



# Correlation of Body Mass Index, Body Fat and Waist Circumference to Blood Pressure in Obese School Boys: An Observational Study

<sup>1</sup> Avijeet Rana, <sup>2</sup> Prof. Sagarika Bandyopadhyay

<sup>1</sup>Research Scholar, <sup>2</sup>Professor

<sup>1,2</sup> Department of Physical Education and Sport Science, Visva Bharati, Santiniketan, India

**Abstract:** The aim of the study was to find out the association of BMI, body fat, waist circumference with blood pressure. This study included 80 obese boys students of age group 13-16 years. All students were from four different govt aided schools of different municipality of Purba Medinipur district. Measurement of height and weight was done by standard procedure. BMI was calculated by Quetlet's equation. Waist circumference was measured by anthropometric tape and blood pressure was measured by auscultatory method. Descriptive statistics and Pearson's product Moment Method was computed by SPSS 16. There was a positive significant correlation between BMI, Body fat%, waist circumference and systolic blood pressure. No significant relationship was observed between BMI, Body fat% and diastolic blood pressure but waist circumference had an association with diastolic blood pressure.

**Key Word:** BMI, Body Fat, Waist Circumference, Blood Pressure, Obesity

## 1. INTRODUCTION

Hypertension is also known as high blood pressure (HBP), is a long-term medical condition in which the blood pressure in the arteries is persistently elevated (*Hypertension - Wikipedia*). Hypertension has been referred to as a typical illness as well as one of the most common diseases, prompting high morbidity and mortality (Bromfield & Muntner, 2013). Numerous deaths were attributed due to high systolic blood pressure as the main factor of cardiovascular diseases (GBD 2017 Risk Factor Collaborators, 2018). Around the world, 7.6 million pre mature death were credited due to hypertension in 2001 and at the same time roughly 50% of stroke and ischemic coronary illness attributed due to hypertension (Raj, 2011)

Fourth National Family Health Survey assessed hypertension, in an enormous populace based example and revealed that 13.8 % men (15-49 years) and 8.8% women (15-54) had hypertension (Gupta et al., 2019). In the years, various research studies demonstrated that hypertension can be found among kids and youths and this specific blood pressure pattern showed a well documented connection to adulthood hypertension (Urrutia-Rojas et al., 2006). Age, sex, body size, race/nationality, obesity and Socio-economic status are the factors for increases Blood pressure (Adolescents, 1996).

Obesity is one of the main effector of blood pressure in children. Childhood obesity increases the risk of obesity, later in life. Irrespective of economy and geographical periphery, not only in developed countries but also in developing countries childhood obesity arising as a pestilence. Overweight and obesity may have significant impact on individual's health. Obesity causes multiple health and social issues that begin in infancy but continue and develop throughout life such as type 2 diabetes, cardiovascular disease, pulmonary disease, metabolic syndrome, obstructive sleep apnea, low self-esteem and depression. BMI is the easiest, practical and most widely used system of indexing body weight. This method is commonly used for identifying obesity in large a scale but it has number of limitations. BMI did not consider physiological differences in the proportions between the adipose, osseous, and muscular tissues. Evidence

from the conducted studies has revealed that abdominal obesity (assessed based on the waist circumference) plays a very important role in the development of metabolic disorders and in the assessment of cardiovascular risk (Gierach et al., 2014). Now a day's WHO and other health organization suggest that combine the BMI and Abdominal obesity or total body fat% to identify overweight or obesity.

In research setting the most commonly used measures of general obesity and abdominal obesity could foresee the danger of cardiovascular diseases and all-cause mortality (Kuciene & Dulskiene, 2019). Waist circumference is a predictor of cardiovascular diseases and diabetes in children. With this background, this study was proposed find the correlation of BMI, body fat, waist circumference with blood pressure.

**Objectives:** The objective of study was to find out the association of BMI, body fat, waist circumference with blood pressure.

## 2. Methodology

**2.1 Selection of the subjects:** The study was conducted on Purba Medinipur region (West Bengal). In this study a total of 80 obese school boys aged 13–16 years were involved from four different govt. aided schools of four different municipality area. For the study only obese boys subjects were selected as per the age specific BMI cutoff marks published by Indian Academy of Pediatrics. All the Physical measurement, body fat and blood pressure were measured in their respective school premises.

### 2.2 Selection of Variables:

The following variables were selected for this study.

- ✚ Height(cm)
- ✚ Weight (kg)
- ✚ BMI(kg/m<sup>2</sup>)
- ✚ Body fat%
- ✚ Waist Circumference(cm)
- ✚ Systolic blood pressure (mm/hg)
- ✚ Diastolic blood pressure(mm/hg)

### 2.3 Administration of test:

Physical measurements such as height, weight, BMI and waist circumference were measured by skilled operator standard equipments was used. Body weight was measured to the nearest 0.1 kg by digital weighing machine (Omron –HBF 224). Height was measured by portable stadiometer (Seca-213, Germany) to the nearest 0.1 cm. BMI was calculated by the equation given by Lambert Adolphe Jacques Quetelet, which is known as Quetelet's index. Waist circumference was measured to the nearest 0.1 cm in standing position at the narrowest point between the lower border of 10<sup>th</sup> rib and the iliac crest and measurement was taken after a normal exhale of breath using a non stretchable anthropometric tape (Cescorf). Three skinfold side measurements (Pectoral, Abdominal and Mid-thigh) were measured by using Harpenden skinfold caliper and body fat % was estimated from the harpenden body assessment software. Blood pressure was measured indirectly by auscultation, using a stethoscope, a mercury column sphygmomanometer with an appropriately sized blood pressure cuff.

### 2.4 Statistical Analysis:

The statistical analyses of the collected data were computed by using IBM-SPSS. To analyze the central tendency and variability of data Mean and Standard deviation was calculated. To assess the relationship of BMI, body fat, waist circumference with blood pressure Pearson's Product Moment Methods of Correlation was administered and the level of significance set at  $p < 0.05$  level of confidence.

## 3. Results and Discussion:

Based on the collected data following results were found.

**Table 1. Descriptive statistics of Personal data, Body Fat %, waist circumference and Blood Pressure**

	Age	Height	Weight	BMI	Body Fat %	WC	SBP	DBP
<b>Mean</b>	14.52	1.58	64.95	26.06	26.89	86.25	132.90	83.67
<b>±Sd</b>	1.12	0.07	6.29	1.68	2.38	5.26	8.07	5.86

BMI = Body Mass Index, WC= Waist Circumference, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure,

The mean height of subject's was 1.58 m. ( $\pm 0.07$ ) and mean weight was 64.95 kg ( $\pm 6.29$ ) with the mean BMI of 26.06 kg/m ( $\pm 1.68$ ). The mean body fat% and waist circumference was 26.89 ( $\pm 2.38$ ) and 86.25 cm ( $\pm 5.26$ ). Their mean systolic and diastolic blood pressure was 132.90 ( $\pm 8.07$ ) and 83.67 ( $\pm 5.86$ ).

**Table – 2 Relationship of BMI, Body fat % and Waist Circumference with Blood Pressure**

	<b>Systolic Blood Pressure</b>	<b>Diastolic Blood Pressure</b>
<b>BMI</b>	0.46**	0.22
<b>Body Fat %</b>	0.25*	0.11
<b>Waist Circumference</b>	0.81**	0.44**

\*Significant at 0.05 level

Table 2 revealed that Systolic blood pressure had significant positive relationship with BMI(0.46), Body fat % (0.25) and Waist Circumference (0.81). It indicates that people with high BMI, body fat % and waist circumference will possess high systolic blood pressure which increases strokes, cardiac diseases. This findings collaborate with the study done by Yano et al.(2015), who assess the association of cardiovascular disease risk with isolated systolic hypertension in younger and middle-aged adults and said that adults with higher systolic blood pressure had higher relative risk for CVD and CHD mortality than those with optimal-normal BP(Yano et al., 2015). Male have tendency to accumulate fat at belly region and accumulation of excess fat is increases body weight. Increment body weight is responsible for increment in body surface area and due to that reason heart pump blood more forcefully to reach the all peripheral part of the body, which might be the reason for well documented relationship of systolic blood pressure and BMI, Body Fat% and waist circumference.

Diastolic blood pressure did not show any significant relationship with BMI (0.22) and body fat % (0.11) but positive relationship was found with waist circumference(0.44).High diastolic blood pressure causes an abdominal aortic aneurysm in which aorta enlarge or over stretched at naval region(Preidt, 2014). Deposition of excess fat in the inside layer of blood vessel may hardening the arteries which causes abdominal aortic aneurysm("Abdominal Aortic Aneurysm," 2020) and biologically in male excess fat deposit in the belly region so it might the reason for getting positive significant association of waist circumference and diastolic blood pressure.

#### 4. Conclusions:

Based on findings it was concluded that systolic blood pressure had a well documented association with all the anthropometric obesity markers and waist circumference is correlated with diastolic blood pressure which indicate that increase in waist circumference leads to abdominal aortic aneurysm diseases.

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