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Original Research Article

PREVALENCE OF OVERWEIGHT AND OBESITY AND ITS ASSOCIATION WITH PUBERTAL MATURITY IN URBAN INDIAN ADOLESCENTS

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ABSTRACT

Background: Childhood and adolescent overweight and obesity are increasing in India and contribute substantially to future cardiometabolic risk. Puberty is a critical developmental period during which excess adiposity may influence growth and maturation. This study assessed the prevalence of overweight and obesity among high school children and examined associated lifestyle factors and sexual maturity rating (SMR).

Materials and Methods: This one-year community-based observational study included 1,000 school-going children aged 11–16 years from an urban field practice area of South India. Anthropometric measurements, including body mass index (BMI) and waist–hip ratio, were recorded. Sexual maturity was assessed using Tanner staging. Sociodemographic and lifestyle factors were documented, and associations with overweight and obesity were analyzed.

Results: Girls comprised 57.4% of participants, with a boy-to-girl ratio of 1:1.34. The mean age was 14.36±1.08 years. The prevalence of obesity and overweight was 4.9% and 4.5%, respectively. Raised waist–hip ratio was observed in 3.4% of children, among whom obesity was significantly more common ($p<0.001$). Most participants (91.7%) were in SMR stage II. Obesity was significantly associated with reduced physical activity, increased television viewing, higher SMR stage, peer-related factors, and family history of diabetes mellitus and obesity.

Conclusion: Overweight and obesity in urban Indian adolescents are closely associated with modifiable lifestyle factors and pubertal maturation. School-based preventive strategies focusing on physical activity and early risk identification during puberty are warranted.

Keywords: Adolescents, Body mass index, Childhood obesity, Puberty, Sexual maturity rating.

INTRODUCTION

Childhood overnutrition has emerged as a major public health concern, with consequences extending into adulthood in the form of obesity. Although not immediately fatal, obesity is a well-established risk factor for metabolic syndrome, coronary artery disease, stroke, pulmonary embolism, and other life-threatening conditions.[1] Obesity is considered the first wave of a cluster of non-communicable diseases referred to as the "New World Syndrome," placing a substantial socioeconomic and public health burden on low- and middle-income countries.[2]

Childhood overweight and obesity represent a growing global public health challenge affecting both developed and developing countries.[3,4] According to the World Obesity Atlas 2024, approximately 158 million children and adolescents aged 5–19 years

were living with obesity worldwide in 2020, a figure projected to increase substantially by 2035, highlighting the growing global burden of pediatric obesity.[5] Traditionally, undernutrition received greater attention in India, as childhood obesity was considered uncommon. However, recent decades have seen a steady increase driven by lifestyle changes, increased purchasing power, sedentary behaviors, and reduced outdoor physical activity related to television viewing, video gaming, and computer use.[6] In India, the overall prevalence of overweight and obese children was found to be 10.8% and 6.2%, respectively. Both 'overweight' and 'obese' were found more frequently among males (11.0% and 7.1%, respectively) than females (10.6% and 5.4%, respectively).[7] A recent meta-analysis of 21 Indian studies conducted between 2003 and 2023 reported a pooled prevalence of obesity of 8.4% and overweight of 12.4%.8 The World Obesity Atlas 2024 further reported that India ranks fourth globally for the most rapid rise in childhood high BMI, with a compound annual growth rate of 7.9% between 2000 and 2016 and an estimated prevalence of 24% by 2035.[5]

The increasing prevalence of childhood overweight has been attributed to nutritional transition associated with urbanization, industrialization, economic growth, and trade liberalization, leading to increased consumption of energy-dense foods and reduced physical activity.[9,10] Urban residence has been consistently associated with a higher risk of childhood obesity in developing countries.[4] Childhood and adolescent obesity are associated with immediate and long-term adverse health outcomes, including low self-esteem, dyslipidemia, elevated blood pressure, hyperinsulinemia, and persistence of obesity into adulthood, thereby increasing the risk of chronic non-communicable diseases and healthcare burden.[11]

Puberty represents a critical period for the development of excess body weight, as hormonal changes influence growth patterns, body composition, and fat distribution. Sex-specific differences in adiposity become more evident during adolescence. Early sexual maturation in females has been associated with higher rates of overweight and obesity,[11] while evidence in males remains inconsistent.[12] Children with early sexual maturation tend to have greater height-for-age irrespective of sex.[13] Despite this, data examining the relationship between obesity and sexual maturity among Indian adolescents remain limited.

In this context, the present study was undertaken to determine the prevalence of overweight and obesity among high school children in an urban South Indian setting and to identify the risk factors associated with obesity. In addition, sexual maturity was assessed using Tanner staging to examine its relationship with adiposity during adolescence. By addressing both lifestyle factors and sexual maturity rating within a community-based framework, this study aims to generate context-specific evidence to support early identification of at-risk adolescents and inform school-based preventive strategies.

MATERIALS AND METHODS

Study design and setting

This community-based observational study was conducted over a period of one year under the Department of Paediatrics at a tertiary care hospital in Karnataka.

Ethical approval was obtained from the Institutional Ethics Committee of S. Nijalingappa Medical College and Hanagal Shri Kumareshwar Hospital and Research Centre, Bagalkot, Karnataka, India, prior to initiation of the study.

Sample size estimation

Based on a previous study by Shah C et al,[14] the prevalence of obesity among children aged 10–18 years in urban areas was reported to be 6%. The sample size was calculated using the formula $n = 4pq/d^2$, where p represents the prevalence (6%), $q = 100 - p$ (94%), and d denotes the allowable error (2%). The minimum required sample size was 564. However, considering eligibility criteria and availability, a total of 1,000 children were enrolled in the study.

Study population and eligibility criteria

Children of both sexes aged 11–16 years studying in government and private high schools located within the urban field practice area were included. Children who were malnourished on physical examination, those with chronic illnesses such as congenital heart disease, chronic kidney disease, liver failure, or endocrinological disorders unrelated to obesity, and those whose parents/guardians or adolescents declined consent were excluded.

Ethical considerations and data collection

The Ethics Committee of S. Nijalingappa Medical College and Hanagal Shri Kumareshwar Hospital and Research Centre, Bagalkot, Karnataka, India, follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) related to GCP (Good Clinical Practice) and all other applicable Indian regulations. The study was conducted in accordance with the norms of WHO standards of obesity. Permission was obtained from school authorities prior to enrolment. Written informed consent was obtained from parents or guardians, along with assent from participating children. Information regarding parental smoking and alcohol consumption, family history of hypertension, diabetes mellitus, and obesity, as well as any underlying chronic illness in the child, was recorded. Physical activity patterns and screen time were recorded using a structured questionnaire.

Anthropometric and clinical assessment

All children underwent a general physical examination, including measurement of height, weight, waist circumference, hip circumference, blood pressure, and other vital signs. Each assessment lasted approximately 20 minutes. Height was

measured using a portable stadiometer, and weight was measured using a digital weighing scale. Body mass index (BMI) was calculated as weight (kg)/height (m^2) and plotted using WHO growth charts.[15] Waist–hip ratio was also calculated.

Assessment of obesity and pubertal staging

Overweight and obesity were classified using WHO BMI charts for boys and girls.[15] Waist–hip ratio was interpreted according to the Report of a WHO Expert Consultation.[16] Sexual maturity rating (SMR) was assessed using Tanner staging after obtaining informed consent.[17,18]

In boys, pubertal development was assessed based on external genitalia (stages 1–5), pubic hair development (stages 1–5), and linear growth velocity. In girls, staging was based on breast development (stages 1–5), pubic hair development (stages 1–5), and linear growth patterns. Detailed criteria for each Tanner stage were applied as described by Marshall and Tanner (Figure 1).[17,18]

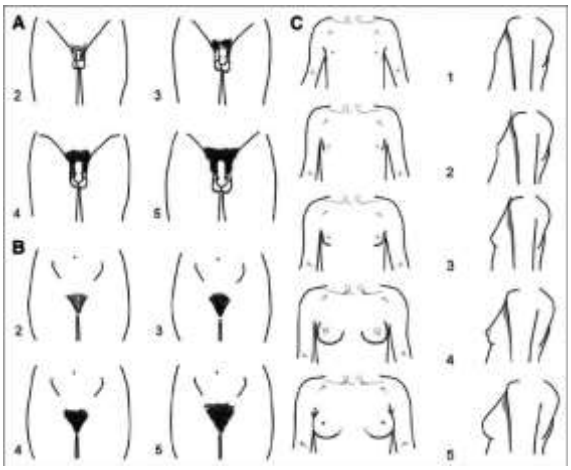


Figure 1: Sexual maturity rating (Tanner staging): Diagrammatic representation of Tanner stages showing breast development in girls and genital development in boys used for assessment of sexual maturity rating in the study population

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS software (version 20). Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation. The prevalence of overweight and obesity was expressed as percentages. Associations between overweight/obesity and categorical risk factors were assessed using the Chi-square test or Fisher's exact test, as appropriate. Correlation between body mass index and interscapular area was evaluated using Pearson's correlation coefficient. All statistical tests were two-tailed, and a p-value ≤0.05 at a 95% confidence interval was considered statistically significant.

RESULTS

The descriptive characteristics of the study population are presented in Table 1, and the prevalence of overweight and obesity is shown in Graph 1. The boy-to-girl ratio was 1:1.34. A slightly higher proportion of girls were obese compared with boys; however, this difference did not reach statistical significance ($p = 0.066$). The mean age of the participants was 14.36 ± 1.08 years, with a median age of 14 years, and the largest proportion of children were aged 15 years. The prevalence of obesity was marginally higher among children aged 12 years compared with other age groups, although this difference was not statistically significant ($p = 0.839$).

Associations between obesity and sociodemographic and lifestyle variables are summarized in Table 2. Lack of participation in sports activities, increased television viewing, reduced participation in activities such as cycling and walking, and a family history of diabetes mellitus and obesity showed significant associations with obesity.

Based on genital/breast development, the majority of participants (91.7%) were classified as Tanner stage II. Distinct patterns were observed across SMR stages, with overweight more common in SMR stages II and III, whereas obesity was more frequent in SMR stage I.[Table 3] Children with a raised waist–hip ratio had a significantly higher prevalence of overweight and obesity. [Table 4]

Table 1: Clinical and anthropometric profile of the children (n = 1000)

Variable	Mean ± SD	Median	Range
Age (years)	14.36 ± 1.08	14	12–16
Calories consumed (kcal/day)	1619.4 ± 139.0	1600	170–2100
Calories required (kcal/day)	2335.7 ± 108.4	2300	2100–2500
Protein intake (g/day)	36.5 ± 1.7	36	30–46
Protein requirement (g/day)	48.8 ± 2.6	50	40–70
Sports activity (min/day)	51.6 ± 49.9	60	0–540
Television viewing (min/day)	62.1 ± 37.0	60	0–600
Walking/cycling (days/week)	4.6 ± 2.7	6	0–7
Walking/cycling (min/day)	45.3 ± 31.4	45	0–180
Pulse rate (beats/min)	81.6 ± 4.9	82	78–92
Respiratory rate (breaths/min)	21.8 ± 3.1	22	14–28
Systolic blood pressure (mmHg)	102.4 ± 9.0	100	110–140
Diastolic blood pressure (mmHg)	68.6 ± 7.5	70	60–100
Temperature (°F)	97.5 ± 0.5	97.6	97.2–99.2
Height (cm)	158.0 ± 7.4	158	128–169

Weight (kg)	48.5 ± 10.3	47	28–106
Body mass index (kg/m²)	19.3 ± 3.7	18.7	12.0–37.1
Waist circumference (cm)	63.8 ± 9.2	62	30–116
Hip circumference (cm)	82.6 ± 8.8	82	60–130
Waist–hip ratio	0.77 ± 0.06	0.77	0.42–1.10

Table 1: Clinical and anthropometric profile of the children (n = 1000): Clinical characteristics and anthropometric measurements of the enrolled children, expressed as mean ± standard deviation, median, and range.

Table 2: Socio demographic characteristics of the study population and its association with overweight and obesity

	Subgroups	Body mass index						Total (n=1000)		P Value
		Normal (n=906)		Overweight (n=45)		Obese (n=49)				
		No.	%	No.	%	No.	%	No.	%	
Sex	Boys	394	92.49	19	4.46	13	3.05	426	42.60	0.066
	Girls	512	89.20	26	4.53	36	6.27	574	57.40	
Age (Years)	12	24	82.76	2	6.90	3	10.34	29	2.90	0.839
	13	198	91.24	10	4.61	9	4.15	217	21.70	
	14	261	90.63	14	4.86	13	4.51	288	28.80	
	15	273	91.30	12	4.01	14	4.68	299	29.90	
	16	150	89.82	7	4.19	10	5.99	167	16.70	
Mother's occupation	Home maker	619	90.10	33	4.80	35	5.09	687	68.7	0.732
	Working	287	91.69	12	3.83	14	4.47	313	31.30	
Mother's education	Graduate	53	84.13	6	9.52	4	6.35	63	6.30	-
	Postgraduate	11	78.57	1	7.14	2	14.29	14	1.40	
	Primary	153	93.87	7	4.29	3	1.84	163	16.30	
	Professional	31	86.11	2	5.56	3	8.33	36	3.60	
	PUC	198	91.24	11	5.07	8	3.69	217	21.70	
	Secondary	90	88.24	7	6.86	5	4.90	102	10.20	
	SSLC	370	91.36	11	2.72	24	5.93	405	40.50	
Religion	Christian	26	86.67	4	13.33	0	0.00	30	3.00	0.058
	Hindu	312	90.70	18	5.23	14	4.07	344	34.40	
	Muslim	568	90.73	23	3.67	35	5.59	626	62.60	
Type of family	Third generation	9	50.00	1	5.56	8	44.44	18	1.80	0.139
	Joint	126	93.33	4	2.96	5	3.70	135	13.50	
	Nuclear	691	90.09	40	5.22	36	4.69	767	76.70	
Socio economic status	Lower middle class	356	91.99	18	4.65	13	3.36	387	38.70	**0.139**
	Middle class	446	89.74	21	4.23	30	6.04	497	49.70	
	Upper middle class	104	89.66	6	5.17	6	5.17	116	11.60	
Diet	Mixed	890	90.45	45	4.57	49	4.98	984	98.40	**0.430**
	Vegetarian	16	100.00	0	0.00	0	0.00	16	1.60	
Western diet and artificial drinks servings (/Week)	1	177	88.06	14	6.97	10	4.98	201	20.10	
	2	277	92.95	11	3.69	10	3.36	298	29.80	
	3	217	92.34	12	5.11	6	2.55	235	23.50	
	4	143	86.67	6	3.64	16	9.70	165	16.50	
	5	92	91.09	2	1.98	7	6.93	101	10.10	
Participation in sports activities	Yes	638	91.40	35	5.01	25	3.58	698	69.80	**0.008**
	No	268	88.74	10	3.31	24	7.95	302	30.20	
Watching Television	Most of the times	216	80.90	16	5.99	35	13.11	267	26.70	**<0.001**
	Sometimes	690	94.13	29	3.96	14	1.91	733	73.30	
Participation in cycling and walking	Yes	773	90.94	41	4.82	36	4.24	850	85.00	**0.039**
	No	133	88.67	4	2.67	13	8.67	150	15.00	
Parents smoking status	Yes	220	90.53	9	3.70	14	5.76	243	24.30	**0.625**
	No	686	90.62	36	4.76	35	4.62	757	75.70	
History of alcohol consumption in parents	Yes	84	92.31	3	3.30	4	4.40	91	9.10	**0.816**
	No	822	90.43	42	4.62	45	4.95	909	90.90	
Family history of hypertension	No	597	90.73	25	3.80	36	5.47	658	65.80	**0.184**
	Yes	309	90.35	20	5.85	13	3.80	342	34.20	
Family history of diabetes mellitus	No	598	92.00	28	4.31	24	3.69	650	65.00	**0.048**
	Yes	308	88.00	17	4.86	25	7.14	350	35.00	
Family history of obesity	No	553	90.07	23	3.75	38	6.19	614	61.40	**<0.001**
	Yes	353	91.45	22	5.70	11	2.85	386	38.60	

Table 2: Association between sociodemographic and lifestyle factors and nutritional status: Distribution of children according to sociodemographic and lifestyle characteristics across body mass index categories (normal, overweight, and obese) and their association with obesity.Values are expressed as number (%). Body mass index classification based on WHO

growth charts. Associations were assessed using the chi-square test or Fisher's exact test, as appropriate.

Table 3: Distribution of children according to SMR stage and body mass index

SMR stage	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)
I	30 (76.9)	1 (2.6)	8 (20.5)	39 (3.9)
II	836 (91.2)	42 (4.6)	39 (4.3)	917 (91.7)
III	40 (90.9)	2 (4.5)	2 (4.5)	44 (4.4)
Total	906 (90.6)	45 (4.5)	49 (4.9)	1000 (100)

p = 0.005

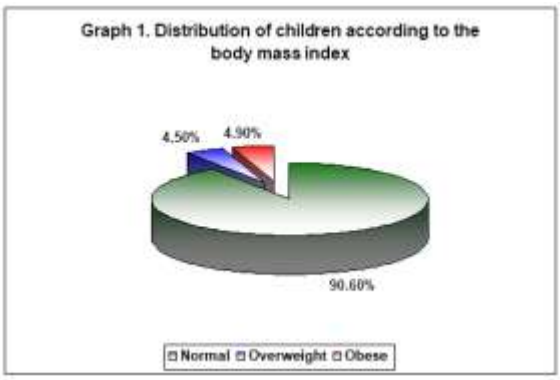
Table 3: Distribution of children according to sexual maturity rating and body mass index: Distribution of body mass index categories across sexual maturity rating (Tanner) stages among the study population. Values are expressed as number (%). Sexual maturity rating assessed using Tanner staging.

Table 4: Distribution of children according to waist–hip ratio and body mass index

Waist–hip ratio	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)
Normal	886 (91.7)	41 (4.2)	39 (4.0)	966 (96.6)
Raised	20 (58.8)	4 (11.8)	10 (29.4)	34 (3.4)
Total	906 (90.6)	45 (4.5)	49 (4.9)	1000 (100)

p < 0.001

Table 4: Association between waist–hip ratio and body mass index: Distribution of children according to waist–hip ratio categories and body mass index classification.Values are expressed as number (%). Waist–hip ratio classified according to WHO expert consultation guidelines.



Graph 1: Distribution of children according to the body mass index

Graph 1: Prevalence of overweight and obesity among high school children: Graphical representation showing the proportion of children classified as normal weight, overweight, and obese based on body mass index categories according to WHO growth charts (n = 1000).

DISCUSSION

Obesity and overweight amongst children were considered primarily as disease of developed countries with high per capita income.1 However, developing countries like India are also joining this pool because of rapid change in food habits and lifestyle. India, which was once struggling with undernutrition, now has a paradox of being considered a fast weight gaining nation.[19] This could be reflection of the recent emerging socio-economic trends in childhood obesity in India. The present community-based study assessed the prevalence of overweight and obesity among high school children in an urban South Indian setting and examined associated risk factors, including lifestyle behaviors and sexual maturity rating.

In the present study, the mean BMI was 20.43±3.06 kg/m^2. The prevalence of obesity (4.9%) and overweight (4.5%) observed in this study is comparable to figures reported in other urban Indian studies which show the current prevalence of childhood overweight in India ranging between 4% and 22%.7,8 However, a recent study by Dasappa H. et al.20 (2017) from Bangalore reported prevalence of overweight and obesity to be 13.2% and 17.13% respectively which are very high compared to the present study. A recent systematic review analyzing prevalence data from 52 studies conducted across 16 of the 28 Indian states reported a pooled prevalence of childhood overweight and obesity of 19.30% in studies published after 2010, representing a significant increase compared with the prevalence of 16.30% reported during 2001–2005.[21] In another study by Pathak S. et al,[22] (2018) from Vadodara the prevalence of obese, overweight, normal and underweight children was 17.6%, 20.2%, 59% and 3.2% respectively. The relatively lower prevalence of overweight and obesity observed in the present study may be attributable to several factors, including differences in sample size, variation in BMI assessment methods—specifically the use of WHO growth charts in this study compared with IAP charts in others—and the application of stringent selection criteria. In particular, children with chronic illnesses and those with undernutrition were excluded based on clinical assessment and history, which may have contributed to the lower observed prevalence.

The study population demonstrated a female predominance, similar to findings reported by Bharati DR et al,[23] in Wardha city, where girls constituted a slightly higher proportion than boys, while contrasting patterns with male predominance have been reported from other regions, including Davangere, Karnataka.[24] Although the prevalence of obesity was marginally higher among girls than boys in the present study, this difference did not reach statistical significance, a finding consistent with

earlier studies that have reported comparable obesity prevalence between sexes.[22]

The age of participants ranged from 12 to 16 years, reflecting enrollment from high school classes. The mean age was 14.36 ± 1.08 years, with the largest proportion of children aged 15 years. Although the prevalence of obesity was marginally higher among 12-year-old children (6.9%), no significant association was observed between age and obesity prevalence (p = 0.839). Similar age-related patterns have been reported previously; however, Sood A et al,[25] observed the highest prevalence of obesity at 12 years among affluent adolescent girls in Bangalore.

In the present study, obesity showed no significant association with religion, family type, parental education or occupation, socioeconomic status, dietary pattern, or weekly consumption of artificial drinks (p > 0.050). While earlier studies have reported parental education and occupation as determinants of childhood obesity.[26] Bharati DR et al.[23] identified urban residence and parental employment in service or business as key factors in schoolchildren from Wardha city. In contrast, findings from western India by Goyal RK et al,[27] demonstrated no difference in obesity prevalence between vegetarian and non-vegetarian diets, which is consistent with the present study.

In the present study, lack of physical activity showed a significant association with obesity. Children who did not participate in sports activities had a higher prevalence of obesity compared with those who participated (7.95% vs. 3.58%; p = 0.008), and obesity was also more prevalent among children who did not engage in activities such as cycling and walking (8.67% vs. 4.24%; p = 0.039). These findings highlight the association between reduced physical activity and childhood obesity and are consistent with observations reported by Bharati DR et al,[23] in Wardha city.

Screen time also demonstrated a significant association with obesity. In this study, 73.3% of children reported watching television for 1–2 hours per day, while 26.7% watched television for more than 2 hours daily, as defined by the Endocrine Society Clinical Practice Guideline.[28] Children who watched television for more than 2 hours per day had a significantly higher prevalence of obesity compared with those who watched for shorter durations (13.11% vs. 1.91%; p < 0.001). Similar findings were reported by Laxmaiah A et al,[29] among urban adolescents in Hyderabad, where the risk of overweight and obesity was approximately twofold higher among children with prolonged television viewing.

With respect to familial factors, nearly one-third of participants reported a family history of hypertension (34.2%); however, no significant association with obesity was observed (p = 0.184). In contrast, family history of diabetes mellitus (35.0%) and obesity (38.6%) were both significantly associated with childhood obesity (p = 0.048 and p < 0.001, respectively), suggesting a familial predisposition. Similar associations between family history of obesity and childhood overweight have been reported in school-based studies from western India.[27]

Puberty represents a critical period for the development of excess body weight, as hormonal changes influence linear growth, body composition, and the amount and distribution of adipose tissue.30 During adolescence, marked sex differences in fat accumulation and distribution emerge, particularly among females.[3]1 Early sexual maturation in females has been consistently associated with a higher prevalence of overweight and obesity,[3]2,33 whereas evidence in males remains inconsistent.34,35

In the present study, the majority of participants were classified as SMR stage II, and a significant association was observed between sexual maturity rating and obesity (p = 0.005), indicating a relationship between pubertal development and adiposity. This association is further supported by the finding of a significantly higher prevalence of overweight and obesity among children with a raised waist–hip ratio, reflecting increased central adiposity. Central fat accumulation during puberty has been recognized as an important marker of metabolic risk.[16]

Longitudinal evidence supports the role of pubertal timing in long-term adiposity. Pierce and Leon34 demonstrated that early sexual maturation was a stronger predictor of adult BMI than childhood BMI, while Demerath et al.35 showed that increases in BMI followed, rather than preceded, pubertal onset in females. Although findings in males are less consistent, cohort studies suggest that early-maturing boys may develop higher total and central adiposity in adulthood.[13] Taken together, these findings highlight puberty as a critical window for identifying adolescents at risk of excess and central adiposity, although causal inferences cannot be drawn from cross-sectional data.

In the present study, a raised waist–hip ratio (WHR) was observed in 3.4% of children, and a significant association was noted between central adiposity and obesity, with 29.41% of children with raised WHR being obese (p < 0.001). These findings are consistent with a study conducted in Delhi by Mehta M et al.36 among affluent adolescent girls, which reported a prevalence of obesity of 5.3% and overweight of 15.2%; notably, central obesity was present in 21 of 22 obese girls, with 10 girls having a waist circumference exceeding 100 cm. These observations highlight the importance of central adiposity as a marker of obesity-related risk in adolescents.

Overall, the prevalence of obesity and overweight in the present study was 4.9% and 4.5%, respectively, among high school children aged 12–16 years. The majority of participants had attained SMR stage II sexual maturity (91.7%). Obesity showed significant associations with lack of participation in sports activities, reduced engagement in cycling and walking, prolonged television viewing, peer-related behavioral factors, family history of diabetes mellitus and obesity, pubertal status, and raised waist–hip

ratio. In contrast, obesity was not associated with sex, age, parental education or occupation, religion, family type, socioeconomic status, dietary pattern, consumption of artificial drinks, parental smoking or alcohol consumption, family history of hypertension, or behavioral attributes such as academic stress, worry, or communication with parents. Sexual maturity rating demonstrated a significant association with obesity, reinforcing the relevance of pubertal assessment in adolescent obesity research.

A notable strength of this study is the comprehensive assessment of behavioral factors alongside sociodemographic and sociocultural variables, as well as the inclusion of pubertal staging and central adiposity measures. However, the findings should be interpreted with caution due to certain limitations. The single-center design limits generalizability, and the absence of detailed dietary quantity assessment may have restricted evaluation of nutritional contributions to obesity. Larger, multicentric studies incorporating detailed dietary analysis are warranted to better estimate the burden and determinants of overweight and obesity among school-going children.

CONCLUSION

The prevalence of obesity and overweight among high school children aged 12–16 years was 4.9% and 4.5%, respectively. Obesity was significantly associated with reduced physical activity, prolonged television viewing, peer-related factors, family history of diabetes mellitus and obesity, pubertal status, and increased waist–hip ratio, but showed no association with sociodemographic factors, diet, or parental smoking and alcohol use. Most children were classified as SMR stage II, and sexual maturity rating was significantly associated with obesity. Incorporating assessment of pubertal status alongside lifestyle evaluation may facilitate early identification of adolescents at risk of obesity and support school-based preventive strategies.

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Author Contributions (CRediT taxonomy)

Dr. Pallavi Charantimath: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing.

Dr. Anita Daddi: Investigation, Data curation, Writing – review & editing.

Dr. Sheela M.S.: Supervision, Methodology, Writing – review & editing.

Dr. Aparna Kori: Investigation, Data curation, Writing – review & editing.

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