Section: Pediatrics

Original Research Article

A STUDY OF PREVALENCE OF OBESITY, OVERWEIGHT, PREHYPERTENSION AND HYPERTENSION AMONG SCHOOL GOING CHILDREN IN TIRUPATI AREA

A Sailaja[1], Padmaja Rani V[2], Bhargav Yogesh K[3], Syed Khadar Basha[4]

[1]*Associate Professor, Department of Pediatrics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India.*
[2]*Assistant Professor, Department of Pediatrics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India.*
3Assistant Professor, Department of Pediatrics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India.
[4]*Postgraduate, Department of Pediatrics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India.*

Received *: 17/04/2026*
Received in revised form *: 09/06/2026*
Accepted *: 25/06/2026*

Corresponding Author:
Dr. A Sailaja,
Associate Professor, Department of Pediatrics, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India.
Email: drsailaja1234@gmail.com

DOI: 10.70034/ijmedph.2026.3.45

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 276-286

ABSTRACT

Background: Childhood obesity and hypertension are emerging public health concerns worldwide. Rapid urbanization, sedentary lifestyles, unhealthy dietary habits, and increased screen time have contributed to a growing burden of overweight, obesity, and elevated blood pressure among school-aged children. Early identification of these risk factors is essential to prevent future cardiovascular morbidity and mortality. Previous Indian studies have demonstrated a significant association between obesity and elevated blood pressure among school children. The **aim is** to estimate the prevalence of obesity, overweight, prehypertension and hypertension among school children of age 10-16 years in Tirupati urban area.

Materials and Methods: A cross-sectional observational study was conducted among school-going children aged 10–16 years in selected schools of Tirupati. Around 10 months for data collection (i.e., from September 2022 to June 2023). Another 2 months for data compilation and analysis and report writing (i.e., July to August 2023). Demographic details, anthropometric measurements including height and weight, and blood pressure recordings were obtained using standardized procedures. BMI was calculated and categorized according to age- and sex-specific reference standards. Blood pressure was classified as normotension, prehypertension, or hypertension based on pediatric blood pressure guidelines. Data were analyzed using appropriate statistical methods to determine prevalence and associations.

Results: In the present study, prevalence of overweight, obesity, prehypertension and hypertension are 13.9%, 9.5%, 1.2% and 0.4% among apparently healthy school children aged 10-16 years of Tirupati urban. Overweight and obesity was more in students who have family history of obesity and this is statistically significant (p=0.001). In this study the prevalence of prehypertension and hypertension was significantly higher in overweight and obese compared to children with normal BMI indicating overweight and obesity as a risk factor for prehypertension and hypertension. Since adult hypertension starts early in life, if these trends continue further, cardiovascular morbidity & mortality will be enormous in future.

Conclusion: The study highlights the growing burden of overweight, obesity, prehypertension, and hypertension among school-going children in the Tirupati area. Regular school-based screening programs, promotion of healthy dietary habits, increased physical activity, and lifestyle modification strategies are essential for early detection and prevention of future cardiovascular diseases. Early intervention during childhood can substantially reduce the risk of adult hypertension and other non-communicable diseases.

Keywords: Obesity, Overweight, Prehypertension, Hypertension, Body Mass Index, School Children, Tirupati, Adolescents.

INTRODUCTION

Malnutrition is a diet-related non communicable diseases, classified as under nutrition, inadequate vitamins or minerals, overweight and obesity.[1] Obesity is most prevalent form of malnutrition, that it is replacing the more traditional public health concerns including undernutrition.[2]

Worldwide obesity has nearly tripled since 1975. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016.[3] The International Obesity Task Force (IOTF); World Health Organization (WHO) estimate of the global prevalence of overweight (including obesity) among children aged 5-17 years is 10% with an unequal distribution ranging from 30% in America to <2% in sub–Saharan Africa.[4] Overweight and obesity are the fifth leading risk of global deaths.[2]

Developing countries like India, the incidence of lifestyle diseases like obesity, hypertension, type 2 Diabetes Mellitus, dyslipidaemia and ischemic heart diseases are rapidly increasing day by day. This is due to a rapid epidemiological transition with increased urbanization and socio-economic development which has resulted in a dramatic change in lifestyle, consisting of physical inactivity, diet rich in fat, sugar and salt coupled with a high level of mental stress.[5] Obesity and hypertension in school children and an adolescent are emerging as newer health problems in developing countries like India and has been called a global epidemic. In 2017, it is estimated that more than 14.4 million children in Indiaare obese, the second highest rate in the world, only behind China. The prevalence of overweight ranges from 9 to 27.5% and obesity ranges from 1 to 12.9%
among Indian children.[5-11]

The comorbidities of obesity include hypertension, diabetes mellitus, coronary heart disease, stroke, and certain types of cancers, gallbladder disease, dyslipidemia, nonalcoholic fatty liver disease, osteoarthritis, and pulmonary diseases including obstructive sleep apnea. Invariably obesity is a product of imbalance between energy intake and energy output. Several factors such as overeating, psychosocial factors, physical inactivity and genetic predisposition trigger this energy imbalance.[2,5,12,13]

WHO has also emphasized the urgent need of understanding the prevalence trends and influencing factors of childhood obesity.[14] Results of such studies are helpful in development of interventional strategies to halt the emerging epidemic of childhood obesity. Success of adult obesity prevention is firmly based on prevention of childhood obesity.

Hypertension: One of the most important leading factors for childhood hypertension is Obesity and overweight.[5,15] Overweight and obesity, together with hypertension, represents major civilisation threats of the 21st century.[16] Childhood hypertension is mostly asymptomatic, so it remains undiagnosed till adulthood.[5,17] According previous studies, childhood hypertension can lead to adult hypertension.[18] Hypertension is a known risk factor for coronary artery disease (CAD) in adult, and the presence of childhood hypertension may contribution to the early development of CAD.[19]

As per 2017 American Association of Pediatrics guideline, to increase early detection of hypertension, accurate blood pressure measurements should be part of the routine annual physical examination of all children, three years or older and every health visit, children who has comorbidities like obesity, diabetes mellitus and chronic kidney disease.[20] The prevalence of hypertension to be ranging between 0.46% to 15% among children and adolescents.[21]

Hence this study is taken up to evaluate the prevalence of obesity, overweight, prehypertension and hypertension among school going children of Tirupati urban. So that, early detection, modifying the risk factors and preventive measures can protect these children from developing complications and thereby reducing the morbidity and mortality. This study also forms a basis to design suitable school-based program of physical activity, diet modification, and nutritional education in controlling overweight, obesity, prehypertension and hypertension. This background has initiated me to undertake the present study entitled "Study of Prevalence of Obesity, Overweight, Prehypertension and Hypertension among school going children in Tirupati Urban area".

Aim and Objectives

Aim of the study:

To estimate the prevalence of obesity, overweight, prehypertension and hypertension among school children of age 10-16 years in Tirupati urban area.

Objectives of the study:

1. To assesses the Prevalence of obesity and overweight among school going children.
2. To assess the Prevalence of prehypertension and hypertension among school going children.
3. To compare the prevalence of obesity, overweight, prehypertension and hypertension in Government and Private schools.
4. To find out dietary patterns among school going children.
5. To find out any correlation between dietary patterns vs obesity, overweight.
6. To find out any correlation between Overweight and obesity vs prehypertension and hypertension.

MATERIALS AND METHODS

Study Design and Setting: A cross sectional observational study.

Place of study: Two government and two private schools, Tirupati Urban.

Target Population: Children between the age of 10 to 16 years.

Study period: Around 10 months for data collection (i.e., from September 2022 to June 2023). Another 2 months for data compilationand analysis and report writing (i.e., July to August 2023).

Inclusion Criteria

1. School going children between the age group 10 to 16 years.
2. Both sexes between 10-16 years

Exclusion criteria

1. Children with chronic illnesses and or on long term medications
2. Children with congenital anomalies

Study methods

The prior permission was obtained from district education officer and concern selected school head master. Informed consent was obtained from parents and students for carrying out the anthropometric measurements and BP recording.

Details of the children was taken in a predesigned case proforma, contains

1. Demographic data like name, age, sex and socio-economic status.
2. Dietary history and physical activity
3. Examination which includes Anthropometry (Weight, Height and Body Mass Index) and general examination findings like Acanthosis Nigricans and blood pressure measurement.

Age was taken as per school records. Then their weight and height were measured and BP was recorded one by one and was noted in their respective case proforma with the help of teachers. After collection of data from all the four schools, the case proforma were used for analysis.

Ethical Issues

Ethical committee clearance for the study was obtained from the Institutional ethical committee, Sri Venkateswara Medical College, Tirupati.

For boys, anthropometry and BP were recorded by the investigator. But for girls, they were recorded by a female doctor as it was an ethical issue. No monetary or no financial burden to the participant.

Data Analysis

The data collected was arranged in accordance with variables and analyzed. Interpretations were drawn with appropriate statistical analysis.

Statistical Analysis

Statistical analysis was performed using MS Excel software and SPSS (Statistical Package for Social Sciences) software version 23 (SPSS Inc., Chicago). The results for continuous variable were given as mean ± standard deviation, median and proportions as percentages. Both univariate and multivariate analysis was performed to identify the influencing factors of childhood obesity. Chi-square test was used for categorical data. The differences between the groups were assessed by 2 tests for proportions. For all the tests P-value of 0.05 or less was considered for statistical significance.

Kuppuswamy's Socioeconomic Status Scale: Kuppuswamy's socioeconomic status scale, was used to assess the socioeconomic status was which takes into consideration the education status, occupation and family income. This scale was put forth in 1976 and was modified in 1998, 2007, 2016 and 2020. Scorecard.

Equipment's used

1. Non stretchable measuring tape (stadiometer).
2. Electronic weight machine (Eagle) capable of weighing upto 150 kgs with accuracy of 100gms.
3. Mercury sphygmomanometer (Diamond) calibrated as 2mm divisions with adequately sized cuffs.

Habits

Pertaining to the study high energy food like; chocolates, biscuits, noodles, jellies and jams, cheese, and sauce, cakes, and pastries, ice cream; pizza and burgers, chips and samosa, cola beverages which are eaten apart from or instead to normal home diet.

For convenience, snacks will be categorized into 3 groups.

a) Chocolates/ sweets / ice – creams
b) Bakery products like biscuits / puffs/ samosa / chips/ cake.
c) Soft drinks / other fast foods like pizza, burger / pastries/ cheese/ noodles. As it was found difficult to measure the quantity of snaking so frequency of snaking was taken into account.

Daily Activities

- Daily activities of children were classified into 3 groups- Physical activity**,**
- Limited activityandsedentary activity.
- Number of hours spent in a day on these activities was considered for the study.

Physical activity:

- Outdoor playing (both at school and outside), walking, cycling, swimming and physical training (PT) in school and any other such energy spending activities were considered as physical activity.
- Physical activity level (PAL) values express daily energy expenditure as a multiple of Basal Metabolic Rate (BMR)
- In children and adolescents aged 5-17 years required 1 hour of moderate to vigorous intensity aerobic physicalactivity daily over week.

Age (Years)	Sex	Habitual physical activity (PAL values)		
		Light (Sedentary)	Moderate (Limited activity)	Heavy (Physical Activity)
6-13	M	1.54	1.75	1.95
14-18	M	1.60	1.80	2.05
6-13	F	1.48	1.70	1.9
14-18	F	1.46	1.65	1.85

Limited activity: an extra half an hour of moderate to vigorous intensity aerobic physicalactivity daily over week.

Sedentary activity: Activities like attending schools, tuitions, reading, homework, watching television, playing computer games, using mobiles, sleep and any other routine activity at home was considered as sedentary activity.[27]

RESULTS

Table 1: Age and sex wise distribution of the study sample

Age(years)	Male (%)	Female (%)	Total (%)
10	23 (8.9%)	33 (13.5%)	56 (11.1%)
11	36 (14%)	48 (19.4%)	84 (16.7%)
12	60 (23.4%)	48 (19.4%)	108 (21.4%)
13	52 (20.2%)	46 (18.6%)	98 (19.4%)
14	40 (15.6%)	46 (9.1%)	86 (17%)
15	22 (8.6%)	16 (6.5%)	38 (7.6%)
16	24 (9.3%)	10 (4%)	34 (6.8%)
Total	257 (51%)	247 (49%)	504 (100%)

Most of the study subjects were aged 12 years followed by 13 and 14 years and least number were in 16 and 15-years age group in the ascending order. The mean age was 12.64±1.68.

Table 2: Gender wise distribution of study participants

Group	Number (%)
Male	257(51%)
Female	247(49%)
Total	504(100%)

The above table shows that out of 504 (100%) children included in the study, 51 % (257) children are males and 49% (247) children are females.

Table 3: Distribution of overweight and obese in the study population

Group	Number
Normal	386 (76.6%)
Overweight	70 (13.9%)
Obese	48 (9.5%)
Total	504 (100%)

The above table shows that out of 504 (100%) children, 70 (13.9%) children are overweight and 48 (9.5%) children are obese.

Table 4: - Age wise distribution of prevalence of obesity and overweight in the study population

Age	Normal (%)	Overweight (%)	Obesity (%)	Total (%)
10	38 (9.8%)	8(11.4%)	10(20.8%)	56(11.1%)
11	69(17.9%)	8(11.4%)	7(14.6%)	84(16.7%)
12	79(20.5%)	20(28.6%)	9(18.8%)	108(21.4%)
13	75(19.4%)	10(14.3%)	13(27%)	98(19.4%)
14	58(15%)	20(28.6%)	8(16.7%)	86(17.1%)
15	36(9.3%)	2(2.9%)	0(0%)	38(7.5%)
16	31(8%)	2(2.9%)	1(2.1%)	34(6.8%)
Total	386(76.4%)	70(12.9%)	48(9.5%)	504(100%)

The above table shows that 76.4 % of children are in the normal levels of BMI, 12.9% are overweight and 9.5% are obese. The body mass index has a range of 10.12 kg/m^2 to 36.84 Kg/m^2. The mean body mass index is 18.03± 4.06 kg/m^2.

Table 5: Gender wise distribution of prevalence of overweight and obesity in the study population

Gender	BMI			
	Normal	Overweight	Obese	Total
Male	197 (76.6%)	34 (13.3%)	26 (10.1%)	257 (51%)
Female	189 (76.5%)	36 (14.6%)	22 (8.9%)	247 (49%)
Total	386 (76.6%)	70 (13.9%)	48 (9.5%)	504 (100%)

p-value=0.836 (not significant) and Chi square value= 0.358.

The above table shows 13.3% of males are overweight and 10.1% obese whereas 14.6% of females are overweight and 8.9% obese. Thus, gender wise no statistically significant difference

was observed among overweight and obese students.

Table 6: Prevalence of overweight and obesity in Government and Private schools' population

School	Normal	Overweight	Obese	Total
Government	201 (79.8%)	33 (13.1%)	18 (7.1%)	252 (100%)
Private	185 (73.4%)	37 (14.7%)	30 (11.9%)	252 (100%)
Total	386 (76.6%)	70 (13.9%)	48 (9.5%)	504 (100%)

p-value=0.092 (not significant) and Chi square value= 2.83.

The above table shows 14.7% of private school children are overweight and 11.9% obese whereas 13.1% of Government school children are overweight and 7.1% obese but this difference is not statically significant.

Table 7: Family H/O obesity in normal vs overweight and obese in the study population

Family obesity H/O	Normal	Overweight & Obese	Total
Yes	185 (68.3%)	86 (31.7%)	271 (100%)
No	201 (86.3%)	32 (13.7%)	233 (100%)
Total	386(76.6%)	118 (23.4%)	504 (100%)

p-value=0.001 (significant) and Chi square value =22.63.

Above table showed that overweight and obesity is more in students who have family history of obesity and this is statistically significant.

Table 8:- Socioeconomic status in overweight and obese in the study population p-value =0.017 (significant) and chi square (Fisher's Exact) =10.665

Socio economic class	Normal	Overweight & Obese	Total
I	3(100%)	0	3(100%)
II	7(53.8%)	6 (46.2%)	13 (100%)
III	75(68.8%)	34(31.2%)	109 (100%)
IV	300(79.6%)	77(20.4%)	377 (100%)
V	1(50%)	1(50%)	2 (100%)
Total	386(76.6%)	118(23.4%)	504(100%)

Above table shows that overweight and obesity is, more in Socio economic status class V followed by II, III and IV and this difference is statistically significant.

Table 9: Dietary pattern in Government and Private schools' population

School Type	Vegetarian	Nonvegetarian	Eggetarian	Total
Government	2(0.8%)	250(99.2%)	0(0%)	252(100%)
Private	13 (5.2%)	237(94%)	2(0.8%)	252(100%)
Total	15 (3%)	487(96.6%)	2(0.4%)	504(100%)

Above table shows that 99.2% of Government schoolchildren are nonvegetarian and 0.8% vegetarian whereas 94% of private school children are nonvegetarian and 5.2% are vegetarian.

Table 10: Dietary pattern in overweight and obese in the study population

Dietary Pattern	Normal	Overweight	Obese	Total
Vegetarian	11 (73.2%)	2 (13.4%)	2 (13.4%)	15 (100%)
Nonvegetarian	373 (76.6%)	68 (14%)	46 (9.4%)	487 (100%)
Eggtarian	2 (100)	0 (0%)	0 (0%)	2 (100%)
Total	386 (76.6%)	70 (13.9%)	48 (9.5%)	504 (100%)

p value=0.581 (not significant) and Pearson correlation test value =0.025.

The table shows that 14% of overweight and 9.4% of obese are seen in non-vegetarian and 13.4% of overweight and 13.4% of obese are seen in vegetarian. This observation is not statistically significant (p value=0.581).

Above table shows that 39.1%, 32.2% and 20.5% of overweight and obesity seen in children who are taking junk food 1 to 2 days/week, 3 to 4 days/week and ≥5days/week respectively. This difference is statistically significant.

Table 11: Snaking Habit (Junk food) in overweight and obese in the study population

Snaking frequency	Normal	Overweight & Obese	Total
1 to 2 days/week	14(60.9%)	9(39.1%)	23(100%)
3 to 4 days/week	61(67.8%)	29(32.2%)	90(100%)
≥5 days/week	311(79.5%)	80(20.5%)	391(100%)
Total	386(76.6%)	118(23.4%)	504(100%)

p-value=0.011 (significant) and Chi square value = 8.96.

Table 12: Level of Physical Activity in overweight and obese in the study population

Physical activity level	Normal	Overweight & Obese	Total
Sedentary	87 (70.2%)	37 (29.8%)	124 (100%)
Limited activity	48 (82.8%)	10 (17.2%)	58 (100%)
Physical activity	251 (78%)	71 (22%)	322 (100%)
Total	386 (76.6%)	118 (23.4%)	504 (100%)

p-value=0.131 (not significant) and Chi square value = 7.00.

The table shows that 29.8% overweight and obese children have physical inactivity, 17.2% have limited activity and 22% have physical activity. But this difference is not statistically significant.

Table 13: Distribution of hypertension and prehypertension in the study population

Group	Number
Normal	496 (98.4%)
Prehypertension	6 (1.2%)
Hypertension	2 (0.4%)
Total	504 (100%)

The above table shows that 98.4% of children are in the normal range of blood pressure recordings, 1.2% is prehypertensive and 0.4% is hypertensive. Systolic blood pressure minimum value 80 mm of Hg, maximum value 138 mm of Hg and mean 98.98 ± 8.051 mm of Hg. Diastolic blood pressure minimum value 50 mm of Hg and maximum value 84 mm of Hg and mean 63.43±5.82 mm of Hg.

Table 14: Age wise distribution of prevalence of hypertension and prehypertension in the study population

Age (yrs)	Normal	Prehypertension	Hypertension	Total
10	55 (98.2%)	1 (1.8%)	0 (0%)	56 (100%)
11	84 (100%)	0 (0%)	0 (0%)	84 (100%)
12	105 (97.2%)	2 (1.9%)	1 (0.9%)	108 (100%)
13	97 (99%)	1 (1%)	0 (0%)	98 (100%)
14	83 (96.5%)	2 (2.3%)	1 (1.2%)	86 (100%)
15	38 (100.0%)	0 (0%)	0 (0%)	38 (100%)
16	34 (100%)	0 (0%)	0 (0%)	34 (100%)
Total	496 (98.4%)	6 (1.2%)	2 (0.4%)	504 (100%)

The above table shows that 2 (2.3%) prehypertension and 1 (1.2%) hypertension is seen in 14 years of age group followed by 12 years (prehypertension-2 (1.9%) & hypertension-1 (0.9%)), 10 years (prehypertension-1 (1.8%)) and 13 years (prehypertension-1 (1%).

Table 15: Gender wise distribution of prevalence of prehypertension and hypertension in the study population

Gender	Blood Pressure			
	Normal	Prehypertension	Hypertension	Total
Male	254 (99.2%)	3 (0.8%)	0 (0%)	257 (100%)
Female	242 (98%)	3 (1.2%)	2 (0.8%)	247 (100%)
Total	496 (98.4%)	6 (1.2%)	2 (0.4%)	504 (100%)

p-value=0.24 and chi square test (Fisher's Exact) =2.08.

The table shows that among males, 0.8% are prehypertensive. Among females, 1.2% are prehypertensive and 0.8% are hypertensive. This difference is not statistically significant.

Table 16: Prevalence of prehypertension and hypertension in Government and Private schools' population

School	Normal	Prehypertension	Hypertension	Total
Government	249 (98.8%)	2 (0.8%)	1 (0.4%)	252 (100%)
Private	247 (98%)	4 (1.6%)	1 (0.4%)	252 (100%)
Total	496 (98.4%)	6 (1.2%)	2 (0.4%)	504 (100%)

p-value =0.842 and chi square (Fisher's Exact) =0.908.

The above table shows 1.6% of private school children are prehypertensive and 0.4% hypertensive whereas 0.8% of Government schoolchildren are prehypertensive and 0.4% hypertensive. This observation is not statistically significant.

Table 17: Family H/O HTN in normal vs PreHTN and HTN in the study population

Family H/O	Normal	PreHTN and HTN	Total
Yes	152 (97.4%)	4 (2.6%)	156 (100%)
No	344 (98.9%)	4 (1.1%)	348 (100%)
Total	496(98.4%)	8 (1.6%)	504 (100%)

p-value=0.26 (not significant) and Chi square value (Fisher's Exact) =1.38.

Above table showed that prehypertension and hypertension is more in students who have family history of hypertension but this is statistically insignificant.

Table 18: Socioeconomic status in normal vs prehypertension and hypertension in the study population p-value =1.0 (not significant) and chi square (Fisher's Exact) =3.45

Socio economic class	Normal	PreHTN&HTN	Total
I	3(100%)	0(0%)	3(100%)
II	13(100%)	0 (0%)	13 (100%)
III	107(98.2%)	2(1.8%)	109 (100%)
IV	371(98.4%)	6(1.6%)	377 (100%)
V	2(100%)	0(0%)	2 (100%)
Total	496(98.4%)	8(1.6%)	504(100%)

Above table shows that prehypertension and hypertension is more in Socio economic status class III followed by IV and this is not statistically significant.

Table 19: Snaking Habits (Junk food) in prehypertension and hypertension in the study population

Junk food	Normal	PreHTN& HTN	Total
1 to 2 days/week	22(95.7%)	1(4.3%)	23(100%)
3 to 4 days/week	88(97.8%)	2(2.2%)	90(100%)
≥5 days/week	386(98.7%)	5(1.3%)	391(100%)
Total	496(98.4%)	8(1.6%)	504(100%)

p-value =0.242 (not significant) and chi square (Fisher's Exact) =2.579.

Above table shows that 4.3%, 2.2% and 1.3% of prehypertension and hypertension seen in children who are taking junk food 1 to 2 days/week, 3 to 4 days/week and ≥5days/week respectively. This difference is statistically insignificant.

Table 20: Level of physical activity in normal vs PreHTN& HTN in the study population

Physical activity level	Normal	PreHTN& HTN	Total
Sedentary	122 (98.4%)	2 (1.6%)	124 (100%)
Limited activity	56 (96.6%)	2 (3.4%)	58 (100%)
Physical activity	318 (98.8%)	4 (1.2%)	322 (100%)
Total	496 (98.4%)	8 (1.6%)	504 (100%)

p-value=0.336 (not significant) and Chi square value (Fisher's Exact) = 1.94.

The table shows that 1.6% prehypertension and hypertension children have physical inactivity, 3.4% has limited activity and 1.2% has physical activity. But this difference is not statistically significant.

Table 21: Distribution of prehypertension and hypertension in overweight and obese children

Blood Pressure	Normal	Overweight	Obese	Total
Normal	386 (100%)	66 (94.3%)	44 (91.6%)	496 (100%)
Prehypertension	0 (0%)	3 (4.3%)	3 (6.3%)	6 (100%)
Hypertension	0 (0%)	1 (1.4%)	1 (2.1%)	2 (100%)
Total	386 (76.6%)	70 (13.9%)	48 (9.5%)	504 (100%)

p value =0.001 (significant) and Pearson correlation test value r=0.23.

The table shows that prehypertensive and hypertensives are found more in overweight and obese group than normal group and this observation is statistically significant.

Table 22: Gender wise distribution of prehypertension and hypertension among overweight and obese children

Gender	Blood Pressure			
	Normal	Prehypertension	Hypertension	Total
Male	57 (95%)	3 (5%)	0 (0%)	60 (100%)
Female	53 (91.4%)	3 (5.2%)	2 (3.4%)	58 (100%)
Total	110 (93.2%)	6 (5.1%)	2 (1.7)	118 (100%)

p-value =0.239 (not significant) and chi square (Fisher's Exact) =2.10.

The above table shows that 5.2% of overweight and obese females are prehypertensive and 3.4% hypertensive whereas only 5% of overweight and obese males are prehypertensive. But this difference is not statistically significant.

Table 23: Age wise distribution of BP patterns among overweight and obese children

Age	Normal	Prehypertension	Hypertension	Total
10-13 years	80 (94.1%)	4 (4.7%)	1 (1.2%)	85 (100%)
14-16 years	30(90.9%)	2 (6.1%)	1 (3%)	33 (100%)
Total	110 (93.2%)	6 (5.1%)	2 (1.7%)	118 (100%)

p-value =0.483 (not significant) and chi square (Fisher's Exact) = 0.49.

Among overweight and obese children, the percentage of prehypertensive (6.1%) and hypertensive (3%) are more under 14-16 years age group when compared to 10-13 years age group (prehypertensive (4.7%) and hypertensives (1.2%)), but the value is not statistically significant.

Table 24: School wise distribution of prehypertension and hypertension among overweight and obese children

School	Blood Pressure			
	Normal	Prehypertension	Hypertension	Total
Government	48 (94.1%)	2 (3.9%)	1 (2%)	**51 (100%)**
Private	62 (92.5%)	4 (6%)	1 (1.5%)	**67 (100%)**
Total	**110 (93.2%)**	**6 (5.1%)**	**2 (1.7)**	**118 (100%)**

p-value =0.850 (not significant) and chi square (Fisher's Exact) =0.550.

The table shows that the 6% of prehypertensive are found in private school children and 3.9% in government schoolchildren but the percentage of hypertension is more in government school children than private school children. This observation is not statistically significant.

DISCUSSION

In India, approximately 253 million of the adolescent's population, accounting of 20.9% of total country population. In that, 19.2% (48.6 million) adolescent's population resides in urban area. Developing country like India is going through a socio-economic and demographic transition leads to change in dietary habits, decreased physical activity thus increasing prevalence of overweight and obesity.[20,21]

Socio demographic profile of the study population

Study was undertaken in two government and two private schools located in "Tirupati" urban area. The present study was carried out among 504 apparently healthy schoolchildren aged 10-16 years. The proportion of males is 51% (257) and that of females is 49% (247). Most of the study subjects were aged 12 years followed by 13 and 14 years with mean age of 12.64±1.68 years. Most of the (government (250; 49.6%) and private (237; 47%)) schoolchildren (96.6%) were non-vegetarian.

According to the Kuppuswamy's Socioeconomic status scale (modified in September 2020), the majority of study subjects (377; 74.8%) were in the upper lower group (class-IV) followed by 109 (21.6%) in the lower-middle group (classIII). But Seema S et al,[22] (2020) study,the majority (64.7%) belonged to the social class group of Class II, followed by class III and I.

Prevalence of overweight

Using BMI as criteria and based on IAP 2015 growth charts, prevalence of overweight (BMI for age and sex above 23 to below 27 adults equivalent) was evaluated. Minimum weight of the study subject was 19 kgs and maximum weight was 96 kgs with mean weight of 41.06±12.19. Minimum height of the study subject was 1.2 meters and Maximum height of the study subject was 1.79 meters with mean height of 1.498±0.106 meters.

Out of the study population of 504 (100%), 70 (13.9%) apparently healthy schoolchildren are overweight. Studies conducted in different parts of India on school children have come out with prevalence ranging from 4% (Yadav PKS et al,[5] 2010) to 20.18% (Patil AD et al,[23] 2017).

Variations were reported in the prevalence of overweight among children in different studies, as they were conducted at different geographical location, in different times with different parameters and different in socio economic status of the study groups.

Prevalence of obesity

Using BMI as criteria and based on IAP 2015 growth charts, prevalence of obesity (BMI for age and sex above 27 adults equivalent) was evaluated. Out of 504 (100%) study population, 48 (9.5%) apparently healthy schoolchildren are obese. Studies conducted in different parts of India on school children have come out with prevalence ranging from 4% (Shaik Karimulla et al,[24] 2019) to 20.18% (Patil AD et al,[23] 2017).

In the present study, the prevalence of obesity (9.5%) correlates with the study done by Shah SS et al,[25] 2011 (8.94%) which was conducted among 682 school children aged 12-18 years at Surath.

In this study, the prevalence of obesity reported in large number, this could be due to regional differences, non-uniformity in the criteria used

among the studies, the different age range of the children studied and different socioeconomic status of the study groups. However, they give reasonable idea regarding prevalence of childhood obesity in different parts of the country.

Gender wise prevalence of overweight and obesity

In the present study, no gender wise difference was observed among overweight and obese students. Also study by Patil AD et al,[23] (2017) showed no gender wise difference in overweight and obese adolescents.

But studies of Shaik Karimulla et al,[24] (2019), Himabindu Meesalaz et al,[25] (2018), and Sadhu Charan Panda.[26] (2017) showed higher prevalence of obesity among females than males and studies of Seema S et al,[22] (2020), Arunkumar Raju et all.[26](2019), and showed that overweight and obesity were more among male than females in adolescent age group.

Age wise prevalence of overweight and obesity

On analysis of age wise distribution of BMI in present study prevalence of 16.7 % overweight and 7.6 % obesity was found to be highest in 12year age group school children followed by 14 years children and similar findings were observed by Goyal RK et al,[27] But Sadhu Charan Panda,[26] (2017) study was showed that overweight and obesity were more in 14-15 age group children.

Type of school wise prevalence of overweight and obesity

The prevalence of overweight and obesity was higher among children from private schools (26.6%) compared to government schools (20.1%) but statistically insignificant (p=0.092). Jain B et al,[28] (2023), Shaik Karimulla et al,[24] (2019) found that overweight and obesity was more in private school children than government school children and statistically significant.

Family h/o obesity vs overweight and obesity

Overweight and obesity was more in students who have family history of obesity and this was statistically significant (p=0.001). Similar findings were observed by Sadhu Charan Panda,[26] (2017).

Socioeconomic status class wise prevalence of overweight and obesity

Prevalence of overweight and obesity was more in Class V (50%) socioeconomic status (Lower) followed by class II (Upper middle) (46.2%), III (31.2%) and IV (20.4%) and showed statistically significant (p=0.017). Ghosh et al,[29] (2015) showed that overweight and obesity was more in class III (5.75%) followed by IV, V and II and statistically significant (p=0.002). But Kumari Veena Sinha. [21] (2019) and Seema S et al,[22] (2020) found that overweight and obesity was more in class II and class III.

Dietary pattern in overweight and obese children

overweight and obesity was more in vegetarians (26.8%) than nonvegetarians (23.4%) but this observation was not statistically significant (p value=0.581). But Bhavana Jain et al,[28] (2023) found that overweight and obesity was more in non-vegetarians than vegetarians.

Snaking habit (Junk food) in overweight and obese children

Present study showed that snaking habit was a significant risk factor for overweight and obesity. Bhavana Jain et al,[28] (2023) was found that positive association of overweight and obesity with eating in between meals, frequent consumption of fast food, carbonated drinks and sweets.

Level of physical activity in overweight and obese children

Overweight and obesity was more in students who were physically inactive but found statistically insignificant. Seema S et al,[22] (2020), Kumari Veena Sinha,[21] (2019), Sadhu Charan Panda.[26] (2017), Ghosh et al,[29] (2015) and Krutarth R Brahmbhatt et al,[30] (2012) found that overweight and obesity was more in physically inactive children and statistically significant.

Prevalence of prehypertension

Prehypertension was diagnosed based on the BP percentile charts of "Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents" which was published by the NHBPEP Working Group on High Blood Pressure in Children and Adolescents. According to these recommendations prevalence of prehypertension (average systolic or diastolic BP is ≥90 to <95th percentile for age, sex and height) was evaluated. Out of 504-study population, 6 (1.2%) apparently healthy school children are prehypertensive.

Indian studies shows that prevalence of prehypertension ranging from 1.3% (Shaik Karimulla et al,[25] 2019) to 9.5% (Ramya Kundayi Ravi et al,[26] 2021. The prevalence of prehypertension in the present study (1.2%) correlates with the study done by Shaik Karimulla et al,[24] (1.3%) which was conducted among 1965 apparently healthy school children aged 11-15 years. According "Fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents" recommendations, prevalence of hypertension (average systolic or diastolic BP is ≥95th percentile for age, sex and height) was evaluated. Out of 504 (100%) study population, 2 (0.4%) apparently healthy school children are hypertensive.

Studies conducted in different parts of India on school children have come out with prevalence ranging from 1.3% (Shaik Karimulla et al,[25] 2019) to 20.09% (Shah SS et al,[25] 2011). The lower prevalence rate of hypertension (0.4%) in present study as compared toabove studies maybe due to small number of children screened forelevatedblood pressure. The prevalence of hypertension in children has been reported to vary between 1.3% to 20.09%.[24,25]

Gender wise prevalence of Prehypertension and Hypertension

In the present study prevalence of prehypertension and hypertension was more in female (2%) than male (0.8%) students. But this was not statically significant. Also study by Himabindu Meesalaz et al,[31] (2018) showed higher prevalence of prehypertension and hypertension among females than males.

Type of school wise prevalence of prehypertension and hypertension

In present study, the prevalence of prehypertension and hypertension was more in private school children (1.8%) comparatively government school children (1.4%.). This could be due to better income status of families, so easy access to fast foods and sedentary life style. Similar findings were found by Shaik Karimulla et al,[24] (2019) (private school children-3.93% and government school children-1.34%).

Family H/O hypertension vs prehypertension and hypertension

Family history of hypertension had no significant association with presence of prehypertension and hypertension in this study. Similar findings noted in Arunkumar Raju et al,[32] (2019).

Socioeconomic class wise prevalence of prehypertension and hypertension

Prehypertension and hypertension were more in Socio economic status class III followed by IV and this was not statistically significant. Manjusha Goel et al,[33] (2016) also found similar findings. VedavathyS et al,[34] (2016) found that prehypertension and hypertension were more in Socio economic status class II followed by IV and this was statistically significant.

Snaking habit (Junk food) in prehypertension and hypertension children

This study showed that snaking habit was not a significant risk factor for prehypertension and hypertension in children. Naeem W et al,[35] (2023) found that junk food consumption significantly associated with prehypertension and hypertension in children.

Level of physical activity in prehypertension and hypertension

Prehypertension and hypertension were more in physically inactive students but statistically insignificant. Similar results found in Sunil Kumar Singh et al,[36] (2019) study (p = 0.53). Christofaro et al,[37] (2011) conducted a similar study in which they found that total physical activity was inversely associated with blood pressure.

Prevalence of prehypertension and hypertension in overweight and obesity

In the present study, the prevalence of prehypertension and hypertension was more in overweight and obese children than normal. This study showed significant correlation between high blood pressure values (PreHTN& HTN) vs high BMI values (overweight and obesity) (r-0.23, p value =0.001).

The results were in harmony with the findings of Shaik Karimulla et al,[24] (2019), Arunkumar Raju et al,[32] (2019), Satyajit Bagudai et al,[38] (2011), Swati Ghonge et al,[39] (2015) and Yadav PKS et al,[5] (2010). This study concluded that overweight and obese children were more prone to develop prehypertension and hypertension compared to normal weight children.

Hypertension in obese children occur due to

- Increased cardiac output
- Increased blood volume
- Excessive sodium intake
- Increased steroid production
- Alteration in receptors for various pressor substances

Age wise prevalence of prehypertension and hypertension among overweight and obese children

An analyzing prehypertension and hypertension among overweight and obese children with age of study subject, it was observed that there was no statistically significant (p = 0.483) difference between the prevalence of hypertension among the two different categories of age (10 to 13 years and 14 to 16 years). Similar results (p = 0.64) found in Sunil Kumar Singh et all.[36] (2019) study who done three different categories of age (11-13, 14 -16 and 17 -19 years).

CONCLUSION

The study highlights the growing burden of overweight, obesity, prehypertension, and hypertension among school-going children in the Tirupati area. Regular school-based screening programs, promotion of healthy dietary habits, increased physical activity, and lifestyle modification strategies are essential for early detection and prevention of future cardiovascular diseases. Early intervention during childhood can substantially reduce the risk of adult hypertension and other non-communicable diseases. Therefore, an effective interventions & preventive strategy like promoting healthy eating; adequate physical activities and health education should be implemented from school age group to improve their life style.

REFERENCES

1. WHO: malnutrition. Available from URL: https://www.who.int/news-room/fact-sheets/detail/malnutrition.
2. Park's textbook of preventive and social medicine, 27th edition, chapter 6, Obesity p.451-455.
3. WHO: Obesity and overweight. Available from URL: https://www.who.int/en/news-room/fact-sheets
4. International Association for the study of obesity. World map of obesity. Available from URL:https://www.iaso.org/resources/world-map obesity/map=children.
5. Yadav PKS, Yadav MB, Yadav C. Prevalence of overweight, obesity and hypertension among school going children in

District Kanpur, Uttar Pradesh, India: a longitudinal study. Int J ContempPediatr 2019; 6:159-62.
6. Ramachandran A, Snehalatha C, Vinitha R, Thayyil M, Kumar CK, Sheeba L, et al. Prevalence of overweight in urban Indian adolescent school children. Diab Res Clin Pract. 2002;57:185-90.
7. Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prevalence of obesity among affluent adolescent school children in Delhi. Indian Pediatr. 2002;39:365-8.
8. Sidhu S, Kaur N, Kaur R. Overweight and obesity in affluent school children. Ann Hum Biol. 2006;33:255-9.
9. Chhatwal J, Verma M, Rair SK. Obesity among pre-adolescent and adolescents of adeveloping country (India). Asia Pac J Clin Nutr.2004;13:231-3.
10. Pathak NN,Gautam Amrita, Saikia Bidyut. Prevalence of hypertension among obese and overweight students in the schools of Silchar, Assam. Int J Health Res Medico Leg Prae 2020 July;6(2):48-51.
11. Vaman Khadilkar, Nikhil shah et al. Indian Academy of Pediatrics Revised Guidelines on Evaluation, Prevention and Management of Childhood Obesity: Indian Pediatrics 2023 December; 60: 1013-1031.
12. Gortmaker SL, Dietz WH Jr, Cheung LW. Inactivity, diet and the fattening of America. Am Diet Assoc. 1990;90:1247-55.
13. Nelson's textbook of pediatrics, 21st edition, part 5, chapter 60, overweight and obesity, p.345-357.
14. World Health Organisation. Obesity: Preventing and managing the global epidemic. WHO Technical Report Series 2000; 894:113-114.
15. Dietz WH, Bandini LG, Gortmaker S. Epidemiologic and metabolic risk factors for childhood obesity. Prepared for Fourth congress on Obesity Research, Austria. Klin Pediatr. 1998;202:69-72.
16. Vijayanath Itagi, Ramesh Patil.Obesity in children and adolescents and its relationship with hypertension. Turk J Med Sci 2011; 41 (2): 259-266.
17. Popkin BM, Richards MK, Montiero CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. J Nutr 1996;126: 3009-3016.
18. Lauer RM, Clake WR et al. Child hood risk factors for high adults blood pressure: The muscatine study. Pediatrics1989; 84:633-41.
19. Berenson GS, Srinivasan SR, Bao W, Newman WP 3rd, Tracy RE, Wattigney WA et al. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. N Engl J med 1998; 338: 1650–6.
20. World Health Organization. Diet, Nutrition and Prevention of chronic diseases, WHO technical report series, Report of a joint WHO/FAO expert consultation, Geneva, 2003.
21. Sinha KV. Prevalence of Overweight and Obesity in Indian adolescent school going children: a cross sectional study done in an urban area of Rohtas, Bihar. Ann. Int. Med. Den. Res. 2019; 5(3):CM13CM16.
22. Seema S, Rohilla KK, Kalyani VC, Babbar P. Prevalence and contributing factors for adolescent obesity in present era: Cross-sectional Study. J Family Med Prim Care 2021; 10:1890-4.
23. Patil AD et all. A study of adolescent obesity and hypertension in urban school in Mumbai. International Journal of Community Medicine and Public Health. 2018 Feb;5(2):790-794.
24. Karimulla S, Rao PN. Prevalence of obesity and hypertension in adolescent school children of Guntur town, Andhra Pradesh. International Journal of Contemporary Medical Research 2021;8(7): G1-G4.
25. Shah SS, Dave BR, Sharma AA, Desai AR. Prevalence of Hypertension and Association of Obesity with Hypertension in School Going Children of Surat City, Western India. Online J Health Allied Scs. 2013;12(2):5.
26. Panda SC. Overweight and obesity and lifestyle of urban adolescent school children of eastern state of India. Int J Res Med Sci 2017; 5:4770-5.
27. Goyal RK, Shah VN, Saboo BD, Phatak SR, Shah NN, Gohel MC, Raval PB, Patel SS. Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. J AssociaPhysicia India. 2010; 58:151-8.
28. Jain B, Jain S, Mittal C, Chopra H, Chaudhary P, Bargayary H, Singh G, Garg SK. Obesity in Adolescents: Prevalence and Association with Sociodemographic and Lifestyle Factors. Indian J. of Com. Health. 2023;35(2):152-158.
29. Ghosh A, Sarkar D, Pal R, Mukherjee B. Correlates of overweight and obesity amongurban adolescents in Bihar, India. J Fam Med Primary Care 2015;4:84-8.
30. Krutarth R Brahmbhatt, Umesh N Oza. Obesity among adolescents of ahmedabad city, gujarat, india- a community based cross-sectional study. Int J Biol Med Res. 2012; 3(2): 1554-1557.
31. Himabindu Meesalaz, K V Sivaramakrishna, Venu Gopala, Sarma Yadati. Prevalence of Obesity and Hypertension among Apparently Healthy School Children Aged 5-15 Years of Affluent Societies of Nandyal. International Journal of Science and Research. January 2020;9(1):1648-1651.
32. Arunkumar Raju, Bharanidharan S, Rajah S. A study of prevalence of hypertension and its determinants among school going children in Salem, India. MedPulseInternational Journal of Pediatrics. December 2019; 12(3): 71-74.
33. Goel M, Pal P, Agrawal A, Ashok C. Relationship of body mass index and other life style factors with hypertension in adolescents. Ann Pediatr Cardiol. 2016 JanApr;9(1):29-34.
34. Vedavathy S, Sangamesh.Prevalence of hypertension in urban school going adolescents of Bangalore, India. Int J Contemp Pediatr2016;3:416-23.
35. Naeem W, Ashraf S, Fatima R, Malik A, Kharl H.A.A, Shabbir A. (2023). Association between obesity induced hypertension and consumption of junk food among university students of district sialkot. Biol. Clin. Sci. Res. J., 2023: 627.
36. Singh SK, Verma A. Prevalence of hypertension among school going adolescent boys in Najafgarh, Delhi, India. Int J Adolesc Med Health. 2020 Jan 18;33(5).
37. Christofaro DG, Ritti-Dias RM, Chiolero A, Fernandes RA, Casonatto J, de Oliveira AR. Physical activity is inversely associated with high blood pressure independently of overweight in Brazilian adolescents. Scand J Med Sci Sports. 2013 Jun;23(3):317-22.
38. Satyajit Bagudai et all. Prevalence of obesity & hypertension in adolescent school going children of Berhampur, Odisha, India. Int J Physiother Res 2014, Vol 2(6):777-80.
39. GhongeS, PatelHS, NagarSK, ThakorN. Prevalence of hypertension and its association with obesity among school children of Pune city, Maharashtra, India: a cross sectionalstudy.Int J Res Med Sci2015;3:3739-42.