2%)	
	Rarely	321	23 (7.2%)	298 (92.8%)	
Total	---	800	234	566	---

DISCUSSION

The present study reveals a substantial prevalence of overweight (28.8%) and obesity (5.5%) among school-going adolescents in North Karnataka, with a combined prevalence of 34.3%. This is higher than figures reported in several previous Indian studies, suggesting an upward trend in adolescent obesity in this region. The increasing

prevalence highlights the growing impact of lifestyle transitions, including dietary shifts, reduced physical activity, and increased sedentary behaviour, on adolescent health. The demographic analysis showed that the mean age of participants was 14.4 years, with the highest proportion being 13 years old. Male students constituted a higher proportion (58.9%) compared to females (41.1%). The gender distribution was consistent with studies by Gautam et al and Suresh Bhai et al, which also found male predominance in school-based obesity research. However, while studies such as those from Qatar have reported higher obesity prevalence among males, our study did not observe any statistically significant gender-based differences in BMI categories. This could be attributed to local cultural practices or environmental factors unique to North Karnataka.[14-16]

In terms of BMI distribution, our findings are concerning. While 51.6% of participants had a normal BMI, a notable 14.1% were underweight, which adds a dual burden of malnutrition to the obesity crisis. This trend has been similarly reported in urban studies in India, where undernutrition and overnutrition coexist, often influenced by socioeconomic status and urbanization.

Dietary habits were a significant focus in our analysis. Over half of the participants (53%) followed a mixed diet, while 47% adhered to a vegetarian diet. The dietary pattern did not show a strong association with BMI in our study, yet frequent consumption of high-calorie items such as chocolates and soft drinks was significantly associated with overweight and obesity.

Notably, 35.7% of participants consumed carbonated beverages at least once a week, and 10.5% reported daily consumption. Similarly, chocolate consumption showed a statistically significant correlation with higher BMI ($p<0.001$), echoing findings from studies conducted in Chennai and Dibrugarh, which identified sweets and chocolate consumption as risk factors for adolescent overweight.[17,18]

Junk food intake was also considerable among participants, with 27.2% consuming junk food more than once a week and 32.6% consuming it once a month. Although not all studies showed significant associations between junk food and obesity, the overall trend suggests that frequent intake of calorie-dense, nutrient-poor food contributes to the rising obesity burden. For instance, studies from Gujarat and Kerala similarly emphasized the impact of processed foods, including chocolates and soft drinks, on adolescent weight gain.[19,20]

Lifestyle behaviour such as screen time and physical inactivity were critical determinants of BMI in our study. High screen time, especially exceeding three hours per day, has been consistently associated with overweight and obesity, as supported by studies from India, and Ethiopia.[19,21]

Our results showed that reduced physical activity and increased engagement with mobile phones, video games, and television were significantly associated with higher BMI, which aligns with prior findings by Pandey et al and Yadav et al Notably, students who participated in outdoor games daily had a significantly lower prevalence of overweight/obesity compared to those who played only once a week.[22,23] Family structure and history also played notable roles. Most participants belonged to joint families (75.7%), in contrast with other studies such as those by Mishra et al and Pandey et al where nuclear families were more prevalent. While our study did not find a statistically significant relationship between family type and BMI, earlier research has noted a higher tendency for overweight in adolescents from nuclear families. Additionally, a significant association was found between overweight/obesity and a family history of diabetes and obesity ($p<0.001$), which supports findings from studies conducted in South India and by Thomas et al genetic predispositions combined with shared family environments likely amplifies the risk.[22,24,25]

Interestingly, our study revealed that urbanization and modernization in North Karnataka may be accelerating the lifestyle and dietary transitions that contribute to adolescent obesity. Although we did not collect detailed socioeconomic data, the findings suggest parallels with studies from metropolitan areas like Chennai and Bengaluru, where urbanization correlates with sedentary behaviour, westernized diets, and reduced physical activity. This supports the hypothesis that even semi-urban or transitioning rural regions are not immune to the global obesity epidemic.

Regional variations in overweight and obesity prevalence also reflect differing social norms, economic conditions, and food availability. For example, a study from Salem, Tamil Nadu, found a lower prevalence of overweight and obesity among girls (6.86%) compared to our findings. Similarly, a study from Madurai reported a strong association between private schooling and obesity prevalence, pointing to socioeconomic factors such as access to processed foods and lifestyle differences. While we did not observe significant variations based on school type, this could be a consideration for future investigations.[26,27]

The academic and public health implications of these findings are significant. Overweight and obese adolescents are at increased risk for metabolic disorders, cardiovascular disease, and psychosocial issues. Early identification and intervention are crucial, especially since many adolescents are unaware of their weight status or do not perceive it as a health concern. Interventions must target modifiable risk factors such as dietary habits, screen time, and physical activity through coordinated school-based and community-level programs.

Educational institutions can play a pivotal role by promoting healthy eating through school canteens,

incorporating regular physical activity into the curriculum, and reducing exposure to junk food advertisements. Parental awareness campaigns are also essential, particularly in addressing genetic risks and encouraging healthy home environments. Additionally, policy-level actions-such as limiting junk food sales near schools, mandating physical education classes, and regulating screen time-can help create healthier environments for adolescents.

CONCLUSION

In conclusion, our study demonstrates a high prevalence of overweight and obesity among adolescents in North Karnataka, strongly associated with dietary and lifestyle factors. The findings underscore the urgent need for multifaceted interventions targeting adolescents, parents, schools, and policymakers to reverse the trend and promote healthier adolescent development.

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