

## A STUDY OF PREVALENCE AND PREDICTORS OF OVERWEIGHT AND OBESITY IN HIGH SCHOOL CHILDREN IN WARANGAL

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### ABSTRACT

#### BACKGROUND

Overweight and obesity represent a rapidly growing threat to the health of population in an increasing number of countries. Indeed, these are now so common that they are replacing more traditional problems such as under nutrition and infectious diseases as the most significant causes of ill health.

#### MATERIALS AND METHODS

The present study was undertaken in 5 schools catering Warangal city. The age groups included in the study were between 5-15 years of age. Out of 3352 children included in the study, 2188 (65.27%) were males and 1164 (34.73%) were females.

#### RESULTS

14.4% of the children were obese, and in that, females (17%) were slightly more in number than males (13%). Obese children had significantly higher caloric intake than non-obese children. There was a significant relationship between birth weight of the child and development of obesity in the later age. Significant relationship was found between obesity in children and their parental BMI. There was no significant difference in physical activity between obese, overweight and non-obese group. Sedentary behaviour had a significant association with the obese group when compared to the non-obese group. There was a significant relationship between sedentary behaviour with overweight and obesity. Pre-hypertension and hypertension were found to be significantly higher in the obese group when compared to the non-obese group, and in the obese group, this was more predominant in the age group of 11-15 than the 5-10 years age group.

#### CONCLUSION

Timely intervention will result in decreased adulthood morbidity and mortality due to obesity in these children.

#### KEYWORDS

Overweight, Prevalence of Obesity, School Children.

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#### BACKGROUND

The fundamental cause of the obesity epidemic are sedentary lifestyle, high fat and energy dense diets; both resulting from changes taking place in society and the behaviour patterns of the communities; as a consequence of increased urbanisation and industrialisation and the disappearance of traditional lifestyles. While there is sherry evidence that certain genes have an influence on BMI and body fat, most do not qualify as necessary genes, i.e. genes that cause obesity only whenever two copies of the defective alleles that cause obesity are present.

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The present study was conducted in children belonging to Warangal city to determine the prevalence of childhood obesity, to study the cardiovascular risk factors and lifestyle factors in obese children, so that the necessary steps can be taken to prevent the childhood onset of adult diseases.

#### Aims and Objectives

1. To estimate the prevalence of obesity among school going children between 5 to 15 years belonging in Warangal.
2. To compare the dietary habits and lifestyle between obese and non-obese children.
3. To study the factors influencing overweight and obesity.

#### MATERIALS AND METHODS

Data regarding list of schools in Warangal was collected from Deputy Director of Public Instructions Office. Out of 50 schools in Warangal, 5 schools were selected based on simple random sampling method (lottery method). A cross-sectional study was conducted in these 5 schools of

Warangal after taking clearance from Kakatiya Medical College Ethical Committee.

### Inclusion Criteria

Children between the age group of 5-15 years.

### Exclusion Criteria

1. Children below 5 years and above 15 years.
2. Children diagnosed to be obese due to endogenous causes on clinical examination.

The age of the children was obtained from the school records. The height was measured by making the child to stand upright, barefoot on the ground with heels, buttocks and shoulder touching the wall and head in Frankfurt plane.

The height was measured using sliding stadiometer (Johnson and Johnson) with an accuracy of 0.1 mm.

Weight was recorded using spring balance (bathroom scale) calibrated to 0.5 kg accuracy.

Body Mass Index (BMI) was calculated based on the formula-

- $BMI = \text{Weight in kg} / \text{height in mts.}^2$
- Children were categorised based on BMI as per NCHS Guidelines with respect to their age and sex.

Category BMI-

- Normal 5th - 85th percentile.
- Overweight 85th - 95th percentile.
- Obese >95<sup>th</sup> percentile.

In those children who were categorised as overweight and obese (cases), dietary habits and lifestyle pattern were analysed and compared with equal number of age and sex matched children with normal BMI (controls).

Resting Blood Pressure (BP) was determined using mercury manometer with appropriate-sized cuffs by auscultating in right arm after a 5 minute resting period.

Systolic BP is determined by the onset of "tapping" Korotkoff's sounds (K1) and diastolic BP as the disappearance of the Korotkoff's sounds (K5) as per update on 1987 Task Force Report, National High Blood Pressure Education Programme Coordinating Committee.

For each subject, two recordings of BP were taken and average of two was recorded. Second and third set of BP readings were taken at four weeks interval each for the students found to have high BP in the first sitting. Children with an average systolic or diastolic BP >90<sup>th</sup> percentile, but <95<sup>th</sup> percentile with respect to their age, sex and height were classified as having pre-hypertension. Children with average systolic or diastolic BP >95<sup>th</sup> percentile with respect to their age, sex and height were designated as having hypertension as per update on 1987 Task Force Report, National High Blood Pressure Education Programme Coordinating Committee.

To analyse the lifestyle factors and dietary habits in obese and non-obese groups, a pretested proforma was designed and explained to each individual parent and was asked to collect data regarding the child's dietetic pattern

including food given in between meals and snacks for a period of 3 days, when the child was healthy. Later, the mean calorie intake of each child was calculated and compared with normal calorie requirement of the child for age and sex and was entered in the proforma as calorie excess or calorie deficit. Child's physical activity (outdoor activity) and TV viewing/video games/computer games were also recorded in minutes per day for 3 consecutive days including one Sunday, when the child was healthy. The number of hours of TV viewing was compared between cases and controls.

**Statistical Methods Applied-** Following statistical methods were applied in the present study-

- Chi-square test.
- Contingency table analysis.
- Independent samples t-test.
- Analysis of variance-one way.
- Analysis of variance-two way.

The statistical operations were done through SPSS (Statistical Presentation System Software) for Windows, version 10.0 (SPSS, 1999. SPSS Inc: New York).



**Figure 1. Weighing Machine (Bathroom Scale)**



**Figure 2. Sliding Stadiometer (Johnson and Johnson)**

**OBSERVATIONS AND RESULTS**

Age	Sex		Total
	Male	Female	
5	108 (4.9%)	70 (6%)	178 (5.3%)
6	115 (5.3%)	81 (7%)	196 (5.8%)
7	124 (5.7%)	110 (9.5%)	234 (7%)
8	124 (5.7%)	86 (7.4%)	210 (6.3%)
9	110 (5%)	66 (5.7%)	176 (5.2%)
10	133 (6.1%)	82 (7%)	215 (6.4%)
11	155 (7.1%)	106 (9.1%)	261 (7.8%)
12	193 (8.8%)	88 (7.6%)	281 (8.4%)
13	353 (16.1%)	161 (13.8%)	514 (15.3%)
14	345 (15.8%)	156 (13.4%)	501 (14.9%)
15	428 (19.6%)	158 (13.6%)	586 (17.5%)
<b>Total</b>	<b>2188 (100%)</b>	<b>1164 (100%)</b>	<b>3352 (100%)</b>

*Table 1. Age and Sex Wise Distribution of Study Sample*

Out of 3352 children included in the study, 2188 (65.27%) children were males and 1164 (34.73%) children were females. Most of children were in the age group of 15, 14 and 13 years and least number were in 5, 6 and 9 years age group.

Age	Normal	Overweight	Obese	Total
5	136 (76.4%)	6 (3.4%)	36 (20.2%)	178 (100%)
6	172 (87.7%)	21 (10.8%)	3 (1.5%)	196 (100%)
7	204 (87.2%)	9 (3.8%)	21 (9%)	234 (100%)
8	179 (85.2%)	15 (7.2%)	16 (7.6%)	210 (100%)
9	164 (93.2%)	3 (1.7%)	9 (5.1%)	176 (100%)
10	170 (79%)	36 (16.8%)	9 (4.2%)	215 (100%)
11	213 (81.6%)	24 (9.2%)	24 (9.2%)	261 (100%)
12	233 (82.9%)	36 (12.8%)	12 (4.3%)	281 (100%)
13	466 (90.7%)	36 (7%)	12 (2.3%)	514 (100%)
14	429 (85.6%)	42 (8.4%)	30 (6%)	501 (100%)
15	499 (85.2%)	69 (11.8%)	18 (3%)	586 (100%)
<b>Total</b>	<b>2865 (85.4%)</b>	<b>297 (8.8%)</b>	<b>181 (5.5%)</b>	<b>3352 (100%)</b>

*Table 2. Age Wise Distribution of Prevalence of Overweight and Obesity in the Study Population*

85.6% of children were in the normal range of BMI, 8.9% were overweight and 5.5% were obese. Thus, including both overweight and obese, a total of 14.4% of children come under the obese category.

There was no significant difference in the prevalence of obesity with respect to age.

Sex	BMI			Total
	Normal	Overweight	Obese	
Male	1903 (87%)	154 (7%)	131(6%)	2188 (100%)
Female	966 (83%)	144 (12.4%)	54 (4.6%)	1164 (100%)
<b>Total</b>	<b>2869 (85.5%)</b>	<b>298 (8.9%)</b>	<b>185 (5.5%)</b>	<b>3352 (100%)</b>

*Table 3. Sex Wise Distribution of the Prevalence of Overweight and Obesity in the Study Population*

P <0.05.

The table shows 7% and 6% of males were overweight and obese, respectively. 12.4% and 4.6% of females were overweight and obese, respectively.

Thus, when overweight and obese categories were taken together, females (17%) were found to be more obese than males (13%).

Age	Group		Total
	Cases (Overweight and Obese)	Control	
5	4 (3.8%)	4 (3.8%)	8 (3.8%)
6	5 (4.7%)	5 (4.7%)	10 (4.7%)
7	4 (3.8%)	4 (3.8%)	8 (3.8%)
8	7 (6.6%)	7 (6.6%)	14 (6.6%)
9	3 (2.8%)	3 (2.8%)	6 (2.8%)
10	8 (7.5%)	8 (7.5%)	16 (7.5%)

11	12 (11.3%)	12 (11.3%)	24 (11.3%)
12	12 (11.3%)	12 (11.3%)	24 (11.3%)
13	11 (10.4%)	11 (10.4%)	22 (10.4%)
14	22 (20.8%)	22 (20.8%)	44 (20.8%)
15	18 (17%)	18 (17%)	36 (17%)
<b>Total</b>	<b>106 (100%)</b>	<b>106 (100%)</b>	<b>212 (100%)</b>

**Table 4. Age Wise Distribution of Cases and Control**

P >0.05.

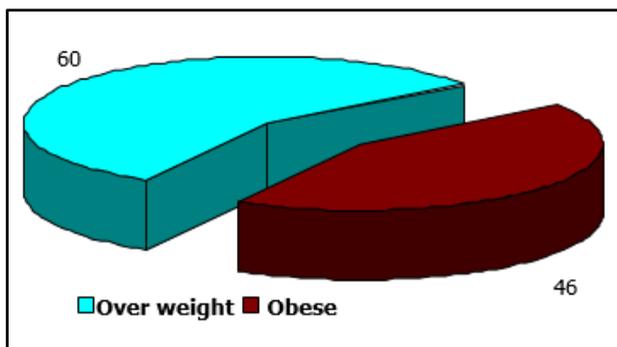
The table shows age wise distribution of cases and controls included in the study. 106 obese children were taken as cases and equal number of age and sex matched children, whose BMI was in normal range were taken as controls.

Age	Group		Total
	Cases (Ow and Ob)	Control	
Male	61 (57.5%)	61 (57.5%)	61 (57.5%)
Female	45 (42.5%)	45 (42.5%)	45 (42.5%)
<b>Total</b>	<b>106 (100%)</b>	<b>106 (100%)</b>	<b>106 (100%)</b>

**Table 5. Sex Wise Distribution of Cases and Controls**

P >0.05.

The table shows sex wise distribution of cases and controls included in the study. Out of 106 cases and controls in the study, 57.5% were males and 42.5% were females.



**Graph 1. Distribution of Overweight and Obese in Cases**

Chi-square = 1.849, P <0.05.

Out of 106 children in the cases, 60 (56.6%) were overweight, i.e. age and sex matched BMI between 85<sup>th</sup>-95<sup>th</sup> percentile and 46 (43.4%) were obese, i.e. age and sex matched BMI greater than 95<sup>th</sup> percentile.

Group	N	Mean BMI
Cases (Ow and Ob)	106	24.2472
Control	106	16.2280

**Table 6. Mean BMI in Cases and Control**

t = 18.612, P <0.05.

The above table shows that the mean BMI in cases and controls were 24.24 and 16.22, respectively. The difference in BMI was statistically significant.

Age	Group		Total
	Cases (Ow and Ob)	Control	
Normal	60 (56.6%)	105 (99.1%)	165 (77.8%)
Pre-hypertension	20 (18.9%)*	0 (0%)	20 (9.4%)
Hypertension	26 (24.5%)*	1 (0.9%)	27 (12.7%)
<b>Total</b>	<b>106 (100%)</b>	<b>106 (100%)</b>	<b>212 (100%)</b>

**Table 7. Distribution of Pre-Hypertension and Hypertension in Cases and Controls**

\*P <0.05.

The above table shows the blood pressure pattern in cases and controls.

In cases, 56.6% were normotensive, 18.9% were pre-hypertensive (i.e., age, sex and height matched blood pressure between 90<sup>th</sup> and 95<sup>th</sup> percentile) and 24.5% were hypertensive (i.e., age, sex and height matched blood pressure above 95<sup>th</sup> percentile).

In control group, 99.1% were normotensive and 0.9% were hypertensive.

This difference in value was statistically very significant.

	Overweight	Obese	Total
Normal	34 (56.7%)	26 (56.5%)	60 (56.6%)
Pre-hypertension	14 (23.3%)	6 (13%)	20 (18.9%)
Hypertension	12 (20%)	14 (30.4%)	26 (24.5%)
<b>Total</b>	<b>60 (100%)</b>	<b>46 (100%)</b>	<b>106 (100%)</b>

**Table 8. Distribution of Pre-Hypertension and Hypertension in Overweight and Obese**

P >0.05.

In both, almost equal percentages of children were normotensive, whereas more number of pre-hypertensives were found in overweight group and hypertensive in obese group though the value is statistically not significant.

Age	Normal	Pre-hypertension	Hypertension	Total
5-10	24 (77.4%)	4 (12%)	3 (9.6%)	31 (100%)
11-15	36 (48%)	16 (21.3%)	23 (30.7%)	75 (100%)
<b>Total</b>	<b>60 (56.6%)</b>	<b>20 (18.8%)</b>	<b>26 (24.51%)</b>	<b>106 (100%)</b>

**Table 9. Age Wise Distribution of Blood Pressure Pattern in Obese Children**

P <0.05.

There were significantly more number of pre-hypertensives and hypertensives in the age group of 11-15 years compared to 5-10 years age group.

This difference in value was statistically significant.

Age	Sex		Total
	Male	Female	
Normal	33 (54.1%)	27 (60%)	60 (56.6%)
Pre-hypertension	11 (18.1%)	9 (20%)	20 (18.9%)
Hypertension	17 (27.8%)	9 (20%)	26 (24.5%)
<b>Total</b>	<b>61 (100%)</b>	<b>45 (100%)</b>	<b>106 (100%)</b>

**Table 10. Sex Wise Distribution of Pre-Hypertensives and Hypertensives in Cases (Ow and Ob)**

P >0.05.

There was no significant difference found between males and females with respect to pre-hypertension and hypertension.

Group	Sex	Mean Birth Weight	N
Cases (Ow and Ob)	Male	3.20	61
	Female	3.07	45
	<b>Total</b>	<b>3.14</b>	<b>106</b>
Control	Male	2.71	61
	Female	2.63	45
	<b>Total</b>	<b>2.68</b>	<b>106</b>

**Table 11. Relationship between Birth Weight and Obesity**

F groups = 51.264, P <0.05; t' female = 4.445, P <0.05; t' male = 5.810, P <0.05.

The above table shows the relationship between birth weight and obesity.

The mean birth weight of obese children was found to be 3.14 kg and the mean birth weight of controls was 2.61 kg. This difference was statistically significant and similar statistical significance was also found when birth weight was compared between similar sexes of cases and controls.

Group	Sex	Mean Calorie Excess in KCal	N
Cases (Ow and Ob)	Male	150.7	28
	Female	158.6	19
	<b>Total</b>	<b>153.9</b>	<b>47</b>
Control	Male	99.5	12
	Female	105.9	11
	<b>Total</b>	<b>102.6</b>	<b>23</b>

**Table 12. Mean Calorie Excess in Cases and Controls**

F = 16.814, P <0.05.

Group		N	Mean Duration in Mins.	t-Value	p-Value
Physical activity	Overweight	60	69.0	3.01	0.54
	Obese	46	73.3		
TV/video games	Overweight	60	90.3	5.77	0.018
	Obese	46	112.7		

**Table 15. Comparison of Physical Activity and Sedentary Activity in Overweight and Obese**

The above table shows the physical activity and sedentary activity in overweight and obese.

Mean calorie excess was compared between cases and controls. In cases, 47 children had calorie excess and the mean calorie excess was found to be 153.9 kcal. In controls, 23 children had calorie excess and the mean excess value was 102.6 kcal. Thus, compared to cases in controls, less number of children had calorie excess and the mean difference in calorie excess was found to be statistically significant.

Statistical significance was also found when calorie excess was compared between similar sexes of cases and controls.

Group	Sex	Mean Calorie Deficit in Kcal	N
Cases (Ow and Ob)	Male	88.8	9
	Female	116.6	9
	<b>Total</b>	<b>102.7</b>	<b>18</b>
Control	Male	109.2	28
	Female	107.7	22
	<b>Total</b>	<b>108.4</b>	<b>50</b>

**Table 13. Mean of Calorie Deficit in Cases and Controls**

F = 0.230, P <0.05.

Mean calorie deficit was compared between cases and controls. In cases, 18 children had calorie deficit and the mean calorie deficit was found to be 102.7 kcal.

In controls, 50 children had calorie deficit and the mean deficit value was 108.6 kcal. Thus, compared to cases in controls, more number of children had calorie deficit, but the mean difference in calorie deficit was not found to have statistically significance.

Group		N	Mean Duration in Mins.	t-Value	p-Value
Physical activity	Cases (Ow and Ob)	106	70.94	-1.114	0.266
	Control	106	75.75		
TV/video games	Cases (Ow and Ob)	106	100.04	6.040	0.000
	Control	106	68.91		

**Table 14. Comparison of Physical Activity and Sedentary Activity in Cases and Controls**

The above table shows the physical activity and sedentary activity in cases and controls.

The mean duration of physical activity (outdoor activity) in controls was slightly more than cases though this value was statistically not significant.

The mean duration of TV viewing by cases was 100.04 mins., whereas that in controls was 68.91 mins. This difference in value was statistically significant.

The mean duration of physical activity (outdoor activity) in obese was slightly more than overweight children though this value was statistically not significant.

The mean duration of TV viewing by obese children was 112.7 mins., whereas that in overweight, children was 90.3 mins. This difference in value was statistically significant.

Cases	Mother and Father-Normal BMI	Father-Obese Mother-Normal BMI	Mother-Obese Father-Normal BMI	Mother and Father-Obese	Total
Overweight	2	8	6	18	34
Obese	0	2	5	9	16
<b>Total</b>	<b>2 (4%)</b>	<b>10 (20%)</b>	<b>11 (22%)</b>	<b>27 (54%)</b>	<b>50 (100%)</b>

**Table 16. Relationship between Overweight/Obese Children and Parental BMI**

P >0.05.

Data regarding the BMI of both parents was available for 50 children.

In the cases, 4% of children had their parental BMI in normal limits (18.5-24.99); 20% of children had only obese fathers; 22% of children had only obese mothers and 54% of children had both obese father and mother (BMI >25).

**DISCUSSION**

The present study was undertaken in 5 schools catering Warangal city. Using BMI as criteria and based on NCHS guidelines, prevalence of obesity was evaluated. Out of 483 children diagnosed as obese and overweight, based on BMI, 106 children were screened for cardiovascular risk factors and analysis of lifestyle factors as only those many children gave consent for further evaluation. Equal number of age and sex-matched children were taken as controls and further parameters were compared.

The prevalence of obesity varies from 2.7% to 31% in different parts of the world. As described by IOTF, the global prevalence of overweight including obesity in children aged 5 to 17 years is 10% with an unequal distribution ranging from 30% in America to <2% in Sub-Saharan Africa. In our country also, the prevalence of obesity varies widely in different cities.<sup>1</sup>

Our study shows less number of overweight and obese children when compared to other studies. This may be due to fact that in India, the available studies were done in metro cities where there was total adoption of western culture, availability of fast food centers and sedentary lifestyle behaviours. The schools selected in the previous studies were on the basis of school fees of approximately Rs. 1000 to 2000 per month. Thus, the prevalence of obesity in these cities correlates with the prevalence in America and other developed countries.

Warangal, being a smaller city where the traditional cultures and practices are still prevalent along with newly-adopted western culture has a prevalence of obesity of 14.4%, which correlates with study done by Krutarath R Brahmhatt et al,<sup>2</sup> where the prevalence of obesity was 18.7% in 2012, if western cultures are adopted and if economic status improves, the prevalence of obesity may increase much more.

The prevalence of hypertension increases progressively as BMI increases from 5<sup>th</sup> percentile to 95<sup>th</sup> percentile. Studies have shown that hypertension in normal children

varies from 0.04% to 4.52%, and in the present study, the prevalence of hypertension in normal children is 0.9%.

The higher prevalence of hypertension in obesity has been documented by all the studies varying from as low as 3.4% by Gupta AK et al,<sup>3</sup> Delhi to 43.1% by Mohan B et al in Ludhiana.<sup>4</sup>

In a study done by Boyd GS, et al<sup>5</sup> elevated BP was detected in 34.7% of obese children. In this, 27.9% had prehypertension and 6.8% had hypertension. The prevalence of elevated BP was more in severely obese boys and girls (46.5% and 39%) than moderately obese boys and girls (28.1% and 23.1%).

The prevalence of hypertension in the present study correlates with the study done by Mohan B, et al and Gillian S Boyd et al with some differences, but deviates largely from studies done by Gupta AK, et al; Verma M, et al; and Sorof JM, et al, as prehypertension was not considered in these studies.<sup>3,6,7</sup>

Birth Weight and Obesity- Several studies have shown direct relationship between birth weight and BMI at a later age. Study done by Lederman SA et al<sup>8</sup> showed a linear increase in BMI with increase in birth weight. In the present study, mean birth weight in the obese group exceeded the non-obese group by 0.5 kg and this was statistically significant.

Calorie Excess and Obesity- In the present study, total calorie consumption more than RDA, in obese group and non-obese group was compared, and in the obese group 44.3% children had calorie excess when compared to non-obese group (21.6%). The obese group had mean calorie excess of 153.9 kcal compared to non-obese group 102.6 kcal.

Physical Activity- In the Framingham children study,<sup>9</sup> preschool children with low physical activity levels as measured by double labeled water technique gained more subcutaneous fat than more active children. Intervention studies to decrease obesity with physical activity component have produced positive, but modest short-term results in terms of reduction of obesity. In the present study, there was no significant difference found between number of hours spent for physical activity between obese and non-obese children. This is probably due to the questionnaire method adopted to assess the physical activity. Similarly, results from the Third National Health and Nutrition Examination Survey<sup>10</sup> (1988-1994), did not find physical activity significantly associated with obesity. The reason given was lack of sensitivity of the questionnaire method used.

TV Viewing and Obesity- TV viewing is significantly associated with obesity and this has been confirmed by several studies. Dietz and Gortmaker<sup>11</sup> examined data from more than 13,500 children and adolescents in the National Health Examination Survey and reported statistically significant association between hours per day of watching television and prevalence of obesity. Robinson TN, et al,<sup>12</sup> study showed children who watched 4 or more hours of television per day had significantly greater BMI compared to those who watched fewer than 2 hours per day.

In the present study, TV viewing was found to be significantly associated with obesity. On an average, an obese child watched TV 1½ times more than non-obese child. Probably, increase in sedentary activity and not the decrease in physical activity is the contributing factor for obesity.

Parental BMI and Obesity in Child- Various studies available have shown the effect of parental obesity on the BMI of their child. Garn SM et al<sup>13</sup> showed that when both parents are overweight, 80% of their children will be obese. When one parent is obese, this incidence decreases to 40%; and when both parents are lean, obesity prevalence drops to 14%. Alemzadeh R<sup>14</sup> showed that there is a 75% chance that children aged 3-10 years will be overweight, if both parents were obese. This drops to a 25-50% chance with just one obese parent.

The present study correlates with the studies done by Garn SM et al,<sup>13</sup> Alemzadeh R et al<sup>14</sup> with significant association between parental obesity and childhood obesity. This may be due to partially genetic and mostly due to similar behavioural pattern and family environment.

## CONCLUSION

Childhood obesity is in increasing trend from past 20 years in both developing and developed countries.

The prevalence of childhood obesity in school children in Warangal city is 14.4% with females (17%) being slightly more obese than males (13%).

Risk factors for childhood obesity like high birth weight, parental obesity, high-calorie intake, increased sedentary behaviour has been confirmed in the present study. The fact that obese children have higher cardiovascular risk factors like hypertension when compared to non-obese children has been reinforced by the present study. These children are at a higher risk of "childhood onset of adult diseases." Thus, timely intervention will result in decreased adulthood morbidity and mortality due to obesity in these children.

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