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BMI Indices and Its Correlation to Underweight, Overweight and Obesity in School Children of Visakhapatnam

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Original Research Article

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Abstract: The rise of childhood obesity has placed the health of an entire generation at risk. The aim of this study is to conduct a surveillance study to determine the prevalence of overweight, obese and underweight on the basis of BMI indices among school children. After taking necessary consent from the school authorities, the proposal of study was explained to the target group.175 students (100 boys & 75 girls) from a private school age ranging from 10-14 years participated in the study. Heights and weights were measured using standard techniques. Age was derived from their date of birth to the date of measurement. BMI and BMI percentile was calculated. The results were depicted graphically. The study reveals only 10% of the students were obese and 24% were overweight. But surprisingly 16% of the students were underweight. Hence measures should also be aimed to reduce the proportion of underweight individuals which is masked by those of obese and overweight.
Keywords: Childhood obesity, overweight, underweight, BMI, BMI percentile.

INTRODUCTION

Increasing incidence of childhood obesity is the present day issue in the developing countries. The prevalence of overweight children has almost increased in all countries over the world, even more in urbanized and economically developed countries [1]. The World Health Organization (WHO) has described obesity as the worst non-infectious epidemic in history [2]. Many studies show the prevalence of overweight and obesity varies from 10%-30% [3-5]. A study in Delhi on affluent school children showed the prevalence of obesity to be 7.4% [6].

Though risk factors like differences in lifestyle, physical activity and dietary patterns contribute to the major cause for overweight and obesity, urbanization and industrialization also form a significant proportion [7]. On the other hand, the developing countries also face the serious problem of underweight. When underweight coexist with overweight and obesity, it is called double burden of malnutrition [8]. The present study is undertaken to determine the prevalence of underweight, overweight and obesity in school children of Visakhapatnam on the basis of BMI values.

MATERIALS AND METHODS

Measurements of height and weight were recorded from 175 students of a private school using standard techniques. Dates of births were taken from each student to calculate the age. 100 boys and 75 girls participated in the study. BMI was calculated by using the standard formula for children from 2-20 years of age. BMI percentile was also done. The results were tabulated and graphically represented. Students with <5% BMI percentile were categorized as underweight.

RESULTS

175 students between the age group 10-14 years participated in the study of which 100 were boys and 75 girls. According to Barlow SE and the Expert Committee, BMI percentile between 5-85 was considered normal and <5 th percentile was considered underweight and $\geq 85^{th}$ percentile was considered as overweight & obese and $\geq 95^{th}$ percentile was considered as obese.

The results are as follows:

- 16%of the students were underweight (18% boys & 13% girls)
- 60% of the students were normal (55% boys & 67% girls)
- 24% of the students were overweight or obese (27% boys & 20% girls)

- 10% of the students were obese (14% boys & 5% girls)

The results are tabulated as follows:

Table-1: Data of 175 students between 10-14 yrs age

Sex	Date of birth	Date of measurement	Height		Weight	BMI	BMI %ile
			Feet	Inches	Pounds		
F	3/7/2005	3/7/2017	4	9	92.5	20.0	73.3
F	3/8/2005	3/7/2017	4	7	94.7	22.0	86.4
F	3/9/2004	3/7/2017	4	3	74.95	20.3	68.8
F	5/10/2005	3/7/2017	4	9	94.7	20.5	78.3
F	4/11/2004	3/7/2017	5	1	92.59	17.5	32.5
F	3/12/2005	3/7/2017	4	9	134.4	29.1	98.1
F	10/13/2005	3/7/2017	4	5	68.34	17.1	40.5
F	7/14/2006	3/7/2017	4	9	66.13	14.3	5.4
F	1/15/2007	3/7/2017	4	3	50.7	13.7	2.6
F	6/16/2006	3/7/2017	5		66.13	12.9	0.2
F	12/17/2005	3/7/2017	4	10	77.16	16.1	25.7
F	3/9/2007	3/7/2017	5	5	94.79	15.8	30.4
F	3/4/2007	3/7/2017	4	10	70.54	14.7	12.9
M	5/12/2006	3/7/2017	4	7	57.3	13.3	0.2
M	6/6/2005	3/7/2017	4	7	66.1	15.4	10.3
F	3/5/2007	3/7/2017	5	1	77.1	14.6	10.6
F	12/30/2006	3/7/2017	4	9	99.2	21.5	91.0
F	11/14/2007	3/7/2017	4	4	68.3	17.8	70.4
M	2/24/2006	3/7/2017	4	5	77.1	19.3	78.4
F	5/23/2006	3/7/2017	4	10	66.1	13.8	2.1
M	10/1/2006	3/7/2017	4	7	88.1	20.5	89.1
F	11/3/2006	3/7/2017	4	4	105.8	27.5	98.4
F	12/8/2005	3/7/2017	5	5	88.1	14.7	6.3
M	4/30/2004	3/7/2017	5	6	73.8	11.9	0.0
M	3/25/2005	3/7/2017	4	8	55.1	12.4	0.0
M	8/5/2005	3/8/2017	5	7	99.2	15.5	13.8
M	9/3/2005	3/8/2017	5		103.6	20.2	82.8
M	10/1/2004	3/8/2017	5	3	110.2	19.5	70.2
M	4/5/2006	3/8/2017	4	9	70.5	15.3	14.1
M	12/1/2004	3/8/2017	4	9	77.1	16.7	27.1
M	8/29/2005	3/8/2017	4	8	66.1	14.8	5.5
F	2/3/2005	3/8/2017	5		79.3	15.5	10.6
M	4/28/2006	3/8/2017	4	7	105.8	24.6	96.8
M	7/12/2005	3/8/2017	4	11	63.9	12.9	0.0
M	12/1/2004	3/8/2017	4	9	105.8	22.9	91.7
M	11/11/2006	3/8/2017	5	2	88.18	16.1	36.3
M	12/2/2005	3/8/2017	4	9	110.2	23.8	95.5
M	7/12/2005	3/8/2017	4	6	99.2	23.9	95.1
M	7/12/2006	3/8/2017	4	8	119.05	26.7	98.2
M	4/12/2005	3/8/2017	4	5	61.7	15.4	10.4
M	3/12/2004	3/8/2017	4	8	97	21.7	84.6
M	7/3/2004	3/8/2017	5	4	94.7	16.3	16.1
M	7/28/2004	3/8/2017	4	11	70.5	14.2	0.6
M	4/3/2005	3/8/2017	4	8	99.2	22.2	90.7
F	3/3/2006	3/8/2017	4	7	85.98	20.0	79.4
F	9/7/2007	3/8/2017	4	4	66.1	17.2	60.7
F	8/15/2006	3/8/2017	4	7	59.5	13.8	2.5
F	10/3/2006	3/8/2017	5	1	99.2	18.7	72.5
M	4/5/2005	3/8/2017	4	8	108	24.2	95.1
M	1/1/2005	3/8/2017	4		68.3	20.8	83.2

F	3/11/2006	3/8/2017	4	9	88.1	19.1	71.4
F	2/1/2005	3/8/2017	5		99.2	19.4	66.1
F	3/3/2004	3/8/2017	4	9	72.7	15.7	8.4
F	8/29/2004	3/9/2017	4	9	88.1	19.1	58.9
F	1/1/2006	3/9/2017	5	1	138.8	26.2	97.1
F	1/2/2005	3/9/2017	4	9	108	23.4	90.8
F	1/31/2004	3/9/2017	5	2	79.3	14.5	1.2
F	4/4/2006	3/9/2017	4	8	77.1	17.3	48.1
F	6/25/2005	3/9/2017	5		101.4	19.8	73.4
M	12/12/2005	3/9/2017	5		88.1	17.2	47.9
M	12/12/2006	3/9/2017	5		92.5	18.1	71.2
M	10/3/2005	3/9/2017	5		132.2	25.8	97.3
M	8/6/2005	3/9/2017	5		88.1	17.2	44.1
M	4/9/2005	3/9/2017	5		99.2	19.4	72.8
M	3/2/2004	3/9/2017	5		66.1	12.9	0.0
M	2/25/2004	3/9/2017	4	9	83.7	18.1	44.1
M	8/9/2004	3/9/2017	5	2	101.4	18.5	56.0
M	7/7/2004	3/9/2017	5	1	90.3	17.1	29.6
M	3/2/2006	3/9/2017	4	10	101.4	21.2	89.9
M	10/3/2006	3/9/2017	4	8	88.1	19.8	85.3
M	5/12/2005	3/9/2017	4	5	74.9	18.7	66.2
M	3/2/2006	3/9/2017	4	11	99.2	20.0	84.1
M	5/6/2006	3/9/2017	4	11	92.5	18.7	73.7
M	3/21/2005	3/9/2017	4	9	108	23.4	93.5
M	8/17/2006	3/9/2017	5	1	123.4	23.3	95.8
M	3/2/2006	3/9/2017	4	8	88.18	19.8	82.2
M	1/1/2005	3/9/2017	4	8	63.9	14.3	1.2
M	12/25/2005	3/9/2017	4	4	48.5	12.6	0.0
M	2/25/2005	3/9/2017	4	7	66.1	15.4	8.7
F	3/2/2006	3/9/2017	4	6	77.1	18.6	65.9
F	10/13/2005	3/9/2017	4	5	79.3	19.8	75.8
M	12/1/2005	3/9/2017	4	6	66.1	15.9	23.1
M	8/9/2004	3/9/2017	4	7	77.1	17.9	45.8
M	8/30/2005	3/9/2017	4	7	77.1	17.9	57.2
M	10/10/2006	3/9/2017	4	8	85.9	19.3	82.0
M	3/4/2006	3/9/2017	4	9	88.18	19.1	76.5
M	10/10/2006	3/9/2017	4	4	59.5	15.5	21.8
M	4/3/2005	3/10/2017	4	5	59.5	14.9	4.7
M	8/9/2006	3/10/2017	4	8	74.9	16.8	47.1
M	1/3/2006	3/10/2017	4	4	68.3	17.8	58.1
M	8/5/2006	3/10/2017	5	1	123.4	23.3	95.8
M	4/30/2006	3/10/2017	4	9	59.5	12.9	0.0
M	5/31/2006	3/10/2017	4	7	88.18	20.5	87.8
M	12/3/2005	3/10/2017	4	9	83.7	18.1	62.7
M	8/5/2005	3/10/2017	4	9	61.7	13.4	0.1
M	3/2/2006	3/10/2017	4	8	66.1	14.8	7.6
M	5/8/2006	3/10/2017	4	7	66.1	15.4	16.4
M	9/3/2006	3/10/2017	4	6	63.9	15.4	19.7
M	8/17/2006	3/10/2017	4	7	66.1	15.4	18.5
M	3/5/2006	3/10/2017	5	6	77.1	12.4	0.0
M	5/12/2005	3/10/2017	4	7	99.2	23.1	93.1
M	7/3/2006	3/10/2017	4	7	59.5	13.8	1.3
M	5/4/2006	3/10/2017	4	8	110.2	24.7	97.0
M	3/31/2005	3/10/2017	4	5	70.5	17.6	48.1
M	7/7/2005	3/10/2017	4	4	55.1	14.3	1.9
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M	12/13/2005	3/10/2017	5	4	88.1	15.1	10.2
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M	3/29/2005	3/10/2017	4	5	70.5	17.6	48.1
F	6/28/2005	3/10/2017	5	1	114.6	21.7	86.0
F	6/15/2004	3/10/2017	4	9	110.2	23.8	90.7
F	7/15/2005	3/10/2017	5		83.7	16.3	25.5
F	8/3/2005	3/10/2017	5		97	18.9	65.2
F	3/11/2006	3/10/2017	4	5	67.2	16.8	39.6
F	2/11/2004	3/10/2017	5	1	85.9	16.2	13.3
F	5/6/2004	3/10/2017	4	5	63.9	16.0	12.0
F	1/1/2005	3/10/2017	5	4	119	20.4	75.6
F	5/6/2004	3/11/2017	4	8	74.9	16.8	22.4
F	3/2/2005	3/11/2017	4	3	85.9	23.2	90.7
F	11/7/2005	3/11/2017	4	9	101.4	21.9	88.6
F	2/3/2004	3/11/2017	4	6	92.5	22.3	83.3
F	3/5/2004	3/11/2017	4	6	79.3	19.1	55.4
F	8/19/2004	3/11/2017	5		77.1	15.1	4.8
F	11/1/2005	3/11/2017	4	8	108	24.2	94.5
F	11/3/2005	3/11/2017	4	5	66.1	16.5	31.5
F	8/3/2003	3/11/2017	5	6	74.9	12.1	0.0
F	12/25/2005	3/11/2017	5	1	110	20.8	83.6
F	3/20/2006	3/11/2017	4	6	66.1	15.9	24.6
F	5/30/2005	3/11/2017	4	7	85.9	20.0	74.3
F	5/15/2005	3/11/2017	4	8	87	19.5	69.6
F	3/12/2005	3/11/2017	4	5	57.3	14.3	2.3
F	1/3/2005	3/11/2017	5	1	77.1	14.6	3.0
F	2/2/2004	3/11/2017	4	8	99.2	22.2	83.0
F	2/18/2005	3/11/2017	5	4	99.2	17.0	32.9
F	5/3/2006	3/11/2017	5		77.1	15.1	12.4
F	8/9/2004	3/11/2017	4	5	63.9	16.0	13.5
F	3/3/2004	3/11/2017	4	9	74.9	16.2	13.4
F	8/8/2005	3/11/2017	4	9	88.1	19.1	66.7
F	11/1/2006	3/11/2017	4	6	59.5	14.3	6.7
M	12/23/2006	3/11/2017	4	5	110.2	27.6	98.7
M	2/20/2005	3/11/2017	4	9	94.7	20.5	81.6
M	1/10/2006	3/11/2017	4	5	55.1	13.8	0.8
F	5/18/2005	3/11/2017	5	1	123.4	23.3	91.6
F	1/3/2005	3/11/2017	4	10	108	22.6	88.1
M	8/15/2005	3/11/2017	5	1	94.7	17.9	56.3
M	2/19/2004	3/11/2017	4	9	77.1	16.7	19.4
M	5/6/2005	3/11/2017	5	4	141	24.2	95.2
M	1/3/2005	3/11/2017	5	1	77.1	14.6	2.1
F	8/6/2005	3/11/2017	4	9	77.1	16.7	31.5
M	10/3/2006	3/11/2017	3	5	55.1	23.0	95.7
M	7/7/2004	3/11/2017	4	9	116.8	25.3	95.5
M	3/3/2006	3/11/2017	4	5	97	24.3	96.4
M	3/2/2005	3/11/2017	4	4	77	20.0	78.1
M	1/5/2005	3/12/2017	4	2	55.1	15.5	9.4
M	11/23/2005	3/12/2017	4	10	99.2	20.7	86.7
M	8/8/2005	3/12/2017	4	9	66.1	14.3	2.0
M	5/8/2005	3/12/2017	5		77.1	15.1	6.4

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M	8/3/2005	3/12/2017	5		70.5	13.8	0.5
M	4/2/2004	3/12/2017	5	1	88.1	16.6	19.9
M	2/1/2004	3/12/2017	5	3	130	23.0	89.8
M	1/3/2006	3/12/2017	5	6	99.2	16.0	25.3
M	8/27/2005	3/12/2017	4	9	101.4	21.9	90.8
M	3/2/2005	3/12/2017	4	1	66.1	19.4	71.7
M	3/9/2005	3/12/2017	5	1	97	18.3	58.6
F	11/15/2005	3/12/2017	5	4	88.1	15.1	10.6
F	2/28/2005	3/12/2017	5	2	154.3	28.2	97.6
M	8/9/2006	3/12/2017	5	3	116.8	20.7	89.4
M	12/13/2006	3/12/2017	4	5	66.1	16.5	45.8

Table-2: Summary of children's BMI for age

Summary of Children's BMI-for-Age			
	Boys	Girls	Total
Number of children assessed:	100	75	175
Underweight (< 5th %ile)	18%	13%	16%
Normal BMI (5th - 85th %ile)	55%	67%	60%
Overweight or obese (≥ 85th %ile)*	27%	20%	24%
Obese (≥ 95th %ile)	*14%*	*5%*	*10%*
*Terminology based on: Barlow SE and the Expert Committee [9]			

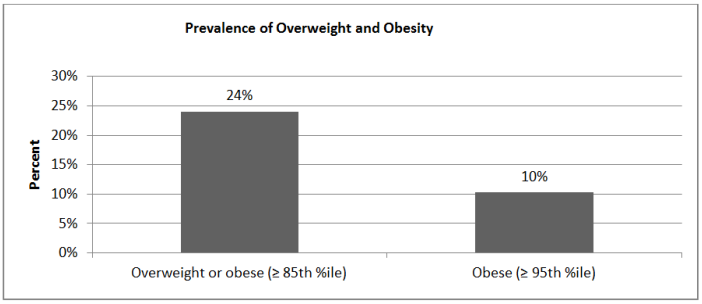

Fig-1: Prevalence of overweight and obesity

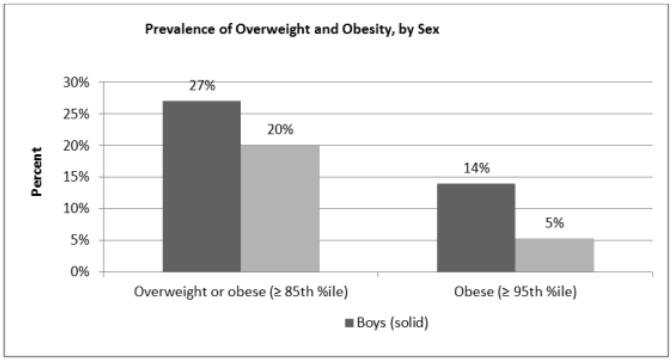

Fig-2: Prevalence of overweight and obesity in boys and girls

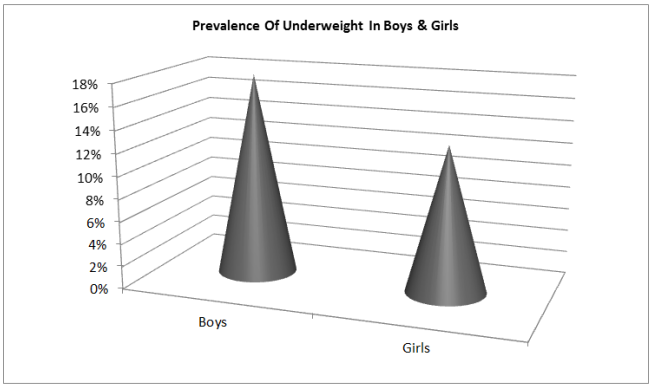

Fig-3: Prevalence of underweight in boys and girls

DISCUSSION

Obesity and overweight have become the global health burden of the recent times. World Health Organization (WHO) estimates that, in 2008, more than 1.4 billion people worldwide were overweight; of these over 200 million men and nearly 300 million women were obese [10]. Studies show that obesity and overweight effects boys more than girls. Children of Canada show an increase for overweight (11 to 33% in boys, 13 to 27% in girls) and obesity (2% to 10% in boys and 2 to 9% in girls) between 1981 and 1996[11]. Studies in USA report a fourfold increase in prevalence of obesity among 6-17-year-old male (5.5% to 21.6%) and only a three-fold increase among female children (5.8% to 17.7%) between 1976 and 2008 [12]. On the other hand, prevalence of underweight is also becoming a potential health hazard. Indonesian study reports a significant proportion of 14.5% underweight children [13]. Indian studies elicit a considerable percentage of underweight individuals [14, 15]. The present study was undertaken to determine the prevalence of overweight, obesity and underweight in school children in urban population. The values coincide with the other studies and show more preponderance to boys. Important measures need to be undertaken to revert back the BMI values to normal range so as to prevent the future development of overweight and obesity. Healthy methods are to be implemented to overcome the burden of underweight also.

CONCLUSION

The global burden of overweight and obesity are affecting the school children significantly. The present study conducted in the urban population shows 24% overweight and 10% obese students in which boys are commonly affected. On the other hand, 16% of the children were underweight which an alarming fact is. Hence, we conclude that proper measures are to be taken to maintain the BMI values within normal range to prevent the deleterious effects of obesity & overweight on one edge and of underweight on other edge of the sword.

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