Prevalence of Obesity and Hypertension among apparently healthy school children aged 5-15 years of affluent societies of Tirupati

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Abstract

Developing countries are undergoing nutritional transition due to increased economic development and market globalization leading to rapid changes in lifestyle and dietary habits. Malnutrition, in every form, presents significant threat to human health. Developing countries like India are facing the peculiar situation of having to deal with both ends of the spectrum (under-nutrition and over-nutrition) of nutritional disorders. The prevalence of hypertension in children is reported to be 1-3%. Elevated blood pressure in children and adolescents may be an early expression of essential hypertension in adulthood. The prevalence of obesity and hypertension in the present study was 3.89% and 1.36% respectively. Girls were found to be more obese than boys and the difference is statistically significant. Out of 74 obese children, nearly three fourth of them 72.9 % (54) were in the age group of 11-15 years and remaining 27.1% (20) were belonged to 5-10 years age group.

Key words: obesity, hypertension, BMI, anthropometry

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Introduction

Malnutrition, in every form, presents significant threat to human health. The world today faces a double burden of malnutrition which includes both under nutrition and obesity, especially in developing countries.¹

WHO designated obesity as a global epidemic¹ in view of increasing incidence of
obesity and its complications. The International Obesity Task Force (IOTF)\(^2\); 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. Developing countries like India are facing the peculiar situation of having to deal with both ends of the spectrum of nutritional disorders. India is poised to be among the top four economic countries by 2020.\(^3\) In India, approximately 19\% (190 million) of the growing population comprises school-aged children of whom 30\% (48 million) currently reside in urban India. Childhood obesity is a single marker of the child at risk for development of various non-communicable diseases later in life.

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.\(^3\)

On one hand, under nutrition is an epidemic which has been in vogue for ages. On the other hand, over nutrition evident as overweight and obesity has been recently on the rise.

The prevalence of hypertension in children is reported to be 1-3\%.\(^4\) World Health Organization has recognized it and expressed its concern by observing the year 1978 with the slogan “Down with Blood Pressure”.

Elevated blood pressure in children and adolescents may be an early expression of essential hypertension in adulthood.\(^5\)

**Aims and Objectives:** To estimate the prevalence of obesity and hypertension and to determine the association between obesity and hypertension among apparently healthy school children aged 5-15 years of Tirupati

**Materials and Methods**

A community based (school-based study) cross-sectional study was conducted from September 2013 to August 2014 in Tirupati urban area. The minimum sample size was estimated from the earlier studies that the prevalence of obesity was 5\% and the prevalence of hypertension was 1-3\%. For the present study, sample size is estimated using the prevalence rate of 5\% with 20\% acceptable (allowable) error at 95\% confidence level. Sample size for the study is 1825. Apparently healthy school children aged 5-15 years were included to the study and those children who are suffering from
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chronic illness, on long term medications and children with congenital anomalies, children diagnosed to be obese and hypertensive secondary to other cause were excluded from the study.

Study Methods

A list of schools with fee structure of around Rs. 30,000/- per annum in the urban area of Tirupati was obtained and the permission to undertake the study in such schools was obtained from the school principals. From the list of schools four schools were selected using lottery method of simple random sampling.

A pilot study was done in the school which was not selected for the study and the data obtained was not used in the study proper. Then the total sample size was increased to 1900 for convenient calculation.

Initially questionnaires were issued to the students. After the questionnaire was filled up, students were asked to come to the investigator with their questionnaires in hand and then their weight and height were measured and BP was recorded one by one and was noted in their respective questionnaires with the help of teachers. After collection of data from all the four schools, the questionnaires were used for analysis.

For boys, anthropometry and BP were recorded by the investigator. But for girls; they were recorded by a female doctor. Data was analyzed by using MS Excel 2010 statistical software package, Epi Info7 version software and also SPSS17 version statistical software package.

Method of anthropometric measurements: As per norms.

BMI was calculated using the formula:

\[
BMI = \frac{\text{Weight (Kg)}}{\text{Height}^2 (\text{sq.m})}
\]

A child with BMI for age and sex between 85th and 95th percentiles were considered over weight and those with BMI for age and sex above 95th percentiles were considered obese.

Results

Table 1- Age group and gender distribution of the study sample

<table>
<thead>
<tr>
<th>Age(years)</th>
<th>Male n (%)</th>
<th>Female n (%)</th>
<th>Total n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 – 08</td>
<td>266 (21.5%)</td>
<td>199 (9.6%)</td>
<td>465 (24.5%)</td>
</tr>
<tr>
<td>09 – 12</td>
<td>470 (38.0%)</td>
<td>231 (35%)</td>
<td>701 (36.9%)</td>
</tr>
<tr>
<td>13 – 15</td>
<td>504 (40.6%)</td>
<td>230 (34.5%)</td>
<td>734 (38.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>1240 (100%)</td>
<td>660 (100%)</td>
<td>1900 (100%)</td>
</tr>
</tbody>
</table>

Note: Percentages indicate column percentages
Table 2- Age group distribution of obese and overweight children

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Normal</th>
<th>Overweight</th>
<th>Obesity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-8</td>
<td>425 (91.3%)</td>
<td>23 (4.9%)</td>
<td>17 (3.6%)</td>
<td>465 (24.4%)</td>
</tr>
<tr>
<td>9-12</td>
<td>654 (93.2%)</td>
<td>25 (3.5%)</td>
<td>22 (3.1%)</td>
<td>701 (36.8%)</td>
</tr>
<tr>
<td>13-15</td>
<td>648 (88.2%)</td>
<td>51 (6.9%)</td>
<td>35 (4.7%)</td>
<td>734 (38%)</td>
</tr>
<tr>
<td>Total</td>
<td>1727 (90.8%)</td>
<td>99 (5.2%)</td>
<td>74 (3.8%)</td>
<td>1900 (100%)</td>
</tr>
</tbody>
</table>

The body mass index has range from 10.84kg/m² to 24.70Kg/m². The mean body mass index was 17.34± 2.32kg/m².

Table 3- Age wise distribution of prevalence of hypertension and Pre-hypertension in the study population

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Normal</th>
<th>Pre-hypertension</th>
<th>Hypertension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 – 8</td>
<td>461 (99.1%)</td>
<td>1 (0.21%)</td>
<td>3 (0.6%)</td>
<td>465 (24.4%)</td>
</tr>
<tr>
<td>9 – 12</td>
<td>685 (97.7%)</td>
<td>6 (0.8%)</td>
<td>10 (1.4%)</td>
<td>701 (36.8%)</td>
</tr>
<tr>
<td>13 – 15</td>
<td>704 (95.9%)</td>
<td>17 (2.3%)</td>
<td>13 (1.7%)</td>
<td>734 (38.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>1850 (97.3%)</td>
<td>24 (1.2%)</td>
<td>26 (1.3%)</td>
<td>1900 (100%)</td>
</tr>
</tbody>
</table>

Table 4 – Sex wise distribution of prevalence of non-obese and obese with hypertension and non-hypertension.

<table>
<thead>
<tr>
<th>Sex</th>
<th>BMI</th>
<th>Non obese</th>
<th>Obese</th>
<th>Total</th>
<th>Blood pressure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Non hypertensive</td>
<td>Hypertensive</td>
</tr>
<tr>
<td>Male</td>
<td>1214 (97.9%)</td>
<td>26(2.0%)</td>
<td>1240(100%)</td>
<td>1221(98.4%)</td>
<td>19 (1.5%)</td>
<td>1240(100%)</td>
</tr>
<tr>
<td>Female</td>
<td>612 (92.7%)</td>
<td>48(7.2%)</td>
<td>660(100%)</td>
<td>653(98.9%)</td>
<td>7 (1.0%)</td>
<td>660(100%)</td>
</tr>
<tr>
<td>Total</td>
<td>1826 (96.1%)</td>
<td>74(3.8%)</td>
<td>1900(100%)</td>
<td>1874 (98.6%)</td>
<td>26 (1.3%)</td>
<td>1900(100%)</td>
</tr>
</tbody>
</table>

\[
\chi^2 = 30.83 \text{ df } 1 \\
p = <0.0001S
\]

\[
\chi^2 = 0.71 \text{ df } 1 \\
p = 0.39\text{NS}
\]
### Table 5- Distribution of hypertension in overweight and obese children

<table>
<thead>
<tr>
<th></th>
<th>Pre-hypertension</th>
<th>Hypertension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight</td>
<td>14 (63.63%)</td>
<td>9 (34.61%)</td>
<td>23</td>
</tr>
<tr>
<td>Obese</td>
<td>8 (36.36%)</td>
<td>17 (65.38%)</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22 (100%)</strong></td>
<td><strong>26 (100%)</strong></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>

\[ x^2 = 4.02 \text{ df } 1 \text{ p} = 0.045 \]

### Table 6- Age wise distribution of Blood Pressure in obese children

<table>
<thead>
<tr>
<th>Age</th>
<th>Non-hypertensive</th>
<th>Hypertensive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 years</td>
<td>18 (90%)</td>
<td>2 (10%)</td>
<td>20 (100%)</td>
</tr>
<tr>
<td>11-15 years</td>
<td>39 (72.2%)</td>
<td>15 (27.7%)</td>
<td>54 (100%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57 (77.02%)</strong></td>
<td><strong>17 (22.9%)</strong></td>
<td><strong>74 (100%)</strong></td>
</tr>
</tbody>
</table>

*Fisher’s exact test and 2tailed p-value= 0.13NS*

### Table 7- Sex wise distribution of hypertension among obese children

<table>
<thead>
<tr>
<th>Gender</th>
<th>Normal</th>
<th>Pre hypertension</th>
<th>Hypertension</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>8 (30.76%)</td>
<td>5 (19.23%)</td>
<td>13 (50%)</td>
<td>26 (100%)</td>
</tr>
<tr>
<td>Female</td>
<td>41 (85.41%)</td>
<td>3 (6.25%)</td>
<td>4 (8.33%)</td>
<td>48 (100%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49 (66.21%)</strong></td>
<td><strong>8 (10.81%)</strong></td>
<td><strong>17 (22.9%)</strong></td>
<td><strong>74 (100%)</strong></td>
</tr>
</tbody>
</table>

\[ x^2 = 22.98 \text{ df } 1 \text{ p}<0.001S \]
Discussion

Study was undertaken in “Tirupati” city, being a locality of Sri Venkateswara medical college. The present study was carried out among 1900 apparently healthy school children aged 5-15 years. The proportion of males is 65.26%(1240) and that of females is 34.73%(660). Most of the study subjects were aged 12 years followed by 15 and 13 years.

Prevalence of obesity and overweight.

Out of the study population of 1900 (100%), 74(3.89%) apparently healthy school children are obese. It correlates with the study done by Premnath M et al (3.4%). Studies conducted in different parts of India on school children have come out with prevalence ranging from 0.35% (Deoke et al 6 –2012) to 6% (Sharma et al –2007). Out of 1900 (100%) study population, 99 (5.21%) apparently healthy school children are overweight. It Correlates with the study done by Chakraborty et al (5.43%).

Prevalence of hypertension

Out of 1900 study population, 26 (1.36%) apparently healthy school children are hypertensive correlates with the study done by Verma et al. Studies have come out with prevalence of hypertension ranging from 0.41% (Gupta et al 10 ) to1.8% (Aggarwal et al ).

Gender wise prevalence of obesity

In the present study out of 1240 (100%) boys, 2.09% (26) were obese whereas out of 660 (100%) girls, 7.27% (48) were obese.

Girls were found to be more obese than boys and the difference is statistically significant similar to Mudur et al 12 and Sonya Jagadesh et al 13

Gender wise prevalence of hypertension

In the present study out of 1240 (100%) boys, 1.53% (19) are hypertensive and among 660 (100%) girls, 1.06% (7) The percentage of hypertensive boys are slightly higher than girls but the difference is statistically insignificant similar to the Anandan et al 14.

Age group wise prevalence of hypertension among obese children

Out of 74 (100%) obese children,72.9% (54) belonged to 11-15years age group whereas only 27.02% (20) belonged to 5-10years age group. Out of 54 (100%) obese children of 11-15 years age group, 27.7% (15) are hypertensive. Out of 20
(100%) obese children of 5-10 years age group, 10% (2) are hypertensive correlates with Chada et al \textsuperscript{15} and Mohan et al \textsuperscript{16} in contrast with Anjan et al \textsuperscript{17}.

**Prevalence of obesity among hypertensive children**

The present study shows that among hypertensive children 65.3\% are obese. Similar findings were reported in many other studies. Close relevance was found in the study conducted by Gupta et al \textsuperscript{10}, Bengalorkar et al \textsuperscript{16}.

**Conclusion**

In the present study, prevalence of obesity is 3.89\% and hypertension is 1.36\% among apparently healthy school children aged 5-15 years of Tirupati. Prevalence of obesity is more in girls than in boys and the observation is statistically significant. Prevalence of hypertension is slightly higher in boys but the observation is statistically insignificant. Anthropometric variables like height, weight and body mass index showed positive correlation with systolic as well as diastolic blood pressure. Obese children are at a higher risk of “childhood onset of adult diseases”. Thus, timely recognition and intervention will result in decreased adulthood morbidity and mortality.

**Limitations of the study**

Though the study was done in co-educational schools, boys constituted a major share of the study population. Most of the children belonged to 12 years and above age group. BMI was used as criteria to label obesity, but BMI may not be a sensitive measure of body fatness in children who are particularly short, tall or have an unusual body fat distribution, and may misclassify subjects with highly developed muscles as obese. Pubertal staging of the study population was not assessed. The adiposity rebound at puberty could have influenced the BMI. No attempt was made to measure the BP of the parents, whose children were labelled as hypertensive. Hence the true state of affairs regarding parental hypertension might have been missed.
References


18. Prasanna Kamath B.T., Girish M. Bengalorkar, Deepthi R., Muninarayan C., Ravishankar S. Prevalence of overweight and obesity among adolescent school going children (12-15years) in urban area, South India. IJCRR (2012), [cited October