



## STUDY OF CORRELATION BETWEEN BODY MASS INDEX, AGE AND VARIOUS CARDIOVASCULAR PARAMETERS

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### ABSTRACT

The development of any state or society depends largely on the quality of health education. Regular physical activity, fitness and exercise are critically important for the health and well being of people of all ages. India in a process of rapid economic development and modernization with changing lifestyle factors has an increasing trend of hypertension, especially among the urban population. Physiological and metabolic functions of the body, which are directly dependent on the body mass index and on its distribution around the body resulting cardiovascular diseases like hyperlipidemia and hemodynamic disturbances. There is a positive association between increasing age, body mass index and blood pressure.

**KEYWORDS:** Age, body mass index, cardiac parameters, obese and non obese.

### INTRODUCTION

It is generally believed that the basis for any true development must commence with the development of human wealth [Pollitt, 1984]. It has been argued that health is an important factor for academic achievement in life [Popkin, 1982 and Jamison, 1986] and in higher education [Moock and Leslie, 1986].

Developing countries are increasingly faced with the double burden of hypertension and other cardiovascular diseases, along with infection and malnutrition [Murray and Lopez, 1996]. Several studies indicate that high BP is associated with age and is also because of the process of modernization Mungreiphy and Kapoor, 2009, and Schall, 2004]. Now a days, high blood

pressure is one of the risk factors for cardiovascular diseases, and the estimated 7.1 million deaths especially among middle, and old-age adults is due to high BP [WHO, 2002]. Hypertension was found to be more prevalent among men than women among senior citizens of Delhi, India reported by [Tyagi and Kapoor, 2004]. India in a process of rapid economic development and modernization with changing lifestyle factors has an increasing trend of hypertension, especially among the urban population [Gupta, 2004]. Various factors adversely affects, with changing social environment, marked increase in BP was noted by [Nirmala, 2001]. Cardiovascular diseases (CVDs) are one of the leading causes of death in both men and women in most Western countries [Padwal et al., 2001]. From ages 35-60 years, the systolic and diastolic blood pressure increases at an average of 20/ 10 mmHg, however, the systolic blood pressure is the most consistent and significant risk factor for CVDs compared to the diastolic blood pressure indicating hyperlipidemia condition with increasing pulse rate and body weight. Similarly, in India, the traditional tribes and caste groups, which represent a substantial percent of the country's population, are believed to have lower BP than other tribal groups reported by various researchers,[ Kusuma et al., 2002].

Several studies showing the relationship of BMI and blood pressure to cardiovascular diseases have been carried out. Body Mass Index (BMI) is recognized as one of the most useful indices for obesity in adults. BMI is determined by dividing weight (wt) in kilograms by height (ht) in meters square. It is highly correlated with weight (0.8-0.9) [Ahmed, 2007]. The relationship between excess weight and diseases has been recognized over time [Visscher and Seidell, 2001; Cameron et al, 2003]. Obesity has been particularly recognized as a major independent risk factor for cardiovascular diseases [Despres, 2001], diabetes mellitus, hypertension and hypercholesterolemia [Gluckman 2004 and Wilson 2002]. This is because increased body fat is accompanied by profound changes in the physiological and metabolic functions of the body, which are directly dependent on the degree of excess weight and on its distribution around the body. Around the world, traditional populations often have low blood pressure (<120/80mmHg) and show little increase with age [W. W. Dressler, 1999].

Body mass index is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases [Pi-Sunyer, 1993]. A number of clinical measurements for obesity have been used to

determine susceptibility to cardiovascular diseases [Cameron et al., 2003]. These include anthropometric indices such as body mass index (BMI), waist-hip ratio (WHR) and waist circumference (WC) [Bray et al., 2005].

### 1. Cardiovascular parameters

The rhythmic contraction and relaxation of heart is called heart beat. Each heart beat includes one systole (contraction) and one diastole (relaxation). The heart of healthy person beats 72 times per minute called heart rate. During each heart beat ventricles pumps about 70 ml of blood, this is called stroke volume. It means heart pumps about  $72 \times 70$  ml or approximately 5 liters of blood per minute called cardiac output.

#### A. Blood pressure

Lateral pressure or force exerted on the wall of arteries is called arterial blood pressure. It is measured with an instrument called sphygmomanometer (sphygmos= pulse, manometer= device to measure pressure). Blood pressure is measured in millimeters of mercury (mm Hg). Blood pressure is of two types,

1. **Systolic blood pressure:** It is the pressure of blood during ventricular systole. It is maximum and responsible for flow of blood in the arteries. The normal systolic blood pressure is 120 mmHg.
2. **Diastolic blood pressure:** It is the pressure of blood during ventricular diastole (relaxation). It is minimum, normal diastolic pressure is 80 mmHg.

Thus the normal blood pressure is 120/80 mmHg.

**Pulse:** Pulse is a pressure wave that travels through the arteries after each ventricular systole. The pulse may be felt in any artery that lies near the surface of the body. The radial artery at the wrist is commonly used to feel the pulse pressure. Since each heart beat generates one pulse in the arteries, the pulse rate per minute indicates the heart rate. The pulse rate is same as that of heart rate, 72 per minute.

Pulse rate is higher in children, females and standing position. It is lower in adults, males and lying position. It increases in emotional state like anger, fear, excitement and during exercise.

#### B. Blood related disorders

Hypertension or high blood pressure is the occurrence of persistent systolic arterial blood pressure of more than 140 mmHg and Diastolic arterial pressure of more than 90 mmHg.

Excessive high blood pressure of about 220/120 mmHg may cause rupturing of blood vessels in eyes causing blindness, kidneys nephritis and brain causing paralysis.

Hypertension is caused by several factors like arteriosclerosis, atherosclerosis, obesity, physical and emotional stress, alcoholism, smoking, cholesterol rich diet, increased secretion of rennin, epinephrine and aldosterone etc.

Very scanty work has been done in relation to age, body mass index and cardiovascular parameters therefore this study was designed to investigate the relationship between body mass index and cardiac parameters among obese and non obese along with their age among Nool village Taluka Gdhinglaj, District Kolhapur, Maharashtra North East India.

## 2. MATERIAL AND METHODS

### 1. Assessment of BMI and classification

BMI was calculated as per WHO norms. It is calculated as the weight in kilograms divided by the square of the height in meters (kg/m<sup>2</sup>). BMI is age-independent and the same for both sexes.

$$\text{Body Mass Index} = \frac{\text{kg in Body weight}}{\text{Height m}^2}$$

A cross-sectional study was carried out among 125 age ranging from 10 to 80 years. The subjects were divided into five different age groups with ten years interval each to study the age trend of height, weight, BMI, and BP. Door-to-door survey was carried out to collect data. The subjects were selected from Nool villages in Kolhapur district of Maharashtra Northeast India.

According to WHO a lower limit of normal BMI in Indians as the risk associated with diabetes and cardiovascular diseases occurs at lower levels of BMI. The WHO suggested BMI categories are as follows.

BMI	Range
18.5–23 kg/m <sup>2</sup>	underweight
over 25 kg/m <sup>2</sup>	overweight
over 30 kg/m <sup>2</sup>	obese

The population of Nool is 10,000 and literacy rate is 80%. Traditionally, the main source of income is agriculture.

The main food of the Nool people is rice, bajari, wheat. Most of them take lesser sweets, oily foods and milk products and leafy vegetables. Their salt intake is usually moderate. Young people often indulged in junk food and soft drinks. Nutritional transition characterized by growing intake of fat-rich diet, processed and fast food culture was observed among the subjects in younger age groups.

### 2.1. Assessment of Blood Pressure and Pulse rate

Automatic blood pressure monitor (OMRON) was used to measure blood pressure. The subject was asked to sit relaxed in a chair with her/his arm supported comfortably. The measurement was repeated twice with five-minute interval and the average taken for accuracy. Blood pressure was classified as follows,

Blood pressure	Range
120/80mmHg	Normal
120–139/80–89mmHg	stage I hypertension
140–159/90–99mmHg	stage II hypertension
above 160/100mmHg	hypertension

WHO suggests, the risk associated with diabetes and cardiovascular diseases occur at fluctuated levels of BMI which can be attributed due to body fat allotment;

Pulse pressure was calculated by calculating the difference between the systolic and diastolic blood pressure. Second, pulse rate was measured by palpation of radial pulse.

Obtained results were reported as means and standard deviation.

## RESULT AND DISCUSSION

### 1. Body mass index

Basic data and BMI five different age groups with mean and standard deviations are displayed in Table 1 and Fig.1. The percentage composition of BMI in different age groups gradually found to be increased with 12%, 19%, 22%, 19% and 28% showed in (Fig. 2). The mean value for height was found to be highest in the youngest 31–40 years. Body weight was found to be highest among 31–40 age group and above 50 age group.

The current study revealed increased mean body mass index in 31-40 and above 50 age group in both male and female. The proportion of obese patients increased across age groups and peaked at 31-40 years. The results of this study about increasing BMI with age is consistent with Ataei, [2004] who studied 5 to 15 years old and adolescents and showed that BMI increases with age. Also, these results in accordance with Chathuranga and Prasanna, [2013] who investigated relationship between Body mass index (BMI) and body fat percentage, estimated by impedance, in a group of Srilankan adults revealed regression line found to be curvilinear in nature at higher BMI values where females ( $p < 0.0001$ ) having a better fit of the curve compared to males ( $p < 0.05$ ). In both genders, with increase of age, BMI seemed to increase in curvilinear fashion.

## 2. Cardiovascular parameters

Basic data and blood pressure in five different age groups with mean and standard deviations are displayed in Table 2 and Fig.3. The percentage composition of blood pressure in different age groups gradually found to be increased with 19%, 19%, 19%, 21% and 22% showed in Fig. 4. Thus, in relation to the comparison of systolic blood pressure among obese and non obese male and female the findings revealed that there is significant statistical difference between obese male and female, so systolic blood pressure is slightly higher in male than female and it was found to be increased in above 50 age group similar line of results were found by Alireza (2011), Bose (2005) and Burke (2004 ) that revealed the systolic reading was more significant in the males 21.5% vs. 3.5% in females with BMI over  $25\text{kg/m}^2$ .

Correlation analyses between BMI and BP showed significant positive correlations between them. When the mean systolic and diastolic blood pressures among different BMI categories were evaluated, it was found that mean systolic and diastolic blood pressure increased with increasing BMI from lowest BMI to the highest BMI category. Both systolic and diastolic BP increased with increase in BMI level. Significant correlation of BMI with blood pressure was also found by [S. S. Kapoor, 2000]. Positive associations between BMI and BP have also been reported in other Indian populations by [R. Gupta, S. Guptha, V. P. Gupta, and H. Prakash1995, K. Tandon, 2006]. There is a positive association between increasing body mass index and blood pressure (BP) in populations reported by, Frost et al.,[1991], Because hypertension is a leading risk factor for cardiovascular disease (CVD) globally studied by [Donnell et al, 2010 and Yusuf et al., 2004].

Table No. 1: Average BMI in different age group.

Sr. No.	Age group	BMI
1	10-20	18.50367±4.114195
2	21-30	20.03304±2.876844
3	31-40	23.0364±4.840745
4	41-50	22.82043±4.48658
5	Above 50	23.84222±4.280361

Table No. 2: Average BMI in different age group.

Sr. No.	Age group	BP(Systolic)	BP(Diastolic)	Pulse rate	Range
1	10-20	116.56±11.4276	67.08±10.61414	83.04±18.19679	Normal
2	21-30	117.4783±11.25276	72.30435±8.209943	87.04348±12.21206	Normal
3	31-40	122.36±12.15483	79.6±10.82051	86.2±12.8582	Normal
4	41-50	134.2609±17.07262	82.30435±13.93307	86.69565±23.15056	Stage I Hypertension
5	Above 50	140.1481±19.57177	77.62963±10.32602	79.44444±12.65012	Stage II Hypertension

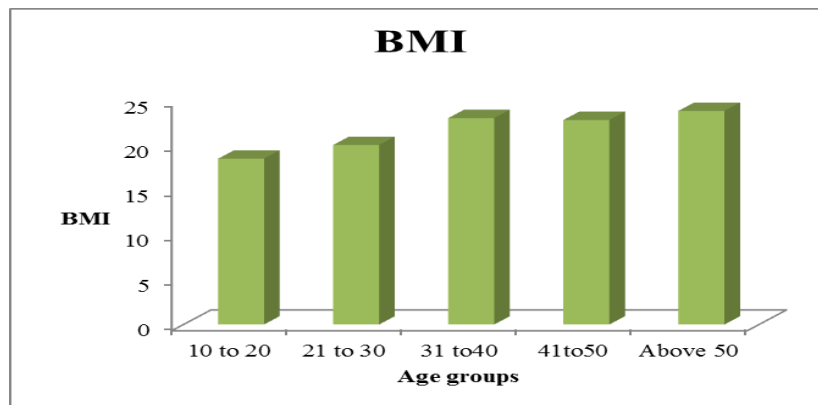


Fig. 1 Graphical representation of body mass index in different age groups.

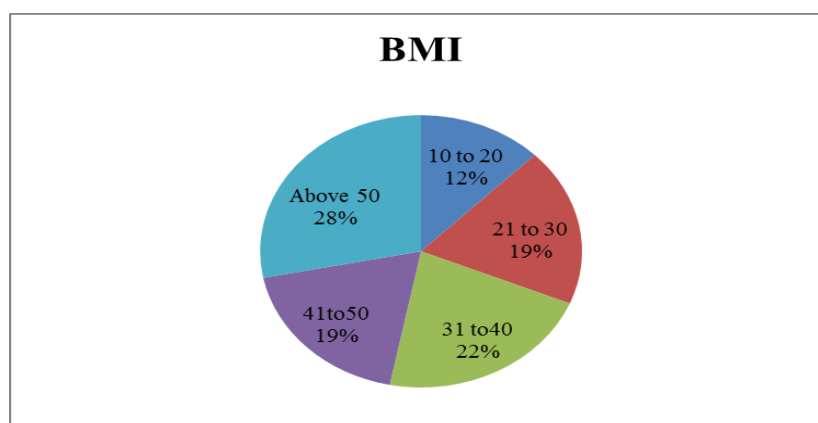
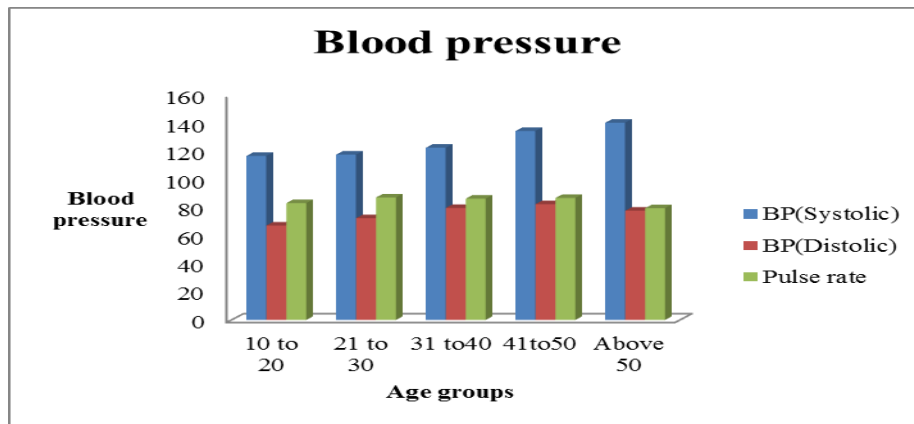
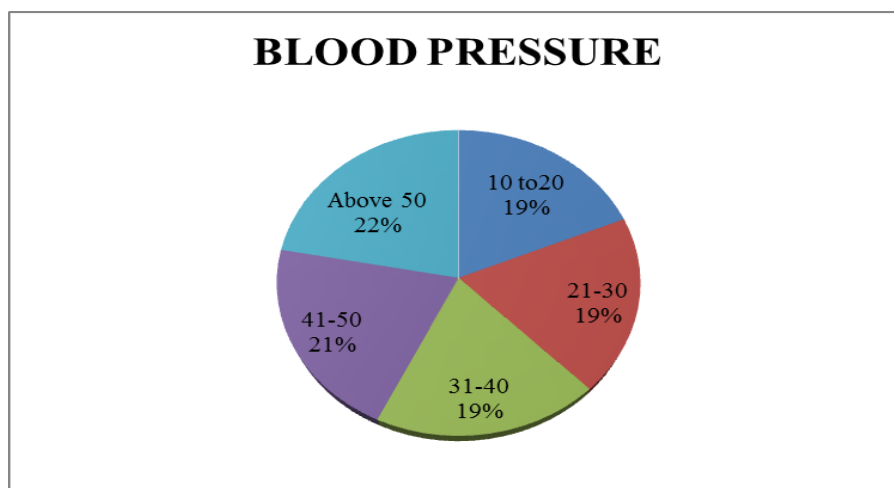


Fig. 2 Percentage of body mass index in different age groups.



**Fig. 3:** Graphical representation of blood pressure in different age groups.



**Fig. 4:** Percentage of blood pressure in different age groups

## CONCLUSION

The study demonstrated that body mass index is closely associated with both systolic and diastolic blood pressure. BP is also associated with rising age independently. Though the degree of correlation differed, there was positive and significant correlation among BMI, age, systolic and diastolic blood pressures. The risk of hypertension was higher among population groups who were overweight or obese. There were great numbers of hypertensive subjects, especially in stage I age group 31-40. Although established populations around the world were often believed to have low blood pressure, gradually with changing socioeconomic environment, marked increase in blood pressure and overweight or obesity level has been noted.



Finally, the current study showed that the stress was going to increased in all age groups resulting hypertension and if the stress level constantly increased they may be suffering from coronary heart diseases, diabetes, dysrhythmias, stroke and cerebral hemorrhage.

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