



## Height, Weight And Body Mass Index of Girls and Boys in a Rural School in Punjab India

### KEYWORDS

Body mass index, obesity, height, weight

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**ABSTRACT** *In a rural school in Punjab, weight and height were monitored monthly for 12 consecutive months for 632 students, age 8-23 years. Using international Body Mass Index (BMI) standard 20% of the students would be considered severely thin (BMI <16). 6-7% with would be considered overweight (BMI 25-29.99) and less than 1% obese (BMI >30). Two unit lower BMI standards are appropriate for Asian population, thus 2-3% were undernourished (BMI <14) and 60-61% with ideal weight BMI 16.5-22.99. 10.3% girls and 11.6% boys were overweight and 2.7% girls and 2.5% boys were obese. Adopting regular higher physical activity and lower caloric intake along with monthly monitoring weight and height could make significant impact on the obesity epidemic and lower the risk of related diseases. Early age education and habits has the potential to last life time to make world population healthy, productive, and physically fit.*

### Introduction

Childhood obesity has been prevalent in the developed world and is increasing in the developing world (Wang and Lobstein 2006). In the developing countries obesity is occurring in the urban areas that have easy access to energy-dense foods and motorized transportation reducing physical activity for daily life (Han, Lawlar and Kimm 2010). Childhood obesity has been associated with increase in preventable premature degenerative life style diseases such as hypertension, diabetes, coronary artery disease and joint disease. Reducing intake of high-density and high-caloric foods, decrease in sedentary behavior and increasing physical activity are essential to rebut this epidemic. Prevention in young people is universally viewed as the best approach to reverse the rising global epidemic of obesity. Many prevention trials have been criticized being too small and insufficient length of follow-up (Summerbell et al 2005).

In US improving child nutrition was the focal point of the Healthy, Hunger Free Kids Act of 2010, Public Law 111-296. The legislation authorized funding and sets policy for United States Department of Agriculture (USDA) core child nutrition programs. This Act allowed USDA, for the first time in over 30 years, opportunity to make real reforms to the school lunch and breakfast programs. The Act was expected to help advance the goal of solving the problem of childhood obesity within a generation. Robert Wood Johnson Foundation on Childhood Obesity (2012) observed that more than two-thirds of adults and one-third of children in America are obese or at risk for obesity. To reverse this epidemic, the policy and environmental changes that lead to increased physical activity and better nutrition should be implemented. Childhood obesity threatens the

health of our young people now and their future potential. If we don't reverse this epidemic, the current generation of young people could be the first in U.S. history to live sicker and die younger than their parents' generation. It's estimated that the obesity epidemic costs US \$117 billion per year in direct medical expenses and indirect costs, including lost productivity.

Dashti et al (2015) observed that longer habitual sleep duration is associated with lower BMI. Chaput (2014) reported that number of meals per day is directly proportional to time spent awake. Nunes (2014) stated that a group of 450 retired admirals and generals affiliated with Mission Readiness, lobbied US Congress to implement the Healthy Hunger-Free Kids Act of 2010. The group argued that childhood obesity creates obstacles for military's ability to develop and effective fighting force. The US military spends \$1.5 billion annually treating obesity related health conditions and replacing those discharged because of being unfit; and more than one in four young adults ages 17 to 24 are too heavy to serve in the military.

### Methods

The school-based health-promoting data reported herein is from a rural school in Punjab. The importance of adopting healthy life long habits of exercise and eating balanced diets was emphasized at Bhagat Puran Singh Memorial Senior Secondary School and Girls College, Rajewal, Punjab, India. The school administration recognized the importance of maintaining healthy weight for all school children and approved this study. All the students were educated to eat balance diet and continue to attend mandatory physical activity 45 minute period on all school days. The height and weight was monitored consecutively for 12

months of grades 4 through 12 (boys and girls) and for two year college (girls only). There were 270 girls and 362 boys with ages ranging from 8-23 and 8-20, respectively, total observations 7,584. The students in this rural village setting in Punjab come from middle and lowering middle class farming and farm labor families. Low income families are given 70% reduction in their school fees. Many students from the vicinity walk to school or use bicycles. Students (nearly 75%) are provided bus transportation by the school at a cost of Rs 300-450 (\$5-7.5) per month based on the distance of their village from the school. Farthest distance students travel by bus is about 18 Km one way.

In general students take two wheat chapattis (Roti), or Pratha (pan fried Roti with butter) with yogurt or left over Dal (lentils or beans) or Sabji (curried vegetables) with a cup of milk or tea for breakfast. Students bring their lunch which in general contains two chapattis or Prathas with Sabji or pickle. There is a canteen at school which sells snacks, candies and carbonated sodas of several kinds. The students are allowed to visit the canteen only during 30 minute lunch break (recess). After school snacks includes Matthis (fried wheat snack) or Pinni (sweetened milk solids and wheat flour) with a cup of milk or tea. The evening meal is 2-3 wheat chapattis with Dal or Sabji. A glass of warm milk is consumed at bed time. Those who consume eggs either boiled or scrambled take about 3 times a week. Meat (chicken or goat) is consumed sparingly. Fruits that are farm grown consumed in season regularly. Rice as rice pudding is consumed once in a while.

All the electronic weighing scales were calibrated to one scale which was considered to be accurate. Age in months were recorded and the final data rounded to whole number years (e.g. 8.5-9.4 = 9 years). Data was analyzed using analysis of variance (SAS Institute, Carey, NC).

## Results

Body Weight, kg; Height, cm and Body Mass Index (BMI, kg/m<sup>2</sup>) and their statistical comparison of girls vs. boys at ages 8-20 years of Bhagat Puran Singh Memorial Senior Secondary School and Girls College, Rajewal, Ludhiana, Punjab, India is given in Table 1.

**Table 1. Body Weight, Height and Body Mass Index (BMI) of students of Bhagat Puran Singh Memorial Senior Secondary School and Girls College, Rajewal, Ludhiana, Punjab, India**

Age, Yrs	Observations, N		Weight $\pm$ SD, Kg		P value	Height $\pm$ SD, Cm		P value	Body mass Index $\pm$ SD		P value
	Girls	Boys	Girls	Boys		Girls	Boys		Girls	Boys	
8	25	8	25.0 $\pm$ 4.0	27.6 $\pm$ 0.9	0.086	127.4 $\pm$ 3.8	137.6 $\pm$ 1.1	0	15.4 $\pm$ 2.2	14.6 $\pm$ 0.4	0.31
9	186	199	26.7 $\pm$ 5.0	29.0 $\pm$ 4.6	0	129.2 $\pm$ 5.3	131.5 $\pm$ 5.9	0	15.9 $\pm$ 2.0	16.7 $\pm$ 2.2	0
10	170	444	30.1 $\pm$ 6.2	31.9 $\pm$ 7.4	0.003	135.5 $\pm$ 7.9	135.6 $\pm$ 6.1	0.782	16.2 $\pm$ 2.3	17.2 $\pm$ 2.8	0
11	257	484	33.4 $\pm$ 7.3	34.5 $\pm$ 8.2	0.055	141.2 $\pm$ 6.7	141.0 $\pm$ 6.5	0.772	16.6 $\pm$ 2.5	17.2 $\pm$ 3.1	0.006
12	186	471	39.8 $\pm$ 6.8	40.5 $\pm$ 8.0	0.35	150.5 $\pm$ 8.3	147.6 $\pm$ 5.7	0	17.5 $\pm$ 2.1	18.5 $\pm$ 3.3	0
13	267	602	44.1 $\pm$ 9.4	45.3 $\pm$ 10.3	0.084	152.6 $\pm$ 5.1	152.5 $\pm$ 7.3	0.885	18.0 $\pm$ 2.1	19.2 $\pm$ 3.4	0.179
14	329	475	45.6 $\pm$ 10.1	49.7 $\pm$ 10.6	0	154.8 $\pm$ 4.7	159.7 $\pm$ 7.8	0	19.1 $\pm$ 3.3	19.4 $\pm$ 3.7	0.237
15	410	561	47.5 $\pm$ 9.5	52.2 $\pm$ 11.6	0	156.2 $\pm$ 5.0	163.6 $\pm$ 7.6	0	19.4 $\pm$ 3.5	19.4 $\pm$ 3.5	0.808
16	409	498	50.7 $\pm$ 10.1	55.8 $\pm$ 10.0	0	158.6 $\pm$ 5.3	167.9 $\pm$ 7.7	0	20.1 $\pm$ 3.4	19.8 $\pm$ 3.1	0.103
17	343	280	50.9 $\pm$ 10.0	61.5 $\pm$ 12.3	0	158.0 $\pm$ 6.2	169.7 $\pm$ 6.8	0	20.4 $\pm$ 4.0	21.3 $\pm$ 3.8	0.004
18	183	219	49.7 $\pm$ 6.2	64.7 $\pm$ 11.7	0	158.7 $\pm$ 5.3	171.4 $\pm$ 5.7	0	19.7 $\pm$ 2.2	22.0 $\pm$ 3.8	0
19	248	49	50.3 $\pm$ 7.0	61.8 $\pm$ 8.5	0	157.4 $\pm$ 6.7	175.5 $\pm$ 5.3	0	20.3 $\pm$ 2.4	20.4 $\pm$ 2.8	0.718
20	155	5	53.0 $\pm$ 9.3	76.6 $\pm$ 6.2	0	157.9 $\pm$ 5.7	176.2 $\pm$ 2.2	0	21.3 $\pm$ 3.8	24.7 $\pm$ 2.5	0.049
21	49		50.4 $\pm$ 7.4			155.8 $\pm$ 4.9			20.8 $\pm$ 3.3		
22	17		52.8 $\pm$ 3.1			161.6 $\pm$ 2.7			19.7 $\pm$ 1.5		
23	1		55.3			162.0			21.1		

Values within weights, heights and BMI for girls and boys differ significantly with P values  $\leq$ 0.05.

Girls observations N=3240 and Boys N=4344.

The values are given mean $\pm$ SD, a difference of (P  $\leq$  0.05) was considered criterion of significance. Girls age 8-23 years ranged in weight 25-55 kg, height 127-164 cm and BMI 15.4-21.1 kg/m<sup>2</sup>. Boy age 8-20 years ranged in weight 28-77 kg, height 138-176 cm and BMI 14.6-24.7 kg/m<sup>2</sup>. Mean body weights and heights for boys were

significantly higher at age 14-20 years. Average BMI for boys was significantly higher than that of girls at the age of 9-12, 17-18 and 20 years.

Using International BMI standard, distribution of BMI and observations (N) for girls and boys in this private rural school in Punjab, India is shown in Table 2.

**Table 2. Distribution of Rural Punjab School students by International Body Mass Index (BMI) Standard (Observations N)**

Classification	BMI (kg/m <sup>2</sup> )	Girls % (N)	Boys% (N)
Severely thin	<16.00	20.7 (670)	20.3 (883)
Moderately thin	16.00 – 16.99	11.0 (359)	12.9 (560)
Mildly thin	17.00 – 18.49	20.2 (653)	21.2 (922)
Normal range	18.50 – 24.99	40.4 (1310)	38.1 (1655)
Overweight	25.00 – 29.99	6.3 (204)	6.8 (294)
Obese	$\geq$ 30.00	1.4 (44)	0.7 (30)

**Students with BMI (<16 kg/m<sup>2</sup>, severely thin) were 20-21% and 8% were overweight or obese with BMI  $\geq$ 25 kg/m<sup>2</sup>.**

Using lower BMI by 2 units for Asian population, descriptive data for girls and boys and observations (N) in this private rural school in Punjab, India is shown in Table 3.

**Table 3. Distribution of Rural Punjab School students by Asian Body Mass Index (BMI) Standard (Observations N)**

Classification	BMI (kg/m <sup>2</sup> )	Girls % (N)	Boys% (N)
Severely thin	<14	3.2 (105)	2.4 (105)
Moderately thin	14.00 – 14.99	7.1 (231)	7.0 (303)
Mildly thin	15.00 – 16.49	15.7 (510)	16.6 (723)
Normal range	16.50 – 22.99	60.8 (1970)	59.9 (2601)
Overweight	23.00 – 27.99	10.4 (335)	11.6 (502)
Obese	$\geq$ 28.00	2.8 (89)	2.5 (110)

BMI used for Asian is 2 units lower than International Standard (Lancet 2004).

There were 2-3% of the students with BMI <14 (underweight) and  $\geq$ 28 (obese). 60-61% of the students were in normal range BMI 16.5-22.99 kg/m<sup>2</sup>.

## Discussion

This is the first study where 12 consecutive monthly measurements of each individual are reported. In this study the girls attained their full adult weight (51-53 kg) and height (158-164 cm) at age 16 (Table 1). However the boys continue to gain weight (77 kg) and height (176 cm) to 20 years of age. The full adult weight and height attained by these boys could not be determined in this study as all the boys graduated from this school at age 20. From age 4-20 years boys were significantly heavier and taller than girls.

Body mass index (BMI) is recognized as predictor of health status. BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m<sup>2</sup>).

Table 1 data appears to indicate that all the rural students in Punjab are in good health with ideal BMI (15-25 kg/m<sup>2</sup>), the true picture is shown by the descriptive data (Tables 2, 3).

Pooling moderately thin, mildly thin and normal range girls and boys with BMI 16-24.99 kg/m<sup>2</sup>, 72% of the students of this rural school would be considered in good health (Table 2). There were 8% of students overweight and/or obese in this study. Ng et al (2014) reported that overweight and obesity in urban India accounts for 5.2-5.3% of girls and boys <20 years of age. The obesity in the rural India is believed to be lower than in its urban young people. Over 40% higher obesity was observed in this rural school than reported from Indian urban affluent students by Ng et al (2014). Data reported herein suggests that overweight and obesity in India is underreported. As the Indian economy is improving and Western life style is being adopted. There is an increasing visibility of western fast food establishments. There is an increasing number of rural and urban people now use motorized conveyances. Such an unhealthy change with the developing economy should be viewed with great concern. Ng et al (2014) reported lower values for overweight and obesity in school age girls and boys in India may be due single data points by questionnaires which are known that parents or students overstating their heights and under reporting their body weights. USA stood out for high prevalence of overweight and obesity in 2013, with 70.9% men, 61.9% women, 29.7% and 28.8% girls and boys <20 years of age respectively.

In Asia risk of premature degenerative diseases is significantly higher with BMI higher than 23 (WHO 2004). Thus Asian populations have different associations between BMI, percentage of body fat, and health risks than do Eu-

ropean populations. It was concluded that the proportion of Asian people with a high risk of type2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight ( $\geq 25$  kg/m<sup>2</sup>). WHO 2004 split normal range BMI into two sections 18.5-22.99 and 23.00 -24.99. It would be appropriate to define the whole Asian BMI spectrum 2 units lower as obesity burden is increasing. The descriptive data using lower BMI standard for this rural school is shown in Table 3. With BMI <14, 2-3% students in this study would be considered severely thin or malnourished. With BMI 14-22.9 kg/m<sup>2</sup>, 84% of students of this rural school would be considered in good health. However, 13-14% of the students would be considered overweight and/or obese. Data reported herein suggests that obesity in India of the school age children is grossly underestimated.

Sedentary habits and high fat, sugar and salt diets have resulted in the obesity epidemic in the developed world. The developing world needs to educate students to refrain from adopting the unhealthy life style and eating habits.

### Conclusions and Recommendations

Initiating weight and height recording every month for all students from elementary schools along with education to promote lifelong lessons of healthy weight management could prevent all obesity-related health and national security issues.

### The following steps are suggested:

1. The height and weight to be recorded each month in all schools.
2. Limit high sugar, salt, fat and caloric density foods.
3. Take healthy snacks and educate that 250 calories could be consumed in less than five minutes and it takes 30 minutes running or 60 minutes brisk walking to burn those calories.
4. Limit TV viewing or time spent on internet or smart phones.
5. Every night sleep for 7-8 hours.

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