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Research article

## A STUDY OF ANTHROPOMETRIC MEASUREMENTS AND PREVALENCE OF OVERWEIGHT AMONGST GIRLS IN AN URBAN SCHOOL

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### ABSTRACT

**Background:** Individuals whose Body Mass Index exceeds the age-gender-specific 95<sup>th</sup> percentile are overweight; while those with BMI between the 85<sup>th</sup> and 95<sup>th</sup> percentiles are at risk of overweight. The prevalence of obesity is increasing worldwide. Children are becoming overweight at younger age. Currently 10% of children worldwide are either overweight or obese. The present study was undertaken to study the anthropometric measurements and determine the prevalence of overweight amongst school girls in the age group of 5-8 years in a school of Pune. **Methods:** Anthropometric measurements of the study subjects were studied by conducting a cross sectional descriptive study. All the 312 girl students, aged 5 to 8 years enrolled in the school during the study period were studied. **Results:** 15.4% of the girls were found to be overweight while 5.4% are at risk of overweight. **Conclusion:** With increasing age, more girls become overweight and at risk of overweight. This increase is steady as the age increases from 5 to 8 years.

**Keywords:** Anthropometry, overweight, children, urban, girls

### INTRODUCTION

Overweight and obesity are by definition, abnormal or excessive fat accumulation that may impair health<sup>1,2</sup> or simply as a state of excess adipose tissue<sup>3</sup>. Another definition says that obesity is an excessive accumulation of adipose tissue containing stored fat in the form of triglycerides<sup>4</sup>. Limited research has been carried

out in case of childhood overweight. However, evidence based on surveys indicates that the rising incidence of overweight and obesity among children parallels that among adults<sup>5</sup>. The prevalence of obesity is increasing worldwide in almost every country in all the age groups and children are becoming overweight at a younger age<sup>6</sup>. Blood pressure, blood lipid levels, and

obesity in childhood “track” into adulthood. The increase in type 2 diabetes among children and adolescents is directly related to the obesity epidemic<sup>1,7,8</sup>. There is a secular trend of childhood obesity to adult life; 41% of obese adults have been overweight or obese during their childhood also<sup>7,8</sup>. The rate of childhood obesity has increased to a great extent in the last two decades<sup>9</sup>. At present, about 10% of children the world over are either overweight or obese<sup>10</sup>. Among Canadian children, the rate of overweight has increased from 11% in 1980s to over 30% in 1990s. Amongst Brazilian children it has increased from 4% (1980s) to 14% (1990s)<sup>11</sup>. In India, available studies from Chennai, Delhi and Bhavnagar have shown the prevalence of obesity as 6.2%, 7.4% and 5.55% respectively. The prevalence of combined overweight and obesity is more in girls (16.66%) than in boys (12.48%)<sup>12</sup>. A “double burden” of disease exists now. This is faced more so by many low- and middle-income countries. While they continue to deal with the problems of infectious diseases and under-nutrition, there is a significant increase in chronic disease risk factors. An upsurge in obesity and overweight is particularly found in urban settings. Very often there is under-nutrition and obesity existing side-by-side within the same country, the same community and even within the same household<sup>2</sup>. According to one study, the overall prevalence of overweight in urban children in New Delhi has shown an increase from 16% (2002) to about 24% (2006-2007)<sup>12</sup>. In another study, the prevalence of overweight in children was 16.75 % in boys and 19.01 % in girls respectively. Besides, it was observed that both overweight and obesity started manifesting as early as 5 years of age<sup>13</sup>. At the time of entry to school at 5 years of age, about 9% of boys and girls were overweight and about 5% were obese<sup>13</sup>. Another study found the overall prevalence of obesity and overweight as 11.1% and 14.2% respectively<sup>14</sup>. Similar study found the prevalence of overweight to be 17.8% in boys and 15.8 % in girls; and the prevalence of obesity

was 3.6% in boys and 2.7% in girls<sup>15</sup>. Yet another study found the prevalence of overweight among school girls to be significantly higher compared to the boys of the same age group<sup>16</sup>. The available data therefore suggests that Indian children today are taller and heavier than their counter parts were fifteen years ago<sup>13</sup>. The present study was undertaken to study the anthropometric measurements and determine the prevalence of overweight amongst school girls in the age group of 5-8 years in an urban school.

**Assessment of overweight:** In the case of children aged 5 to 8 years, emphasis is placed on the assessment of physical status by the measurement of height, weight and mid-upper arm circumference<sup>17</sup>.

The anthropometric measurements recommended for the children aged 5 to 8 years are:

Weight, Height, Body Mass Index, and Mid Upper Arm Circumference<sup>18</sup>.

BMI has been recommended as the preferred measure by many expert and advisory groups, for evaluating overweight among children and adolescents 2 to 19 years of age<sup>20</sup>. BMI is recommended since it can be obtained easily, is co-related strongly with body fat percentage (especially at extreme BMI levels), is associated only weakly with height, and it identifies the fattest individuals correctly, with acceptable accuracy at the upper end of the distribution (e.g. 85<sup>th</sup> or 95<sup>th</sup> percentile for age and gender)<sup>19,20,21</sup>.

The BMI is a derived index and is calculated as per the guidelines given by the WHO as follows<sup>17</sup>:

$$\text{BMI} = \text{Weight (in Kgs)} / \text{Height}^2 \text{ (in meters)}$$

Using the above equation, BMI is calculated until the second decimal value.

### **Classification**

The most commonly used parameter is BMI which is calculated as weight in kg divided by the square of the height in meters. After BMI is calculated, the number is plotted on the CDC

BMI-for-age growth charts to obtain a percentile ranking. These charts are separate for girls and boys. Percentiles are the most commonly used indicator to assess the size and growth patterns of individual children. Percentile indicates the relative position of a particular child's BMI number in comparison to children of the same sex and age. The growth charts show the weight status categories used with children. They depict underweight, healthy weight, at risk of overweight, and overweight, as shown in Table 1<sup>21</sup>.

**Table 1: CDC Classification of Weight Status According to the Percentile Range**

Weight status category	Percentile range
Underweight	Less than 5 <sup>th</sup> percentile
Healthy weight	5 <sup>th</sup> percentile up to the 85 <sup>th</sup> percentile
At risk of overweight	85 <sup>th</sup> to less than 95 <sup>th</sup> percentile
Overweight	Equal to or greater than the 95 <sup>th</sup> percentile

#### **Aims and Objectives:**

The study was undertaken with the following aims and objectives:

1. To study the anthropometric measurements of school girls in the age group of 5-8 years.
2. To determine the prevalence of overweight.

#### **MATERIAL AND METHODS**

The anthropometric measurements of school girls in the age group of 5-8 years in an urban school were studied by conducting a cross sectional descriptive study. All the 312 girl students, aged 5 to 8 years enrolled in the school during the study period were studied. Before start of the study, ethical clearance was obtained from institutional ethics committee, informed consent was taken from the parents and the relevant authorities of the school were briefed about the scope of the study, with a view to solicit their co-operation. The age was recorded to the nearest

completed year (6 months and above being rounded off to the next year and less than six months to the previous year) as per the official records of the school. Record of the educational status of the child was restricted to the class in which the child was studying at the time of data collection. Anthropometric Measurements recorded during the conduct of the study were weight, height, Body Mass Index (BMI), Mid Upper Arm Circumference (MUAC) and was done with the full uniform on, less the belt and shoes and was conducted on the guidelines issued by the World Health Organisation<sup>13</sup>. Data was analysed using Epi Info software.

#### **RESULTS**

It was observed that out of the total of 312 subjects examined, all the subjects aged 5 years were studying in class 1, 97% of those aged 6 years were in class 1, while the remaining 3% aged 6 years were in class 2. 57.1% of those aged 7 years were in class 1, 36.3% in class 2, and the remaining 6.6% were in class 3, as shown in Table-2. Out of the 8 year old subjects, 1.6% were in class 1, 36.3% in class 2 and the remaining 62.1% were in class 3, respectively.

The distribution of BMI percentiles according to age of the subjects is as shown in Table-2. It was observed that based on BMI criteria as defined, overall, 16.7%, 42.4%, 33.0% and 16.5% subjects had BMI <5<sup>th</sup> percentile at the age of 5,6,7, and 8 years, respectively. 83.3%, 45.5%, 51.6% and 57.7% subjects had BMI 5<sup>th</sup> - <85<sup>th</sup> percentile at the age of 5, 6, 7, and 8 years, respectively. 9.1%, 9.9% and 19.8% subjects had BMI 85<sup>th</sup> - <95<sup>th</sup> percentile at the age of 6, 7, and 8 years, respectively. 3.0%, 5.5% and 6.0% subjects had BMI 95<sup>th</sup> percentile at the age of 6, 7, and 8 years, respectively. It was found that BMI percentile categories as shown in the table were homogenous with respect to age (p<0.05). The distribution of mean MUAC and standard deviation of the subjects by age, is as shown in Table-3. It was observed that the mean MUAC

of the subjects decreased till 7 years and increased thereafter. Similarly, the median MUAC decreased from 5 to 6 years of age, and increased thereafter. It was found that mean MUAC, median MUAC and standard deviation as shown in the table were homogeneous with respect to age of the subjects ( $p < 0.05$ ).

The distribution of percentiles of weight of subjects according to age is as shown in Fig-1. On plotting the percentile distribution of weight with respect to age of the subjects; it is observed that there is an increasing trend in respective percentile with respect to age. The weight at 5, 6, 7, and 8 years of age being 17, 14, 14, and 16 kg at the 5<sup>th</sup> percentile; the same being 21, 18, 20, and 24 kg at the 50<sup>th</sup> percentile; and the corresponding weight at the 95<sup>th</sup> percentile being 23, 36, 35 and 40 kg. There is a gradual decrease till the age of 7 years, after which there is a rapid increase observed to 8 years of age. Further, this increase in the weight is more marked at the higher percentiles.

The distribution of percentiles of height of subjects according to age is as shown in Fig-2. On

studying the percentile distribution of height with respect to age of the subjects, it is observed that there is generally an increasing trend in respective percentile with respect to age. The height at 5, 6, 7, and 8 years of age being 115, 101, 104, and 106cms at the 5<sup>th</sup> percentile; the same being 118, 113, 117, and 124cms at the 50<sup>th</sup> percentile; and the corresponding height at the 95<sup>th</sup> percentile being 121, 129, 137, and 140cms.

The distribution of percentiles of BMI of subjects according to age is as shown in Fig-3. On studying the percentile distribution of BMI with respect to age of the subjects; it is observed that there is an increasing trend in respective percentile with respect to age, except for a slight dip around 6 years of age. The BMI at 5, 6, 7, and 8 years of age being 12, 10, 12, and 10 kg/m<sup>2</sup> at the 5<sup>th</sup> percentile; the same being 14, 14, 14, and 15 kg/m<sup>2</sup> at the 50<sup>th</sup> percentile; and the corresponding BMI at the 95<sup>th</sup> percentile being 16, 22, 23 and 24 kg/m<sup>2</sup>. The fall and rise in the BMI is more marked at the lower percentiles.

**Table 2: Distribution of BMI percentiles according to age**

Age	BMI Percentiles				Total
	<5 <sup>th</sup>	5 <sup>th</sup> - <85 <sup>th</sup>	85 <sup>th</sup> - <95 <sup>th</sup>	95 <sup>th</sup>	
5	1 (16.7)	5 (83.3)	0	0	6 (100)
6	14 (42.4)	15 (45.5)	3 (9.1)	1 (3.0)	33 (100)
7	30 (33.0)	47 (51.6)	9 (9.9)	5 (5.5)	91 (100)
8	30 (16.5)	105 (57.7)	36 (19.8)	11 (6.0)	182 (100)
<b>Total</b>	75 (24.0)	172 (55.1)	48 (15.4)	17 (5.4)	312 (100)

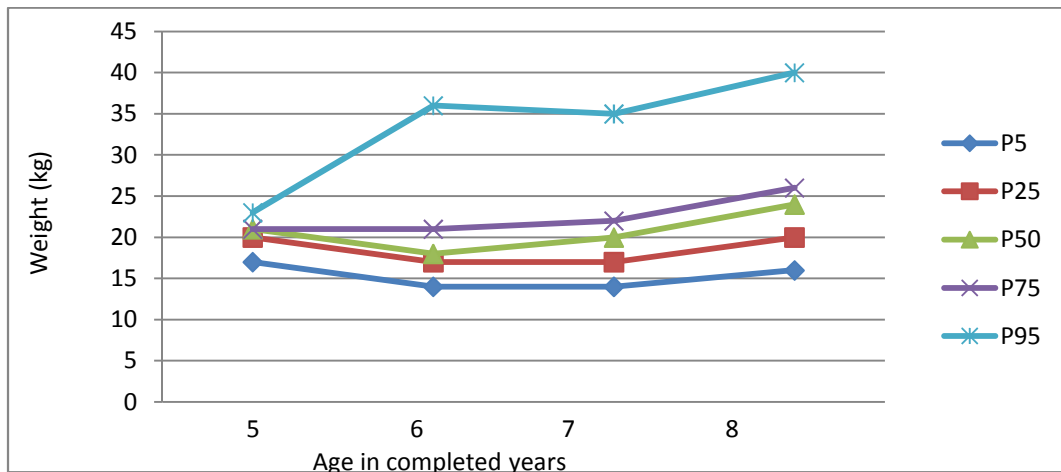
$$X^2 = 20.6024, df = 9, p < 0.05$$

Note: As per CDC 2000 guidelines, percentile of the BMI define Underweight, Healthy weight, At risk of overweight and Overweight in case of children. The figures in parenthesis refer to the percentages.

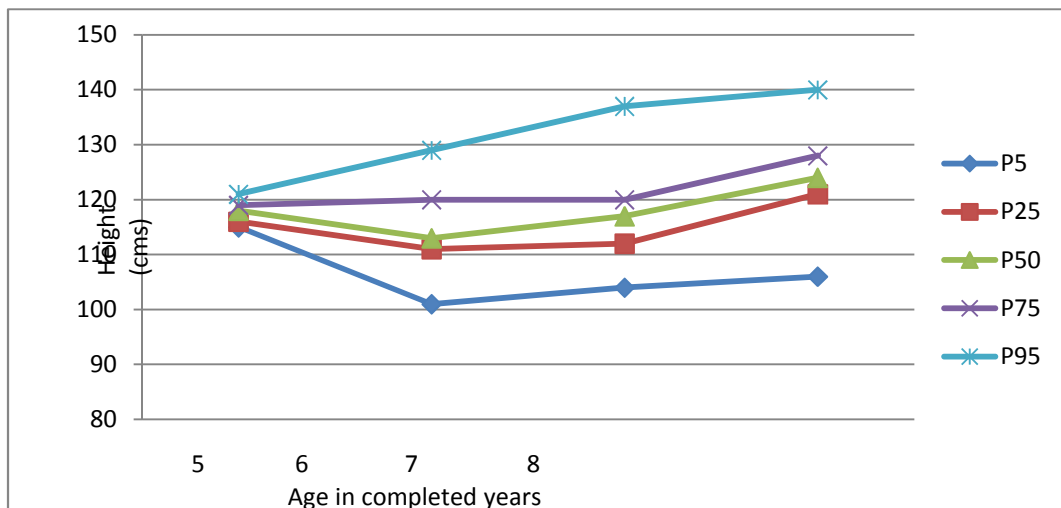
**Table: 3 Distribution of MUAC Mean  $\pm$  Standard Deviation according to age of the subject**

Age (completed years)	Observations	Mean $\pm$ SD
5	6	17.66 $\pm$ 1.40
6	33	16.99 $\pm$ 2.07
7	91	16.96 $\pm$ 2.55
8	142	17.99 $\pm$ 2.47

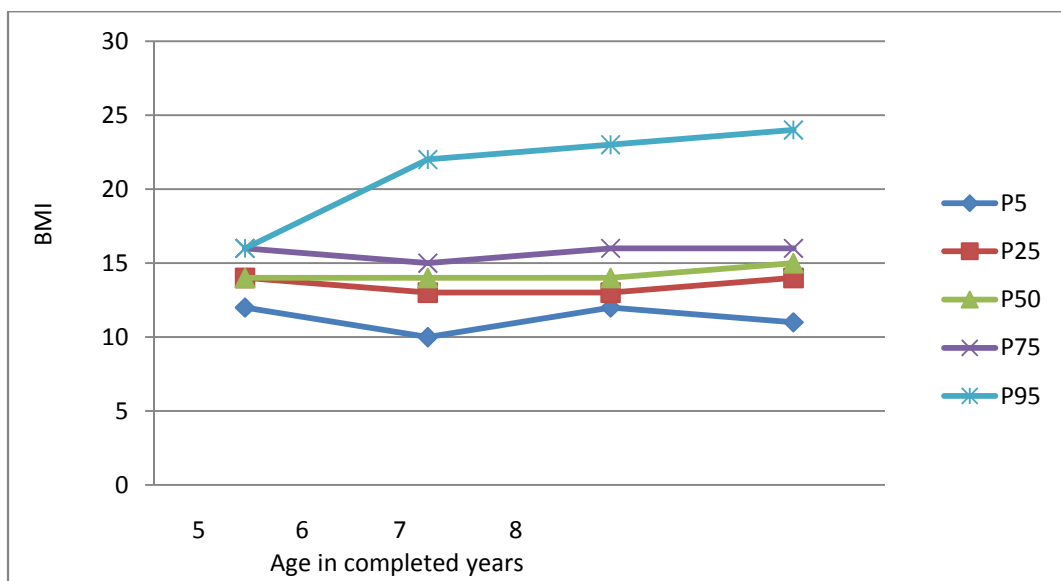
$\chi^2 = 21.0258, df = 3, p < 0.05$



**Fig 1: Distribution of percentiles of weight of subjects according to age**



**Fig 2: Distribution of percentiles of height of subjects according to age**



**Fig 3: Distribution of percentiles of BMI of subjects according to age**

**Table 4: Comparison of median height of subjects**

Age	Present Study	Agarwal et al <sup>26</sup>	Rath et al <sup>29</sup>	Marwaha et al <sup>13</sup>	Vijaya Raghavan et al <sup>28</sup>	CDC <sup>23</sup>	WHO <sup>31</sup>
5	117.83±0.0223	104.92±27.38	109.69±4.84	111	112.24±3.91	108	110
6	114.76±0.0639	110.5±44.34	118.78±4.65	117	117.73±5.08	115	115
7	116.70±0.0633	115±42.10	122.99±4.74	122	122.65±5.79	122	121
8	124.40±0.0582	123.8±35.51	127.79±6.83	128	127.22±6.58	128	127

Note: The values in parenthesis correspond to the mean and SD. The values of SD are not available in respect of the other studies.

**Table 5: Comparison of median weight of subjects**

Age	Present Study	Agarwal et al <sup>26</sup>	Rath et al <sup>29</sup>	Marwaha et al <sup>26</sup>	Vijaya Raghavan et al <sup>28</sup>	CDC <sup>23</sup>	WHO <sup>31</sup>
5	20.33±2.14	15.77±11.14	18.72±2.4	19	18.67±1.89	18	18
6	19.08±4.21	17.89±18.72	21.72±3.85	21	21.56±3.44	20	20
7	20.15±4.09	19.34±23.40	23.03±3.49	24	24.45±4.41	23	22
8	23.82±4.54	22.34±22.56	26.39±6.11	27	25.97±4.87	26	25

Note: The values in parenthesis correspond to the mean and SD. The values of SD are not available in respect of the other studies.

**Table 6: Comparison of median BMI of subjects**

Age	Present Study	WHO <sup>31</sup>	CDC <sup>23</sup>	Marwaha et al <sup>13</sup>
5	14.63±1.32	13	13	12
6	14.38±2.05	13	13	12
7	14.72±2.07	13	13	12
8	15.30±2.13	13	13	13

Note: The values in parenthesis correspond to the mean and SD. The values of SD are not available in respect of the other studies.

**Table 7: Comparison of means of MUAC of subjects**

Age	Present Study	Shrivastava et al <sup>32</sup>	Rath et al <sup>29</sup>	Vijaya Raghavan et al <sup>28</sup>
5	17.66 ±1.40	15.3 ± 1.1	16.34 ± 1.24	16.3 ± 1.31
6	16.99± 2.07	15.9 ± 1.3	17.72 ± 1.71	16.96 ± 1.60
7	16.96±2.55	16.5 ± 1.2	17.58 ± 1.76	17.70 ± 2.14
8	17.99±2.47	17.2 ± 1.5	18.57 ± 2.82	18.00 ± 2.16

## DISCUSSION

The comparison of median height of subjects is as shown in Table-4. On comparing with other studies, it was observed that the median height of

the subjects in the present study is higher at all ages than that observed by KN Agarwal et al<sup>26,27</sup> whereas it is lower at all ages than that observed

by Marwaha et al<sup>13</sup>, VijayaRaghavan et al<sup>28</sup> and Rath et al<sup>23</sup> at all ages except at the age of 5 years. On the whole, it was observed that the median height of the girls in the present study is comparable to the other studies.

The comparison of median weight of subjects is as shown in Table-5. On comparing with other studies, it was observed that the median weight of the subjects in the present study is higher at all ages than that observed by KN Agarwal et al<sup>26</sup> whereas it is lower at all ages than the median weight observed in the other studies, except at the age of 5 years.

The comparison of median BMI of subjects is as shown in Table-6. On comparing the median BMI with respect to age of the subjects, it was observed that the median BMI of subjects in the present study is generally more than that in the CDC standards<sup>23</sup>, the WHO standards<sup>31</sup>, and the BMI observed by Marwaha et al<sup>13</sup> at all ages.

The comparison of MUAC of subjects is as shown in Table-7. On comparing with other studies, it was observed that the mean MUAC of the subjects in the present study is higher at 5 years of age, than the mean MUAC of the subjects observed in the studies by DK Shrivastava et al<sup>32</sup>, Rath et al<sup>29</sup> and VijayaRaghavan et al<sup>28</sup>. However, there is a dip at 6 and 7 years of age, after which it again rises.

## CONCLUSION

In the present study we have observed that at the age of 6 years, 3.0% of the subjects are overweight while 9.1% of the subjects in the study population are at risk of overweight. Similarly, at the age of 7 years, 5.5% of the subjects are overweight while 9.9% of the subjects in the study population are at risk of overweight. The similar figures at 8 years of age are 6.0% and 19.8% respectively. Overall, 15.4% of the girls were found to be overweight while 5.4% are at risk of overweight. From the present study we can conclude that with increasing age during childhood, more girls become overweight

and at risk of overweight. This increase is steady as the age increases from 5 to 8 years.

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