Prevalence of overweight in urban Indian adolescent school children

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Prevalence of overweight in urban Indian adolescent school children


Diabetes Research Centre and M.V. Hospital for Diabetes, 4 Main Road, Royapuram, Madras 600013, India

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Abstract

The prevalence of diabetes mellitus (DM) and cardiovascular disease (CVD) is increasing in urban India. Overweight in adolescence is a marker of overweight in adult age, and it shows an association with the above diseases. There have been meagre data from India on the prevalence of childhood obesity. The objective of the study was to quantify the prevalence of overweight and its risk factors in adolescent children in urban India. School students in the age group of 13–18 years (n = 4700, M:F 2382:2318) were studied. Body mass index (BMI) was measured. Data on physical activity, food habits, occupation of parents and their economic status, birth weight of the children and age at menarche in girls were obtained by questionnaire. Age-adjusted prevalence of overweight was 17.8% for boys and 15.8% for girls. It increased with age and was higher in lower tertiles of physical activity and in higher socio-economic group. Birth weight and current BMI were positively associated. The study highlighted the high prevalence of overweight in adolescent children in urban India. Life style factors influenced BMI in adolescent age. © 2002 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Obesity; Adolescence; Birth weight; Urbanization; India; Socio-economic factors; Childhood obesity

1. Introduction

Developing countries such as India have a rising prevalence of diabetes in the urban population [1,2]. Body Mass Index (BMI) is strongly associated with diabetes in all studies [1]. Overweight is a major problem in many developed countries and is an important risk factor for many diseases including diabetes and cardiovascular diseases (CVD) [3–6]. Overweight in children is an antecedent of adult obesity. Therefore, the need to estimate overweight in children has been recognized as a step towards identifying high risk groups and to evolve preventive strategies for diseases associated with overweight by several countries [3–12]. There are only meagre data available from India [13–15]. This study was instigated to determine the prevalence of overweight and the associated factors in adolescents in urban
India. Internationally based cut off points for obesity based on BMI were used [16].

2. Subjects and methods

The study included 4700 school children in the age group of 13–18 years; 2382 (50.7%) were boys and 2318 (49.3%) were girls. The schools were selected from different zones in the city to get an equal distribution of children by socio-economic strata (SES) and gender. Government schools for low-income group (n = 2) and private schools attended by middle income (n = 2) and high-income groups (n = 2) were chosen. School authorities were requested to provide a list of children attending ninth to 12th standards. We aimed to screen 2500 boys and 2500 girls between 13 and 18 years with an equal distribution from the low, middle and upper income groups. Informed consent was obtained from the school authorities to make anthropometric measurements and also to collect data by questionnaire from the children. The questionnaire provided information on physical activity, food habits, and occupation of parents, economic status, birth weight (BW) of children and the age of menarche in girls. The children were advised to take home the questionnaire to fill in the details regarding the last two parameters. Filled forms were returned the next day. Completed age of the children was noted. Height and weight were measured using standard procedure [2] and BMI (kg/m²) was calculated. Measurements were made by two trained technicians. Inter-observer error was < 5%. The BMI of each child was determined and adjusted for expected BMI at age 18 [16]. The number of overweights (corresponding to age 18, BMI ≥ 25 kg/m²) and obese (BMI ≥ 30 kg/m²) were calculated. Occupation of parents was classified as category 1, skilled and unskilled workers; category 2, executive jobs; category 3, professional and business class; category 4, retired. SES were arbitrarily based on the possession of automobiles (1, no automobiles; 2, motor cycles; 3, car) which was found to be a reliable index of SES in urban India, in a previous study [17]. Physical activity score was calculated based on sports activities, kilometers walked per day and mode of transport to school. Activity score ranged from 0 to 7; 0, least physical activity at work and during leisure time; 7, maximum — walking/cycling to school and sports activities. Activity score used in the study was validated against a reference method suggested by Taylor et al, in a sample of 60 children. It was used with slight modifications to suit the sports activities in India [18]. The correlation between the two methods was r = 0.41, P = 0.001. Diet score was calculated by adding the frequency per week of intermediate food items such as ice-creams, sweets, soft drinks, chocolates, fried foods and eating out. This was validated against the daily consumption of calories calculated by using a 24 h diet recall method. The correlation coefficient was r = 0.46, P < 0.01. The total score was divided into tertiles. Parents of 2678 children were able to provide the BW of their children which were verified from birth certificates. The study protocol was approved by the ethical committee of the Research centre.

3. Statistical analysis

Prevalence of overweight and obesity were age-standardized using the census for the urban population of Tamilnadu, India, in 1991. Group means were compared using analysis of variance (ANOVA) or t-test, and proportions in groups were compared by trend χ²-test as relevant. Pearson’s correlation test was used to calculate the correlation between the variables studied. Variables associated with BMI were determined using multiple linear regression analysis.

4. Results

Height and weight were higher in boys than girls (P < 0.001), but girls had higher BMI (P < 0.001) (Table 1). Age-standardized prevalence of overweight was 17.8% (95% confidence interval (CI) 16.1–19.5%) among boys and 15.8% (CI 14.1–17.4%) among girls (gender difference χ² = 3.12, P = 0.08). Obesity corresponding to > 30 kg/m² at age 18 years was present in 3.6% (CI
The prevalence of overweight was inversely related with the activity score (prevalence (95% CI) 19.7% (18.2–21.3%), 13.1% (11.5–14.8%) and 10.5% (8.1–13.2%) in increasing tertiles (trend $\chi^2 = 45.6$, $P < 0.001$). Obesity was present in 4.3% (3.6–5.2%), 2.7% (2.0–3.6%) and 0.7% (0.2–1.7%) in the second tertiles. The mean activity score was 2.2 ± 1.9 (S.D.). Percentage of overweight was not associated with increasing tertiles of diet score (11.9, 8.4 and 7.3% in tertiles 1–3 of diet score (NS)). Activity score was higher among non-obese compared with overweight subjects for all tertiles of diet score.

The completed questionnaire was returned by 3028 of 4700 (64.4%) children. Birthweight was available in 58.4, 56.1 and 55.6% of the high, middle and low economic groups, respectively. Table 2 shows the characteristics of the children according to economic background. In both genders, there was an increasing trend in BW, BMI and percentage of overweight with increasing economic status. Age at menarche in girls was significantly higher in low SES.

Prevalence of overweight in the total group was also related with parental occupation. It was low if the fathers were workers or were retired persons (4 and 4.1%, respectively) and higher if they had executive jobs (12.0%) or were professionals or businessmen (12.9%). There was a direct correlation between the prevalence of overweight and the BW of the children (total group $r = 0.106$, $P < 0.0001$).

Multiple linear regression analyses were done separately for boys and girls with BMI as the dependent variable (Table 3). Age, BW, income group, and parental occupation had a positive association in boys. All the parameters except BW showed a significant association in girls. Physical activity score had a negative association with BMI in boys and girls (Table 3).

### 5. Discussion

BMI has a strong independent association with diabetes in epidemiological studies in adult populations in India [2,18]. Consistent positive correlation between childhood obesity with adult obesity has been reported [19,20]. There are no epidemiological data on childhood overweight from urban India.

The present study showed that the prevalence of overweight (BMI ≥ 25) was high among urban southern Indian children. (17.8% in boys, 15.8% in girls) obesity (BMI ≥ 30 kg/m²) was seen in 3.6% of boys and 2.9% of girls. Obesity defined as a BMI ≥ 30 kg/m² is uncommon among Asian subjects, although BMI is a strongly associated risk factor for diabetes [21]. In this analysis, we arbitrarily used the criteria of Cole et al. [16] for calculation of overweight ($\geq 25$ kg/m²). There is a likelihood of an underestimation of overweight in this study, since lower BMI values may be more appropriate for determining overweight in Asian–Indian populations.

None of the earlier Indian studies had measured the prevalence of obesity in school children. However, in the studies by Anand and Tandon

### Table 1

Demographic and anthropometric characteristics of study subjects

<table>
<thead>
<tr>
<th></th>
<th>Total n = 4705</th>
<th>Boys n = 2387</th>
<th>Girls n = 2318</th>
<th>P value boys vs. girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>14.9 ± 1.3 (13.0–19.0)</td>
<td>15.0 ± 1.3 (13.0–19.0)</td>
<td>14.9 ± 1.2 (13.0–18.0)</td>
<td>0.03</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.9 ± 9.2 (124–195.5)</td>
<td>164.8 ± 9.8 (124–195.5)</td>
<td>156.8 ± 6.4 (132–188)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>51.2 ± 12.9 (20–135)</td>
<td>53.2 ± 14.1 (20–135)</td>
<td>49.1 ± 11.1 (25–108)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>19.6 ± 4.0 (10.8–45.6)</td>
<td>19.4 ± 4.0 (10.8–45.6)</td>
<td>19.9 ± 3.9 (11.3–40.7)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Table 2
Characteristics of children based on economic group

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Middle</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>3.0 ± 0.6 (1.5 – 5.0)</td>
<td>3.1 ± 0.5a (1.4 – 5.0)</td>
<td>3.2 ± 0.6a (1.4 – 5.0)</td>
<td>2.8 ± 0.5 (1.5 – 5.0)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>17.0 ± 2.9 (12.0 – 37.3)</td>
<td>19.2 ± 3.6a (10.8 – 32.1)</td>
<td>20.4 ± 4.2a-b (13.0 – 45.6)</td>
<td>18.1 ± 3.1 (12.4 – 40.7)</td>
</tr>
<tr>
<td>Overweight* (%)</td>
<td>4.2 – 13.9</td>
<td>23.5</td>
<td>13.1 ± 0.92 (10.8 – 32.1)</td>
<td>13.6 ± 0.94a</td>
</tr>
<tr>
<td>Age at menarché years</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5.0</td>
</tr>
</tbody>
</table>

* Overweight, boys-trend \( \chi^2 = 69.7, \ P < 0.001 \); girls-trend \( \chi^2 = 55.3, \ P < 0.001 \). Values are mean \( \pm \) SD (range).

a \( P < 0.05 \) vs. low.
b \( P < 0.05 \) vs. middle.
c \( P < 0.01 \) vs. boys (comparison of mean values by ANOVA).
Table 3
Multiple linear regression. Variables significantly associated with BMI.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Boys</th>
<th></th>
<th></th>
<th>Girls</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>SEβ</td>
<td>P values</td>
<td>β</td>
<td>SEβ</td>
<td>P values</td>
</tr>
<tr>
<td>Age (years)</td>
<td>1.35</td>
<td>0.243</td>
<td>&lt;0.001</td>
<td>1.24</td>
<td>0.276</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BW2 (kgs)</td>
<td>0.78</td>
<td>0.196</td>
<td>&lt;0.001</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Economic group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0.79</td>
<td>0.21</td>
<td>&lt;0.001</td>
<td>1.19</td>
<td>0.23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Middle</td>
<td>–</td>
<td>–</td>
<td></td>
<td>0.651</td>
<td>0.196</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Activity score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertile 1</td>
<td>1.94</td>
<td>0.24</td>
<td>&lt;0.001</td>
<td>0.75</td>
<td>0.16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Tertile 2</td>
<td>0.68</td>
<td>0.25</td>
<td>0.006</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>1.12</td>
<td>0.21</td>
<td>&lt;0.001</td>
<td>1.27</td>
<td>0.22</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Executives</td>
<td>1.08</td>
<td>0.22</td>
<td>&lt;0.001</td>
<td>1.22</td>
<td>0.22</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Categorization of variables: birth weight (kg)-Bw1 1–2: reference 2.1–3.0; BW2 >3.0; activity score Tertile 1; Tertile 2; reference Tertile 3; occupation reference category, unskilled workers, housewife, retired person; non-significant independent variables, boys, birthweight, economic group, middle: girls, birthweight 1 and 2, activity score, tertile 2.

[14] and Varma et al. [15] from northern India, it was noted that children with obesity had a high risk of hypertension. Their data on obesity are not strictly comparable with our study, as children of age 5–15 years were studied. In low-income Mexican Americans, the prevalence of overweight in adolescence was 40.1% [22]. A rising trend in the prevalence of obesity in childhood and adolescence has been noted in several studies [5–7]. In Germany, obesity in children has almost doubled between 1975 and 1995 [7].

Prevalence of overweight was associated with lower physical activity score and higher economic status. A strong association of physical inactivity and obesity is well recognized, even in school children [12,14,23]. Moussa et al. [12] and Musaiger et al. [9] had noted that a family history of obesity and diabetes mellitus were risk factors for obesity in the children. A limitation of our study was that we could not obtain data on family history of obesity and diabetes. In our population, a gender difference in obesity rate was not seen unlike some previous studies in which higher rates of obesity were found in boys than girls [6].

Classification of SES would have been ideally based on family income. This was not possible as parents were not directly approached for details.

An arbitrary classification was made based on the possession of automobiles and thus sample selection may not be entirely representative of the SES in the population. Food habits including eating between meals which were evaluated by a scoring system did not show a correlation with overweight. Diet scores were higher among the less physically active children which probably explained the lack of association between the diet score and overweight. However, under reporting of dietary intake by the children, cannot be ruled out.

In developed countries such as the UK, an association between social deprivation and childhood obesity was strong, especially in the girls [10]. In our country, social deprivation resulted in lower BMI among the children. This difference may be due to the fact that criteria of social deprivation vary in developed and developing countries. In the latter, social deprivation results in unavailability of sufficient food and thus causes nutritional deficiencies. The higher age at menarche in girls of low economic group, probably reflects nutritional imbalance as a result of poverty [24].

We observed a linear correlation between the BW and the present BMI among the students.
Birth weight of the babies increased with increasing economic background. The study was not designed to look for the association of low BW with the risk variables for diabetes and other diseases, in adulthood.

The study has highlighted a high prevalence of overweight among adolescent school children in an urban population in a developing country. Probably, this is a pointer towards greater morbidity from diseases such as diabetes, CVD and hypertension in years to come. Life-style influenced the BMI in children. Overweight in children was related to the economic status and low physical activity.

Acknowledgements

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References