Original Research Article

A comparative study of effect of body mass index on blood pressure level in obese and non-obese individuals

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Abstract

Background: The aim of present study is to find out the effect of body mass index (BMI) on blood pressure level in obese subjects in comparison with the non-obese subjects. We also assessed the relationship of general and central obesity measurement tools like-(BMI, WC, WHpR, WHtR, body fat percentage and SubScapular skinfold thickness) with the systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in an obese individuals. **Materials & methods:** Study included 400 adult subjects both males and females comprising 200 non-obese and 200 obese subjects. 200 obese adults (consisting of 118 adult subjects with BMI≥30kg/m^2 and 82 adult pre-obese /overweight subjects with BMI ≥25 to 29.99 kg/m^2) subjects within the age group of 30 to 60 years who were attending OPDs in tertiary care hospital. 200 non-obese adults (BMI ≥ 18.50 to 24.99 kg/m^2) were selected on voluntarily participation from employees. Anthropometric measurement and blood pressure were recorded. **Results:** In 200 obese (pre-obese/overweight + obese) and 200 non-obese subjects, the mean values of age in obese subject was (mean 45.96+8.38 years) compared with the mean values of age of non-obese subjects (mean 44.87+9.41years) with the help of unpaired t- test, we can conclude that there was no statistically significant difference seen in the age of participants between the two groups. It was found that the mean value of body fat % and subscapular skinfold thickness of obese subjects was significantly higher than that of non-obese subjects The mean value of waist circumference (WC), waist to hip ratio (WC/HIP) and waist to height ratio (WC/HT) in obese subjects was found to be 100.65+6.80cm, 0.95+0.04 and 0.62+0.04 where as in non-obese subjects it was 86.41+6.62cm,0.91+0.05 and0.52+0.04respctively,when unpaired t test was applied it was found that the mean values of above 3 parameters were significantly higher in obese than that of non- obese subjects. SBP, DBP and MAP has positive association with each anthropometric parameters in obese subjects .i.e. increase in any above mentioned anthropometric parameters in obese population of our study leads to further consistent increase in SBP, DBP and MAP. **Conclusion:** There is a necessity of creating awareness regarding overweight and obesity and related chronic disease like hypertension which would otherwise become emerging problem in the near future. So, that clinicians should counsel their patients to maintain a healthy BMI or lose weight if they are overweight or obese in order to reduce the future risk of HTN and subsequent CVD.

Key words: Body Mass Index, Blood Pressure, Obese

Introduction

21st century is a century of great changes. In the 21st century, changes were noted not only in science and technology but also in the life style of its inhabitants. Changes in the life style made life easier and marked the beginning of certain chronic ailments such as osteoarthritis, cardiovascular disorders, hypertension and obesity. Obesity is not just limited to urban and affluent society but also affects the rural places and persons belonging to the lower socioeconomic strata as well[1]. Overweight and Obesity is defined as excess body weight or fat accumulation in the body to the extent that health may be impaired. It may lead to reduced life expectancy and increased life problems[2].

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According to World Health Organization (WHO) overweight is defined as BMI>25-29.99kg/m^2 and obesity as BMI >30kg/ m^2 [3] (Body Mass Index) BMI not only identifies obesity but also person in pre-obese stages[1]. It is simple index of weight for height that is commonly used to classify underweight, overweight and obesity in adults[3] Nowadays, obesity has become a chronic disorder affecting the larger population than any other disease in the world. It mostly affects the adult population but children and adolescent are also prone to develop obesity. According to the WHO nearly 20 to 40 % of adult population and 10 to 20 % of children are affected by obesity [1]. Developing countries are increasingly faced with a double burden of hypertension and other cardiovascular diseases, along with infections and malnutrition[4]. The term 'blood pressure' means the force exerted by the blood against any unit area of the vessel wall. If this force is very high beyond certain limits, a condition known as hypertension or high blood pressure occurs. High blood pressure usually may have no symptoms. In fact, many people have high blood pressure for years without knowing it. That is why it is called as the "Silent killer'[5]. A number of important contributory factors for hypertension have been identified, including overweight/obesity, excessive dietary sodium intake, low physical activity, smoking, and high alcohol intake[6] . According to WHO considering prevalence of

any disease hypertension ranks 4th in the world. It is directly responsible for 57% of stroke death & 42% of coronary heart disease death in India[7]. A recent analysis of worldwide data from different regions estimated that the total number of adults with hypertension in 2000 was 972 million of which 333 million adults were from countries with established market economies and 639 million were from economically developing countries. This proportion will increase by 60% i.e. 1.56 billion by the year 2025. The magnitude of the hypertension burden contributes to predict a worldwide cardiovascular disease epidemic[8]. Obesity and hypertension are increasing in parallel across populations along with their degree of development and acculturation[4]. Weight gain in adult life especially seems to be an important risk factor for the development of hypertension[9]. Different anthropometric measurements like body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHpR), waist-to-height ratio (WHtR), subscapular skinfold thickness (SSF) or triceps skin fold (TSF) measurement as a part of index of trunk or peripheral skin folds are investigated for the purpose of assessment of patients with elevated blood pressure[10]. So, the aim of present study is to find out the effect of body mass index (BMI) on blood pressure level in obese subjects in comparison with the non-obese subjects. And also we assessed the relationship of general and central obesity measurement tools like-(BMI, WC, WHpR, WHtR, body fat percentage and SubScapular skinfold thikness) with the systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in an obese individuals.

Material and methods

The study was conducted in a major teaching college and hospital in Mumbai with prior permission of Dean and ethical committee of the institute and approval from university.

The study was undertaken over a period of 1year in a tertiary care hospital in Mumbai and included 400 adult subjects both males and females comprising 200 non-obese and 200 obese subjects.

Selection criteria for obese subjects

200 obese adults (consisting of 118 adult subjects with BMI$\geq$30kg/m^2 and 82 adult pre-obese /overweight subjects with BMI $\geq$25 to 29.99 kg/m^2) subjects within the age group of 30 to 60 years who were attending OPDs in tertiary care hospital.

Selection criteria for non-obese subjects

200 non-obese adults (BMI $\geq$ 18.50 to 24.99 kg/m^2) were selected on voluntarily participation from employees.

Inclusion Criteria For cases

1) 200 obese subjects within the age group of 30 to 60 years selected randomly from both the sexes.

2) BMI of person $\geq$25 to 29.99kg/m^2 as pre-obese/overweight subjects. (according to WHO classification)

3) BMI of person $\geq$30kg/m^2 as obese subjects. (according to WHO classification)

For controls

1) 200 non-obese, normotensive and healthy subjects within the age group of 30 to 60 years selected from both the sexes.

2) BMI of person $\geq$18.50 to 24.99 kg /m^2 (according to WHO classification).

Exclusion Criteria

a) Age < 30 and > 60 years.
b) Subjects having any history of diabetes, any drug addiction and psychiatric illness.
c) Pregnant woman in all trimesters.
d) Subject with endocrinal disorders such as – hypothyroidism, Cushing's syndrome.
e) Subject having polycystic ovarian disorder (PCOD)
f) Subjects who were on chronic steroid therapy.
g) Alcoholics and smokers.
h) Any other medical and surgical condition known to affect blood pressure

Method

For this study subjects were divided basically into two groups, obese and non-obese. In obese group further included 118 adult subjects with BMI$\geq$30kg/m^2 and 82 adult pre-obese /overweight subjects with BMI $\geq$25 to 29.99 kg/m^2. The purpose of the study and brief explanation of the tests to be performed on them was explained to the subjects in their own language. Written informed consent was taken from both of them (case and controls). Procedure of each test was explained to all subjects in their own language immediately prior to each test.

Anthropometric measurement and blood pressure were recorded as follows.

1. Height (Ht)

Height was measured in standing position of the subject, with the subject looking straight ahead, with joined feet (without shoes) and arms hanging on both sides., and marking the subject to stand straight against an even wall. It was measured by a plastic measuring tape in centimeters. A sliding wooden head piece is used for accurate work. Height was recorded nearest to 0.5cms[11].

2. Weight (Wt)

Body weight of all the subjects (wearing light clothing and without any footwear) was measured by using standardized weighing machine, which is calibrated in kilograms. Weight was taken to the nearest 0.5 kg[11].

3. Body Mass Index (BMI)

It was determined by 'Quetlet's index i.e.

Quetlet's index = Body weight in kg / Height^2 in meter[3].

4. Body Fat Percentage

It was measured by Omron's body fat monitor as follows –Body fat percentage was measured by the bioelectric impedance method by using an Omron hand held bioelectric impedance analyzer which measures the hand to hand impedance. The height, weight, sex and age of the subjects were entered into the instrument, they were asked to hold the instrument in both hands. While taking above reading subjects were in a standing position and after that, the digital reading of the body fat percentage was recorded[12].

5. Waist circumference

Waist circumference was measured with a plastic measuring tape, of a subjects in his standing position. The following anatomical landmarks were used: laterally, midway between the lowest portion of the rib cage and iliac crest, and anteriorly midway between the xiphoid process of the sternum and the umbilicus. Nearest to 0.5 cms circumference was taken[11].

6. Hip circumference

The subject assumes a relaxed standing position with feet should be close together and the arms folded across the thorax. Measurement was taken at the level of greatest posterior protuberance of the buttock which usually corresponds anteriorly to about the level of symphysis pubis. While taking this measurement tape should be in a horizontal position. Measurement should be taken in cm. [13]

7. Waist – Hip Ratio

The measured waist circumference was divided by the hip circumference to determine the waist to hip ratio of the subject[11].

8. Waist to Height Ratio

It was measured by dividing subjects measured waist circumference with his/her measured height[5].

9. Sub scapular skinfold thickness

While taking this measurement subject was in a relaxed standing position with the arms hanging by the side. The skin fold was raised with left thumb and index finger and then measured by making a pinch 2 cm along a line running laterally and obliquely downward from inferior angle of scapula at about 45 degree. While taking this thickness subject was exposed up to the waist and measurement was taken by using Vernier caliper. This measurement was taken in cm [13].

10. Measurement of blood pressure

Blood pressure was measured in right arm in sitting posture, with the subject in a relaxed state. Standardized mercury sphygmomanometer with adult size cuff was used. The first appearance of (phase 1 of korotkoff sounds) sound was used to define systolic blood pressure (SBP). The disappearance of sound (phase 5) was used to define diastolic blood pressure (DBP). Two readings were taken five minutes apart, and the average of the two readings was taken as the final blood pressure reading. A person was considered to be a hypertensive if he/she was an already diagnosed as a case of hypertension and on treatment or had current SBP ≥ 140 mm of Hg and DBP ≥ 90 mm of Hg (according to JNC VII criteria)[14]

11. Mean arterial blood pressure (MAP)

It was calculated as follows- Mean arterial pressure = diastolic blood pressure + 1/3rd pulse pressure. Its values corresponds to the level of blood pressure as follows – >106.7mmHg considered as a hypertension, 93.3 to 106.7mmHg as a intermediate MAP, and < 93.3mmHg as a normal MAP[15].

Statistical analysis

Statistical analysis was done by using SPSS software version17.Descriptive statistics i.e. mean and standard deviation was used for numerical data. Comparison of numerical variables among groups was done by using unpaired t- test. Statistical analysis was also done by using Pearson correlation test. P-value<0.05 was considered as statistically significant.

Result

In the present study, test was applied on various anthropometric parameters like (Body mass index, body fat percentage, waist circumference, waist circumference to hip ratio, waist circumference to height ratio and subscapular skinfold thickness to compare and correlate their effect on various blood pressure parameters like (systolic blood pressure, diastolic blood pressure and mean arterial blood pressure) in obese subjects. The study involved 400 age matched subjects out of which 200 were obese subjects (pre-obese/overweight + obese subjects with BMI≥25 kg/m^2) and 200 were healthy non-obese subjects. (Controls).

TABLE 1:- COMPARISON OF AGE, ANTHROPOMETRIC AND BLOOD PRESSURE PARAMETERS OF OBESE (PRE-OBESE + OBESE) AND NON-OBESE GROUPS.

STUDY PARAMETER	OBESE (N=200) Mean±SD	NON-OBESE (N=200) Mean±SD	t-VALUE	P -VALUE
AGE	45.96±8.38	44.87±9.41	1.223	**0.222(NS)**
BMI	30.99±3.41	21.759±1.75	32.279	**0.000(S)**
BF%	40.06±5.77	27.60±4.38	24.324	**0.000(S)**
SSSFT	2.31±0.269	1.80±0.31	17.173	**0.000(S)**
WC	100.65±6.80	86.41±6.62	21.198	**0.000(S)**
WC/HIP	0.95±0.04	0.91±0.05	7.583	**0.000(S)**
WC/HT	0.628±0.04	0.527±0.047	21.837	**0.000(S)**
SBP	147.25±11.93	111.83±6.11	18.155	**0.000(S)**
DBP	92.99±8.65	76.75±4.63	15.937	**0.000(S)**
MAP	111.07±8.93	88.439±3.90	18.090	**0.000(S)**

Above table shows the mean values of age, various anthropometric parameters like- Body mass index (BMI), body fat percentage, waist circumference, waist to hip ratio, waist to height ratio, subscapular skinfold thickness, and also blood pressure parameters like – systolic blood pressure, diastolic blood pressure and mean arterial blood pressure with their standard deviation in obese and non-obese group. On analysis of the above table it was observed that, in 200 obese (pre-obese/overweight + obese) and 200 non-obese subjects, the mean values of age in obese subject was (mean 45.96±8.38 years) compared with the mean values of age of non-obese subjects (mean 44.87±9.41years) with the help of unpaired t- test, we can conclude that there was no statistically significant difference seen in the age of participants between the two groups. The mean value of body mass index (BMI) in obese subjects was 30.99±3.41kg/m^2 whereas in case of non-obese subjects it was 21.75±1.75kg/m^2. When the unpaired t - test was applied it was found that the body mass index of obese subjects was significantly higher than that of non-obese subjects. The mean value of body fat % and subscapular skinfold thickness in obese subjects was 40.06±5.77% whereas in non-obese subjects it was 27.60±4.38% and in obese subjects was 2.31±0.26cm and in case of non-obese subjects it was 1.80±0.31cm. respectively. When the unpaired t - test was applied it was found that the mean value of body fat % and subscapular skinfold thickness of obese subjects was significantly higher than that of non-obese subjects The mean value of waist circumference (WC), waist to hip ratio (WC/HIP) and waist to height ratio (WC/HT) in obese subjects was found to be 100.65±6.80cm, 0.95±0.04 and 0.62±0.04 where as in non-obese subjects it was 86.41±6.62cm, 0.91±0.05 and 0.52±0.04 respectively, when unpaired t test was applied it was found that the mean values of above 3 parameters were significantly higher in obese than that of non- obese subjects. The mean systolic blood pressure, diastolic blood pressure and mean arterial blood pressure of obese group was found to be 147.25±11.93mmHg 92.99±8.65mmHg and 111.07±8.93mmHg respectively and in non-obese group was 111.83±6.11mmHg 76.75±4.63mmHg and 88.43±3.90mmHg respectively. When the unpaired t - test was applied it was found that the systolic blood pressure, diastolic and mean arterial blood pressure of obese subjects was significantly higher than that of non- obese subjects.

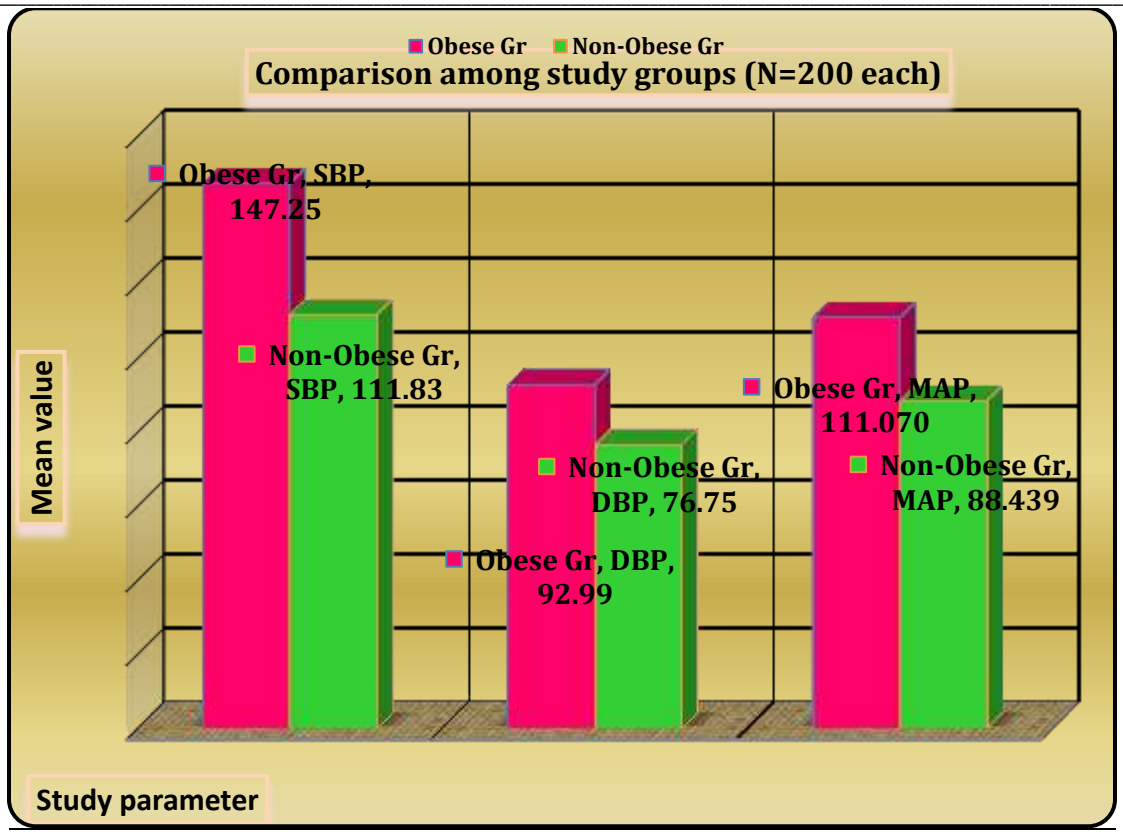

Fig 1: Comparison of mean values of blood pressure parameters (systolic blood pressure, diastolic blood pressure and mean arterial blood pressure) among obese and non-obese group.

TABLE 2:-CORRELATION OF ANTHROPOMETRIC PARAMETERS WITH BLOOD PRESSURE PARAMETERS IN OBESE GROUP (N=200, PRE-OBESE/OVERWEIGHT+OBESE SUBJECTS

PARAMETERS	SBP	DBP	MAP
BMI	.399(**)	.424(**)	.452(**)
WC	.441(**)	.460(**)	.493(**)
WC/HT	.266(**)	.249(**)	.279(**)
WC/HIP	.335(**)	.352(**)	.377(**)
SS SFT	.166(*)	.181(*)	.191(**)
BODY FAT%	.230(**)	.193(**)	.228(**)

**Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The above table shows that in our study correlation was done in between BMI (Body Mass Index) and various blood pressure parameters like- systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese subjects. it has been observed that there was positive correlation present between Body mass index (BMI) and various blood pressure parameters (i.e. SBP, DBP and MAP) in obese subjects and this positive correlation was found to be statistically significant(p- value <0.01). There was positive correlation present between body mass index and systolic blood pressure (r value 0.399). There was positive correlation seen in between body mass index and diastolic blood pressure (r value 0.424) and also positive correlation present between body mass index and mean arterial blood pressure (r value 0.452). So, from above table it has been observed that increase in body mass index causes further consistent increase in SBP, DBP and MAP in obese group.

In our study correlation was done in between waist circumference (WC) and various blood pressure parameters like systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese subjects. On analysis of above table it has been observed that there was positive correlation present between waist circumference and BP parameters (SBP, DBP and MAP) in obese group and this positive correlation was found to be statistically significant (p- value <0.01). There was positive correlation present between waist circumference and systolic blood pressure (r value 0.441). There was positive correlation seen in between waist circumference and diastolic blood pressure (r value 0.460) and also between waist circumference and mean arterial blood pressure (r value 0.493).,),In above study correlation was done in between waist circumference to height ratio i.e. WHtR with various blood pressure parameters like- systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese subjects. On analysis of above table it has been observed that there was positive correlation present between waist circumference to height ratio WHtR and various blood pressure parameters (i.e. SBP(r=0.266), DBP (r=0.249)and MAP(r=0.279)) in obese subjects and this positive correlation was found to be statistically significant (p- value <0.01)., the above table shows that correlation was done in between waist circumference to hip ratio (WHpR) and various blood pressure parameters like- systolic blood pressure (SBP), diastolic

blood pressure (DBP) and mean arterial blood pressure (MAP) in obese subjects. On analysis of above table it has been observed that there was positive correlation present between waist circumference to hip ratio (WHpR) and various blood pressure parameters (i.e.SBP(r=0.335), DBP(r=0.352) and MAP(r=0.377)) in obese subjects and above positive correlation was found to be statistically significant (p- value <0.01) in our study correlation was done in between subscapular skinfold thickness (subscapular SFT) and various blood pressure parameters like - systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese subjects. On analysis of above table it has been observed that there was positive correlations present between subscapular skinfold thickness and various blood pressure parameters (SBP, DBP and MAP) in obese subjects. There was positive correlation present between subscapular skinfold thickness and systolic blood pressure (r value 0.166) and this correlation was found to be statistically significant (p value< 0.05) There was positive correlation seen between subscapular skinfold thickness and diastolic blood pressure (r value 0.181) and this correlation was found to be statistically significant (p value< 0.05). There was positive correlation also seen in between subscapular skinfold thickness and mean arterial blood pressure (r value 0.191) and this correlation was found to be statistically significant (p value< 0.01). in above table correlation was done in between Body fat percentage (Body fat %) and various blood pressure parameters like- systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure in obese subjects. On analysis of above table it has been observed that there was positive correlation present between Body fat percentage (Body fat %) and various blood pressure parameters (i.e. SBP(r=0.230), DBP(r=0.193) and MAP(r=0.228)) in obese subjects. and above positive correlation was found to be statistically significant (p- value <0.01).

So, from above table it has been observed that SBP, DBP and MAP has positive association with each anthropometric parameters in obese subjects .i.e. increase in any above mentioned anthropometric parameters in obese population of our study leads to further consistent increase in SBP, DBP and MAP.

Discussion

Our findings (table1) are in accordance with J. Kaur et al.(2013)[5], D.Sarkar et al (2009)[16], M.T. Guagnano et al.(2003)[17] and D. A. Santos silva et al.(2012)[18].According to them in obese subjects there was increase in waist circumference (WC), waist-height ratio (WHtR), waist-hip ratio (WHpR), body mass index (BMI) and subscapular skinfold thickness takes place and later on this obesity causes potential detrimental effect on blood pressure and leads to increase in cardiovascular event. Hyperinsulinemia and leptin released from adipose tissue in case of obese subjects play an important role in the development of hypertension in such a way that, insulin and leptin increases sympathetic tone,which results in sodium retention and hyper responsiveness of blood vessels and later on, causes the development of hypertension in obese individuals. Our findings are also in accordance with the findings of Sara L. Shuger et al(2008)[6], A.I. Uhernik et al(2009)[19],G. Berglund et al(1982)[20], D. Sarkar et al(2009)[16], Adedoyin et al (2008)[21]and S.S. Todakar et al.(2009)[7]. According to them these effects of development of hypertension in obese individuals are because of complex interactions present between metabolic and neurohormonal pathways may be the underlying mechanism by which hypertension develops. Insulin resistance, the renin–angiotensin–aldosterone system, and sympathetic tone may get altered by increase in body mass index (BMI), and these alterations may play a causative role in the development of increase in blood pressure among persons who are obese.

In our study (table no.2) we have done correlation of body mass index (BMI) with blood pressure parameters like- systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese group. There was positive correlation seen between BMI and systolic blood pressure (r value0.399) BMI and diastolic blood pressure (r value 0.424) and BMI and mean arterial blood pressure (r value0.452) and above positive correlation was found to be statistically significant (p- value<0.01). Our study is in accordance with the P.Kokiwar et al (2011)[22],R.Chakraborty et al.(2009)[23], R. Gupta et al.(2007)[24] and Kanviroopa shekharppa et al (2011)[25] they also found similar positive correlation of body mass index (BMI) with systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) i.e. increasing BMI values was associated with increase in levels of SBP,DBP and MAP. According to them this is because of factors linking obesity to increase in BP includes the increment in total blood volume and cardiac output that is caused in part by the increased metabolic demand induced by excess body weight and also mechanisms linking obesity and an increase in peripheral vascular resistance is endothelial dysfunction, insulin resistance, increased sympathetic nervous system activity, substances released from adipocytes (IL-6, TNF) they showed in their study that obese subjects have increased sympathetic nerve activity, increased insulin levels and increased activity of the renin–angiotensin-aldosterone system. In our study there was positive correlation seen between waist circumference and blood pressure parameters like- systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) in obese group. Our findings are similar with Paul Poirier et al. (2005)[26],D. Sarkar et al.(2009)[16] , R.Gupta et al (2007)[24] and A.I.Uhernik et al(2009)[19]. In our study there was positive correlation seen between waist circumference to height ratio (WC/HT) and blood pressure parameters (SBP, DBP and MAP) in obese group which is in accordance with findings of D. Sarkar et al. (2009)[16] and Choy-Lye Chei et al(2008)[27]. In our study there was positive correlation seen between waist circumference to hip ratio (WC/HIP) and blood pressure parameters (SBP, DBP and MAP) in obese group. Our findings are in accordance with the Choy Lye Chei et al. (2008)[27] P. Kokiwar et al. (2011) [22] and R. Gupta et al. (2007) [24]. They found similar positive correlation in between waist circumference to hip ratio and blood pressure parameters in their study. On the contrary Roberta S.L. Cassani (2009) [28] found that waist to hip ratio was not significantly associated with BP parameters. In our study there was positive correlation seen between subscapular skinfold thickness and blood pressure parameters (SBP, DBP and MAP) in obese group. Our findings are similar to the findings of Roberta S.L. Cassani et al (2009) [28] and Choy Lye Chei et al (2008) [27] according to them it is because of centrally located fat has good positive correlation with blood pressure. In our study there was positive correlation seen between body fat percentage and blood pressure parameters (SBP, DBP and MAP) in obese group. Our findings are similar to the findings of D.A.Santos Silva et al(2012)[18] according to them it is because of body fat percentage have high correlation with body fat and high or excess body fat is strongly associated with hypertension in obese group.

Conclusion

To summarize all anthropometric parameters were higher in obese group as compared to non obese group. The systolic, diastolic and mean arterial blood pressure was higher in obese subjects as compared to non obese subjects. In our study in case of obese group waist circumference was positively associated with blood pressure parameter i.e. systolic, diastolic and mean arterial blood pressure when compared to all other anthropometric parameter. Thus waist circumference was more predictable factor for development of hypertension in obese group in our study. This study also indicates that positive association of other anthropometric parameter with blood pressure parameter. Overwight and obesity now a day become major public health problem. So, there is a necessity of creating awareness regarding overweight and obesity and related chronic disease like hypertension which would otherwise become emerging problem in the near future. So, that clinicians should counsel their patients to maintain a healthy BMI or lose weight if they are overweight or obese in order to reduce the future risk of HTN and subsequent CVD.

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