International Journal of Physiology, Health and Physical Education
www.physiologyjournals.com
Online ISSN: 2664-7273, Print ISSN: 2664-7273
Received: 26-07-2021, Accepted: 10-08-2021, Published: 26-08-2021
Volume 3, Issue 1, 2021, Page No. 1-8

Relationship between blood pressure and body composition of male and female faculties of Guru Ghasidas University, Bilaspur, Chhattisgarh

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Abstract
This study investigates the relationship between blood pressure and body composition of male and female faculties of Guru Ghasidas University, Bilaspur, C.G. It was not very clear how blood pressure was affected by such factors as body mass index, waist circumference, waist-to-hip ratio and percent body fat. To this study was formulated for testing. In this study population consists of 202 male and 63 female faculties of GGV University, Bilaspur (C.G) in 2016-2017 academic session. The male faculties average age was 39.47 years and female faculties average age was 37.70 years.. The Omron digital blood pressure monitor, a flexible measuring tape, digital weighing scale, stadiometer and Harpenden skinfold calliper were used to collect data on blood pressure, waist and hip circumferences, body weight, height and three skinfolds from both genders respectively. While waist to hip ratio and body mass index were determined, percent body fat was calculated from total skinfolds and gender specific body density formula. The data was imputed into the system and was analysed using the Pearson Product Moment Correlation Coefficient (SPSS 16 for Windows) to determine relationship between the variables at 0.05 level of significant. Major findings of the study revealed that: relationship between systolic and diastolic blood pressures was positively significant among the male and female faculties in this study; relationship between systolic blood pressure and body mass index was positively significant among the male and female faculties in this study; relationship between diastolic blood pressure and body mass index was positively significant among the male and female faculties in this study and relationship between waist circumference and body mass index was positively significant among the male and female faculties in this study. The relationship between systolic blood pressure and diastolic blood pressure was positively significant with waist circumference, percent body fat and waist-to hip ratio of the male and female faculties in this study. On the basis of these findings, it was therefore recommended that since high blood pressure is a silent killer disease; adults should be encouraged to participate in at least moderate intensity physical activity three to five times per week throughout life.

Keywords: body composition, blood pressure, waist circumference, percent body fat, body mass index, waist-to hip ratio

Introduction

Body Composition

In physical fitness, body composition is used to describe the percentage of fat, bone, water and muscle in human bodies. Because muscular tissue takes up less space in our body than fat tissue, our body composition, as well as our weight, determines leanness.

Excess fat in relation to lean body mass, known as altered body composition, can greatly increase your risk to cardiovascular disease, diabetes, and more BIA fosters early detection of an improper balance in your body composition, which leads for earlier intervention and prevention.

A healthy lifestyle including a well maintained diet and adequate physical activity can produce many health benefits and increase quality of life. Some of these health benefits include a decrease in risk and improve conditions in cardiovascular disease, diabetes, metabolic disease, osteoporosis and a host of other diseases. Regular physical activity and maintenance of a healthy body composition can also improve ability to perform activities of daily life, increase energy and help to maintain cognitive function and decrease stress.

Body Mass Index

Weight and height are the subsets of body mass index (BMI) in anthropometric measurement; similarly, body mass index is a ratio of total body weight to height expressed as kilogramme per metre square (Wt/Ht^2). This ratio is also known as Quetelet index. Calculated body mass index can then be compared against table values to determine whether the individual has acceptable body weight, overweight or obese.

Waist to Hip Ratio

Computation of waist-to-hip ratio was suggested as a way to estimate the risk pattern of fat distribution. Research has shown that the waist-to-hip ratio (WHR) is a stronger predictor for diabetes, coronary artery disease, and overall morbidity risk than body weight, body mass index, or percent body fat as reported by White, *et al;* (1986) [1].

Percent Body Fat

The most widely used anthropometric estimation of body size or composition involves the measurement of skinfolds at selected

sites. Skinfolds (or fatfolds) are the double thickness of skin plus the adipose tissue between the parallel layers of skin. Technically, however, adipose tissue (and hence the subcutaneous fatfolds) have both fat and fat free components. The fat free component is composed of water, blood vessels, nerves, tendons, cartilage, ligaments and bones.

Blood Pressure

In all parts of the system, blood flow is always from a region of higher pressure to one of lower pressure. The pressure exerted by any fluid is termed hydrostatic pressure. In the cardiovascular system, this denotes the force exerted by the blood against any unit area of the walls of the blood vessels (Vander, *et al;* 2001; Musa, *et al;* 2001 and Hlaing, *et al;* 2001) [2, 3]. Pressure is the force generated in the blood by the contraction of the heart, and its magnitude varies throughout the system (Butkap, 2002) [4].

High blood pressure (HBP), also called hypertension is a sustained elevation of the systemic arterial pressure It is both a risk factor for coronary heart disease and disease by itself. Blood pressure is usually categorised as follows:

1. Normal category in which systolic blood pressure (SBP) is less than 130mm Hg and diastolic blood pressure (DBP) is less than 85mm Hg.
2. High normal category in which systolic blood pressure is between 130mm Hg and 139mm Hg and diastolic blood pressure is between 85mm Hg and 89mm Hg.
3. High or severe category in which systolic blood pressure is 140mm Hg and higher and diastolic blood pressure is 90mm Hg and higher (United States Department of Health and Human Services, 1996 in Heyward)

There are several factors associated with the incidence of high blood pressure. Some of these factors are like hereditary, family background, age and sex which are beyond one's control. There are factors that are modifyable like diet, exercise, sleep, consumption of fatty diet, obesity, overweight and cigarette smoking. Exercise physiologists attempt to use different forms of exercise as an intervention to prevent the incidence of overweight and obesity. Appropriate, adequate and timely intervention can be beneficial and effective only when it is based on the relationship between blood pressure and different modifyable risk factors.

This study was therefore conducted to determine the relationship between blood pressure and body composition of male and female faculties of GGV University, Bilaspur (C.G). It was not very clear how blood pressure was affected by such factors as body mass index, waist circumference, waist-to-hip ratio, percent body fat hence the problematic of this study. The study was therefore conducted to determine the relationship between blood pressure and body mass index, waist circumference, waist-to-hip ratio, percent body fat of male and female faculties of GGV University, Bilaspur (C.G).

Purpose of the Study

The study was conducted to determine the:

1. Relationship of blood pressure with body composition of male faculties.
2. Relationship of blood pressure with body composition of female faculties.

Methodology

In this study, population consists of 202 male and 63 female faculties of GGV University, Bilaspur (C.G) in 2016-2017 academic session. The male faculties average age was 39.47 years and female faculties average age was 37.70 years. This data was released on request by the G.G.V. Administeration.

Criterion Measures

Blood Pressure

The subjects were made to rest in a sitting position for 5-10 minutes. Following which, resting systolic and diastolic blood pressures were determined by sounds in the right arm using Omron Automatic Digital Blood Pressure Monitor (endorsed by the American Heart Association, model no. HEM 713C) with contoured cuffs.

Body Mass Index

Weight and height were measured separately to determine the body mass index. The body weight of subjects were measured in light indoor clothing, without shoes, overcoat, hat, hair braids, or handsets using a digital weighing scale. The body weight of each subject was written in the appropriate column of the raw data sheet in kilogramme. The stadiometer was used to measure height. Measurements were recorded in metres (m) to the nearest 0.1cm.Body mass index (BMI) was determined by dividing weight (wt) in kilogrammes (kg) by height (ht) in square metre (m2) as in the following formula:

BMI = wt (kg)/ht (m2)

The international body mass index classification by the National Institute of Health and the International Obesity Task Force as approved by the World Health Organization, Geneva, (2006) was adopted.

Waist - to - Hip Ratio

- Waist and Hip ratio was measured using Anthropometric tape (Lufkin EXECUTIVE THINLINE). Waist and hip circumferences were measured to determine the waist-to-hip ratio. While the waist circumference was measured at the level of the narrowest point of coastal borders after complete expiration. Hip measurement was taken at the hip circumference at the greatest posterior protuberance of the buttocks. The waist-to-hip ratio was determined by dividing the waist circumference by the hip circumference. It is mathematically calculated as:

WHR = Waist Circumference (cm) / Hip Circumference (cm)

The average values of waist-to-hip ratio between 0.80-0.90 and 0.90-0.98 for both females and males respectively are considered safe.

Percent Body Fat

The body fat percentage (BFP) of a human or other living being is the total mass of fat divided by total body mass; body fat includes essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. The percentage of essential fat is 2-5% in men, and 10-

13% in women. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. A number of methods are available for determining body fat percentage, such as measuring with skin fold calipers or through the use of bioelectrical impedance analysis.

Testing Procedure
A written permission to conduct the study in all departments was obtained from the University. A letter was notified to all the departments regarding the data collection. At least two days notice preceded each visit and arrangements for a suitable venue. The subjects were briefed by the researcher in order to seek consent, also research assistants were introduced and this was followed after inspection of instruments used for data collection.

Validation of Instruments
Blood pressure apparatus and skinfold calliper were checked by the Instrument expert, before the commencement of data collection to ensure that they were working correctly. The weighing scale was constantly tested with known measure (10Kg) to verify accuracy. The following instruments were used in the process of data collection:

Blood Pressure Apparatus
Omron Automatic Digital Blood Pressure Monitor (endorsed by the American Heart Association) produced and marketed by Omron Health Care Inc. made in China (Model no. HEM 713C, Serial number 24259976 uses Duracell alkaline battery 4 * 1.5v= 6volts) was used to measure resting blood pressure. It has a maximum systolic capacity of 240 mm Hg with a least count of 1mm Hg. The instrument had a very high reliability coefficient r=0.90.

Percent Body fat
Body Fat percentage was measured using Omron Body Fat Analyser. The equipment gives the various ranges of body fat percentage and also the body fat in kilograms.

Stadiometer
A wooden stadiometer two metrer high with a platform was graduated from bottom to the top in centimetres (1% error) by a structural engineer and certified by a physicist. The instrument was used for the measurement of height in metres (m) to the nearest 0.1cm. The self-constructed device had an adjustable flat set-square placed above the head to reduce parallax error. The device had a reliability coefficient r = 0.90.

Measuring Tape
A flexible Anthropometric tape (Lufkin Executive Thinline) was used for measuring the waist and hip circumferences of the subjects. The device had a reliability coefficient r=0.70.

Statistical Techniques
The data collected were fed into the system and analysed using with SPSS 16.0 version. Pearson Product Moment Correlation Coefficient (r) was used to determine the relationship of the variables studied. The level of significance was set at 0.05.

Results and Discussion
Before the results are presented, it is important to state that, while blood pressure consists of systolic and diastolic blood pressures respectively, body composition was treated as having four different components, namely; body mass index, waist circumference, waist-to-hip ratio, and percent body fat. Therefore, the relationships of systolic and diastolic blood pressures with body mass index, waist circumference, waist-to-hip ratio and percent body fat among male and female faculties were computed separately.
The Pearson Correlation Coefficient was computed between systolic and diastolic blood pressures and body mass index, waist circumference, waist-to-hip ratio and percent body fat of male faculties of GGV University, Bilaspur (C.G). The results of which are shown in Table 1.

Table 1: Relationship between Blood Pressure and Body Composition of male faculties

Variables	SBP	DBP	WC	BMI	WHR	%BF
SBP	1					
DBP	.742**	1				
WC	.294**	.335**	1			
BMI	.220**	.314**	.866**	1		
WHR	.306*	.363**	.728**	.471**	1	
%BF	.242**	.336**	.782**	.796**	.566**	1

**Correlation is significant at the 0.05 level (2-tailed) r(202) = 0.113 ≤ 0.05

Table 1 shows significant correlation between systolic and diastolic blood pressure (r = 0.742) of male faculties of GGV University, Bilaspur (C.G). The two blood pressure components, systolic and diastolic blood pressures correlated significantly with body mass index (r = 0.220 and 0.314), waist circumference (r = 0.294 and 0.335), waist-to-hip ratio (r = 0.306 and 0.363) and percent body fat (r = 0.242 and 0.336) respectively. Interestingly, there was a significantly high association between body mass index and waist circumference (r = 0.866) at p ≤ 0.05. The positive high correlation between body mass index and waist circumference suggests that both are proportional to each other in the male faculties.

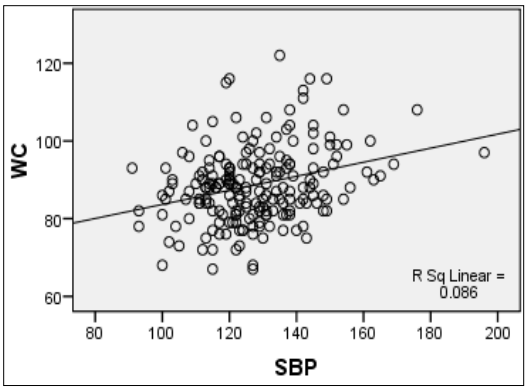

Fig 1: Correlation between Systolic Blood Pressure and Waist Circumferenc of male Faculties

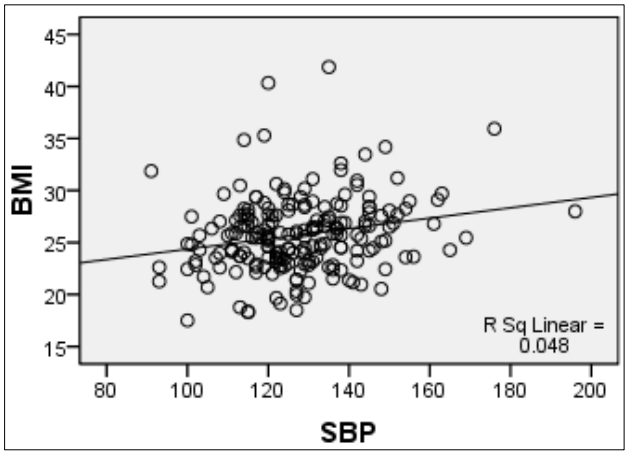

Fig 2: Correlation between Systolic Blood Pressure and Body Mass Index of male Faculties

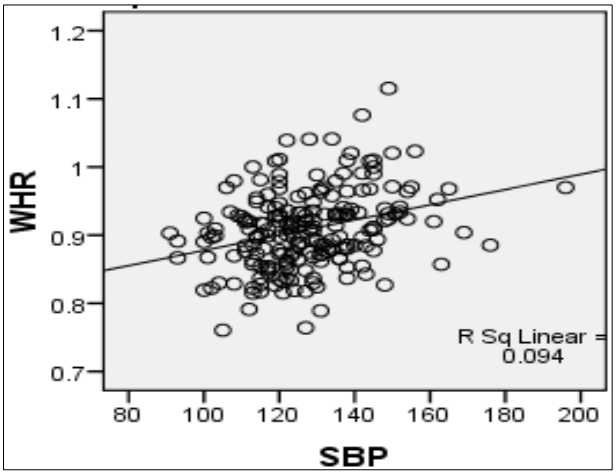

Fig 3: Correlation between Systolic Blood Pressure and Waist-to-Hip Ratio of male Faculties Correlation between Systolic Blood Pressure and Waist-to-Hip Ratio of male Faculties

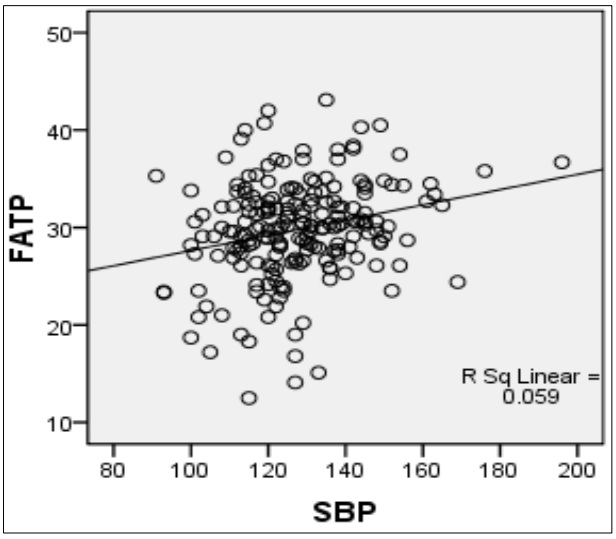

Fig 4: Correlation between Systolic Blood Pressure and Percent Body Fat of male Faculties

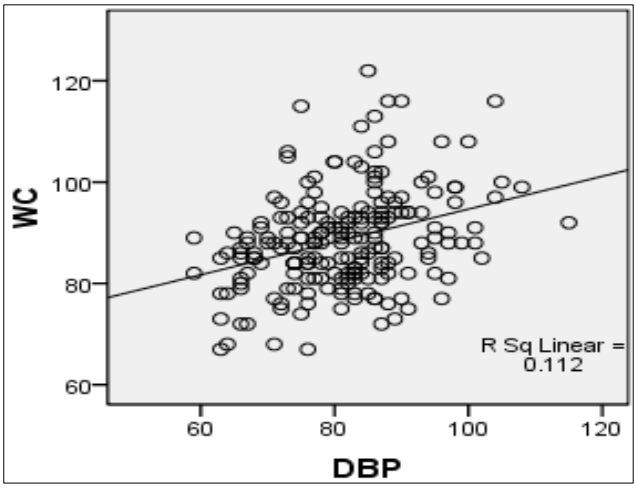

Fig 5: Correlation between Diastolic Blood Pressure and Waist Circumference of male Faculties

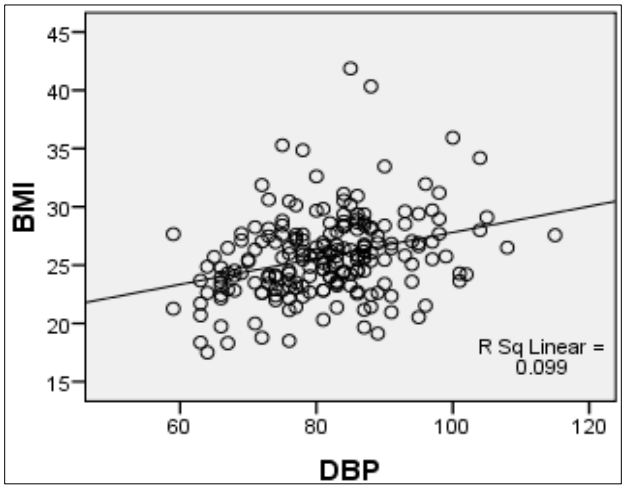

Fig 6: Correlation between Diastolic Blood Pressure and Body Mass Index of male Faculties

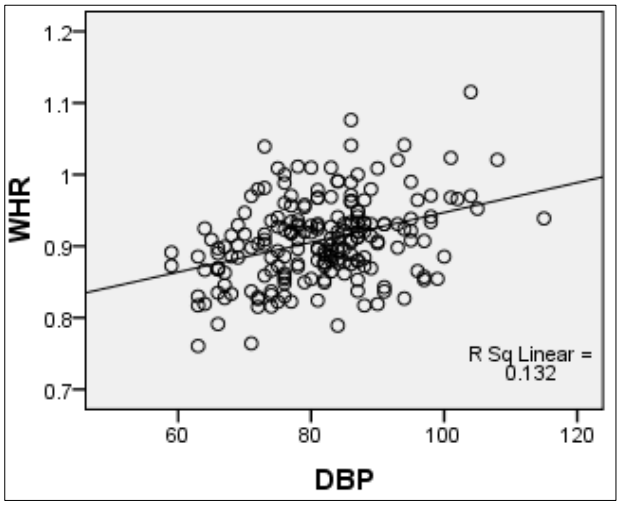

Fig 7: Correlation between Diastolic Blood Pressure and Waist-to-Hip Ratio of male Faculties

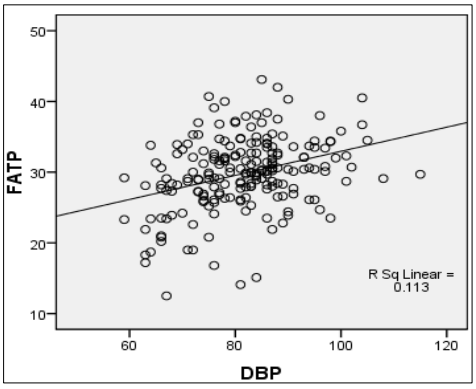

Fig 8: Correlation between Diastolic Blood Pressure and Percent Body Fat of male Faculties

Table 2: Relationship between Blood Pressure and Body Composition of female faculties

Variables	SBP	DBP	WC	BMI	WHR	%BF
SBP	1					
DBP	.613**	1				
WC	.493**	.406**	1			
BMI	.387**	.370**	.889**	1		
WHR	.398**	.302*	.817**	.544**	1	
%BF	.392**	.364**	.849**	.896**	.523**	1

**Correlation is significant at the 0.05 level (2-tailed) r(61) = 0.235 ≤ 0.05

Table-2 shows significant correlation between systolic and diastolic blood pressures (r = 0.613) of female faculties of GGV University, Bilaspur (C.G). The two blood pressure components, systolic and diastolic blood pressures had significant correlation with waist circumference (r = 0.493 and 0.406), body mass index (r = 0.387 and 0.370), waist-to hip ratio (r = 0.398 and 0.302) and percent body fat (r = 0.392 and 0.364) respectively. Similarly, there was a significant correlation between body mass index with waist-to hip ratio (r = 0.544) and with percent body fat (r = 0.896). There was also a significant relationship between waist circumference with body mass index (r=0.889); with waist-to hip ratio (r= 0.817) and with percent body fat (r = 0. 849). Finally, there was a significant association between waist-to hip ratio and percent body fat (r=0.523) at $p \leq 0.05$. The positive high correlation between waist circumference with body mass index, with percent body fat, with waist-to hip ratio and between body mass index with percent body fat suggest that both were directly proportional to each other in the female faculties.

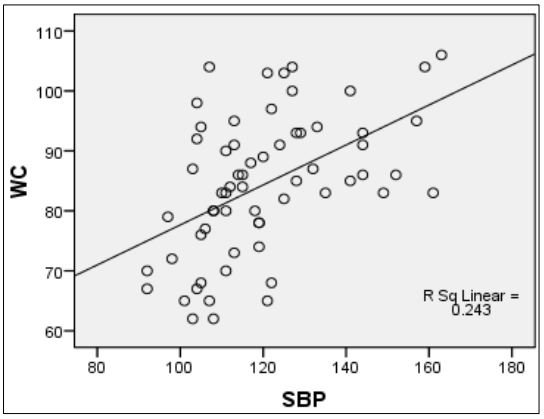

Fig 9: Correlation between Systolic Blood Pressure and Waist Circumference of female Faculties

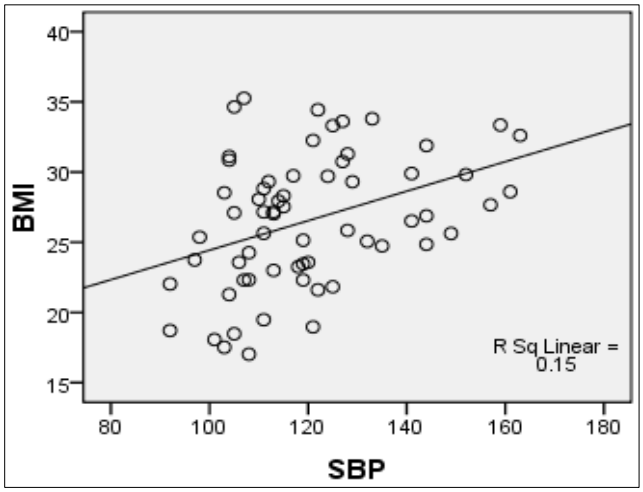

Fig 10: Correlation between Systolic Blood Pressure and Body Mass Index of female Faculties

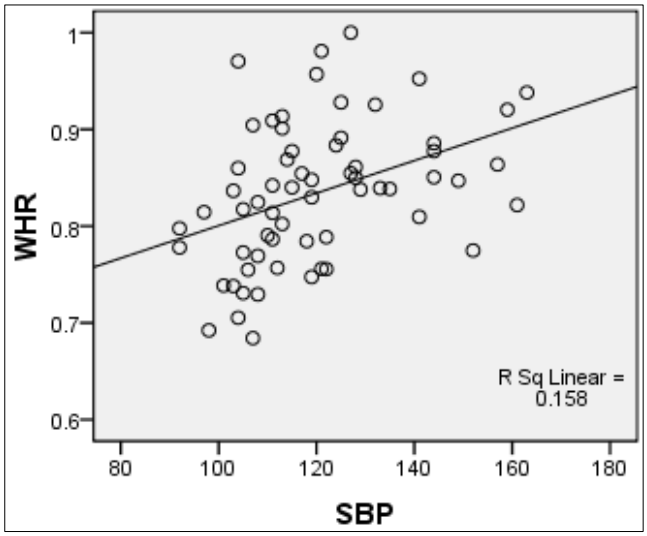

Fig 11: Correlation between Systolic Blood Pressure and Waist-to-Hip Ratio of female Faculties

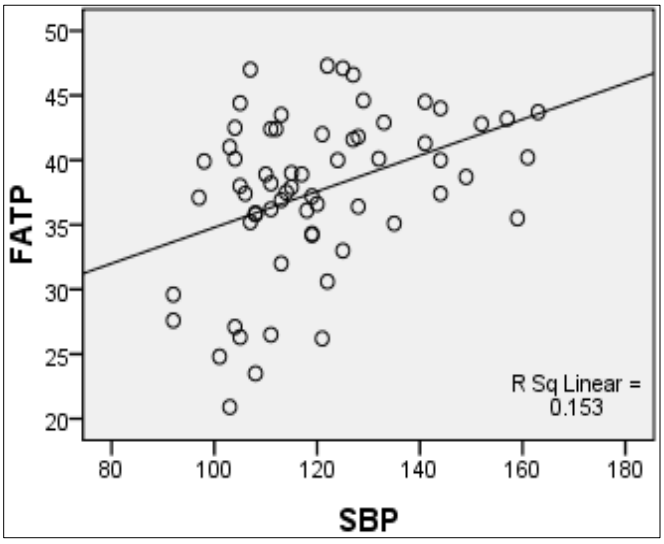

Fig 12: Correlation between Systolic Blood Pressure and Percent Body Fat of female Faculties

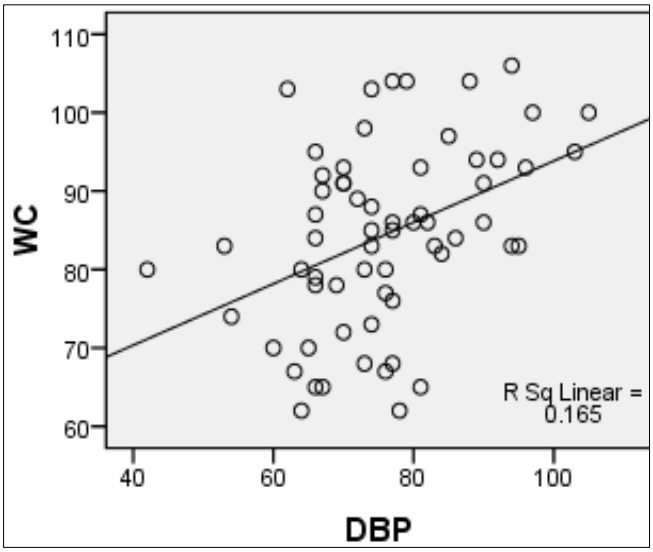

Fig 13: Correlation between Diastolic Blood Pressure and Waist Circumference of female Faculties

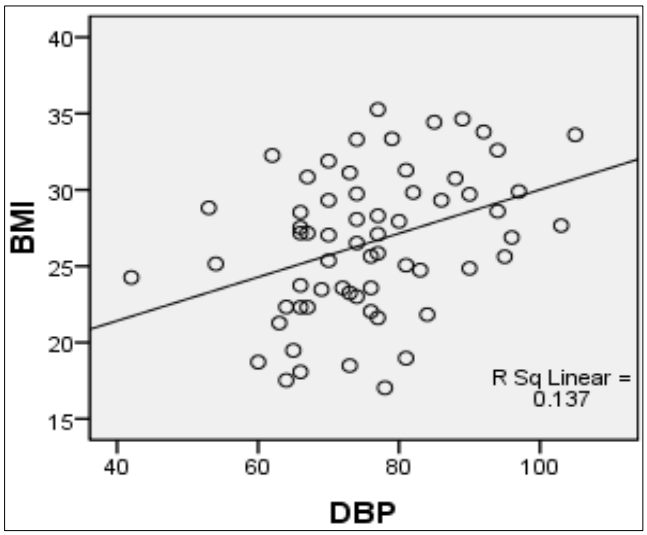

Fig 14: Correlation between Diastolic Blood Pressure and Body Mass Index of female Faculties

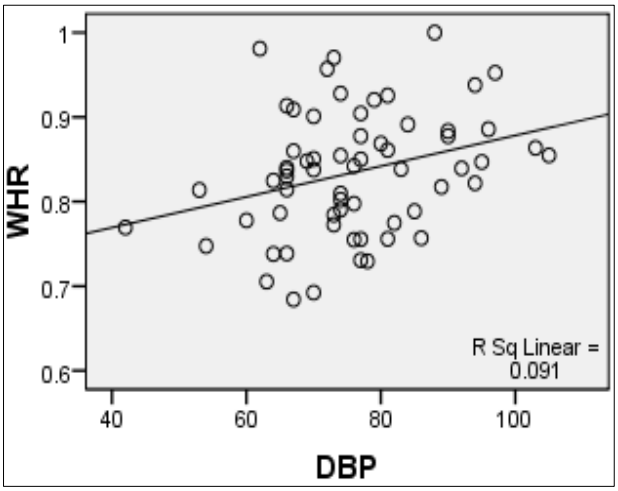

Fig 15: Correlation between Diastolic Blood Pressure and Waist-to-Hip Ratio of female Faculties

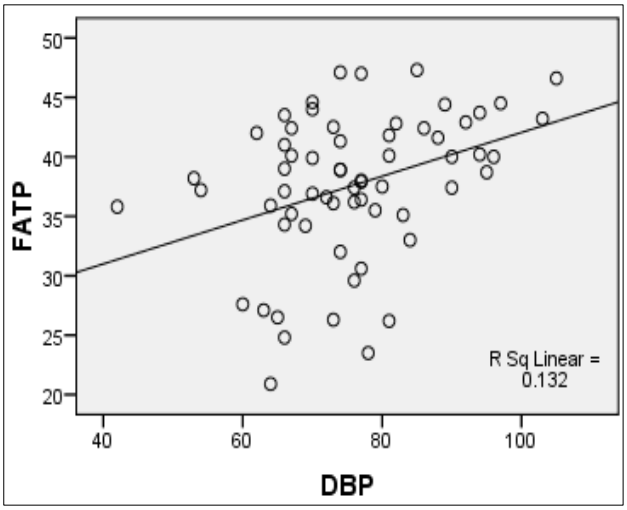

Fig 16: Correlation between Diastolic Blood Pressure and Percent Body Fat of female Faculties

The results of the study showed that:

1. The relationship between systolic and diastolic blood pressures was positively significant among the male and female faculties in this study. This showed that the two variables were directly proportional to each other; as systolic blood pressure increased, diastolic blood pressure also increased.
2. The relationship between systolic blood pressure and body mass index was positively significant among the male and female faculties in this study. This showed that the two variables were directly proportional to each other; as body mass index increased, systolic blood pressure also increased.
3. The relationship between diastolic blood pressure and body mass index was positively significant among the male and female faculties in this study. This showed that the two variables were directly proportional to each other; as body mass index increased, diastolic blood pressure also increased.
4. The relationship between waist circumference and body mass index was positively significant among the male and female faculties in this study. This showed that the two variables were directly proportional to each other; as body mass index increased, waist circumference also increased.
5. The relationship between systolic blood pressure and diastolic blood pressure was positively significant with waist circumference, percent body fat and waist-to hip ratio of the male and female faculties in this study. This showed that these variables were directly proportional to each other; as waist circumference, percent body fat and waist-to hip ratio increased, systolic blood pressure and diastolic blood pressure also increased.

Discussion

The purpose of the study was to show how blood pressure changes with body composition among male and female subjects of Guru Ghasidas University, Bilaspur (C.G.). This was mainly to infer from the relationship between blood pressure and the different independent risk factors that can be used as the basis for indicating exercise intervention to positively modify blood pressure. The relationship between the aforementioned, which is

blood pressure with body mass index, waist circumference, waist-to-hip ratio and percent body fat among the subjects were reported in Tables 1 and Table 2.

The study of Table 1 showed significant correlation of systolic with diastolic blood pressures and percent body fat (r = 0.242; r = -0.336) among male and female subjects of Guru Ghasidas University, Bilaspur (C.G.). In separate studies conducted by White, *et al;* (1986) [1]; Santos, *et al;* (2008) [7], and Mutikainen *et al;* (2009) it was held that correlations of body mass index, waist-to-hip ratio and skinfold measurements with diastolic blood pressure varied with age and sex. For men, high blood pressure was more highly correlated with body mass index than with percent body fat in all activity levels in both gender. The two blood pressure components, systolic and diastolic blood pressures had significant correlation with body mass index (r = 0.220; r = 0.314) and with waist-to-hip ratio (r = 0.306; = 0.363). This is in consonance with studies conducted by Durnin, (1994) in Plowman and Smith, (1997); Williams, (2002); Jeukendrup, (2005) and Otinwa, (2005) in Venkateswarlu, (2007). They opined that subjects with low body mass index in relation to height, expressed as the body mass index, have less difficulty moving their body during weight bearing activities like walking or stair climbing than subjects with a higher body mass index. They added that these individuals regularly have lower systolic and diastolic blood pressures in either active or inactive population. There was also a significant relationship between waist circumference and body mass index (r = 0.866) and between body mass index with waist-to-hip ratio (r = 0.471) in this study at $p \leq 0.05$. These suggest that there was a significant relationship between systolic and diastolic blood pressures with body mass index among the subjects. White, *et al;* 1986 [1]; Maud and Foster, (1995), Oladipo and Angba, (2006) and Santos, *et al;* (2008) [7] affirmed from surveys in California, Connecticut and Maryland and the nationwide Community Blood Pressure Evaluation Clinic Programme that in the United States, it all showed that the prevalence of blood pressure, body mass index and waist circumference were higher in male counterparts.

The study of Table 2 shows significant correlation of systolic with diastolic blood pressures (r = 0. 613) of female faculties of Guru Ghasidas University, Bilaspur (C.G.). Diastolic blood pressure correlated significantly with waist circumference(r = 0. 406); and with body mass index (r = 0. 370). Similarly, body mass index correlated highly with waist circumference (r = 0. 889) at $p \leq 0.05$. It has been suggested that physical activity might prevent weight gain and rise in blood pressure through increased energy expenditure or favourable changes in adipose tissue (Ross and Jansen, 2001 in Yang, *et al;* 2007). While the waist circumference is an indicator of adipose tissue in the waist and abdominal area; hip circumference is an indicator of adipose tissue over the buttocks and hips (Maud and Foster, 1995 and Henry, *et al;* 2004); which is used to determine body fat percent of the active populations (SIRC, 2007, Christensen, *et al;* 2008 and Mutikainen, *et al;* 2009). The ratio thus provides an index of relative fat distribution in adults, whereas; the higher the ratio the greater the proportion of abdominal fat. However, the validity of these circumferences as measure of fat distribution in youth is unknown (Mueller and Nalina, 1987 in Maud and Foster, 1995). In a study conducted by Pollard, *et al;* 2008 on Migrant and British Born British Pakistani women they ventured that, reported physical activity levels were highest in the European women and lowest among immigrant British Pakistani women, but this difference was significant for the MET – minutes measure of physical activity only. In another study conducted by Hagstromer, 2007, in Sweden, it was demonstrated that men were more active than women (Trost, *et al*; 2002, Socialstyrelsen, 2005 in Hagstromer, 2007). Blood pressure was more correlated with body mass index than percent body fat (Venkateswarlu, 2007). This therefore suggests that body mass index and waist circumference were better predictors of blood pressure in the female faculties group in this population.

Conclusion

Based on the findings and in view of the limitations, the study therefore confirmed that:

1. As systolic blood pressure increased, diastolic blood pressure also increased.
2. As body mass index, waist circumference, percent body fat and waist - to - hip ratio increased, systolic blood pressure and diastolic blood pressure also increased. Therefore body mass index, waist circumference, percent body fat and waist-to hip ratio as a modifiable risk factor of elevated blood pressure can be the best predisposing risk factor for cardiovascular disease in the male and female faculties of GGV, Bilaspur (C.G.).

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