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Association of Anthropometric Indices with Type II Diabetes mellitus, Hypertension and Hyperlipidemia.

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ABSTRACT

This **c**ross sectional study was conducted in Shifa Foundation Falahi Clinic, Islamabad to determine the association of obesity related indices like waist circumference (WC), waist to hip ratio (WHR), & body mass index (BMI) with type II diabetes mellitus, hypertension and hyperlipidaemia. A total of 328 patients were included. The blood pressure, fasting blood sugar (FBS) and lipid profile was also performed. The correlation and significance was determined among dependent and independent variables. The mean age of the patient was 47.14 $^{+}$ 11.07. There was 220 (67.1%) female and 108 male (32.9%). The frequency distribution of BMI revealed that only 37 female patients (16.8%) were normal, while 27 male patients (25%) had normal BMI. The diabetes mellitus was present in 164 (50%) of the patients. Hypertension was present in 170 (51.82%) patients. The WC, WHR & BMI has a positive correlation with hypertension and statistically significant. The WC also has a positive correlation with type 11 diabetes mellitus and TG. The study results concluded that the anthropometric indices (WC, WHR & BMI) has a positive correlation with hypertension and statistically significant. The WC also has a positive correlation with type 11 diabetes mellitus and triglyceride (TG). Further community based studies are required to ascertain the findings of this study.

Keywords: Anthropometric indices, Diabetes mellitus, Hypertension, Blood Glucose, Lipid profile.

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INTRODUCTION

In this modern era of technology obesity is one of the most serious global health issues. The alarming high prevalence of obesity over the past two decades rings the bell that it could be considered as pandemic disease. The worldwide burden of obesity was recorded to be over 3000 million adults.[1] Obesity can be classified as general and regional. The regional obesity further sub classified in terms of fat distribution. The distribution of fat deposition has some association with development of certain diseases. These fat distributions are android and gynoid type. The gynoid type of distribution is common in woman. The "pear shape" indicates the heavier deposit of fat around the buttocks and thighs. The main function of this fat is to act as a reservoir for pregnancy and lactation. Individuals with this type of impairment rarely develop diabetes mellitus. On the other hand android type of fat distribution or "apple shape" is typical of man feature, fat around the waist and upper abdomen. This pattern is associated with significant risk of cardiovascular disease and type II diabetes mellitus[2].

Obesity is diagnosed by anthropometric parameters like body mass index (BMI), waist circumference (WC) and waist to hip ratio (WHR).[3] The most widely used indicator for the measurement of obesity is BMI, but it is not helpful in determining the body fat distribution. The body fat distribution has a role to determine the risk of certain diseases. Excessive fat accumulation in the abdominal region is related to the increase risk of cardiovascular diseases[4]. It is also a risk factor for type II diabetes mellitus. The rising prevalence of obesity in developed and developing countries increases the risk of developing cardiovascular diseases and type11 diabetes mellitus.[5]

This study was designed to see the correlation of obesity indices with hypertension, type II diabetes and dyslipidemia. The purpose of this study is to make awareness among people about diseases associated with obesity and adoption of the different measures to prevent these diseases.

MATERIALS AND METHOD

This cross sectional study was conducted in Shifa Foundation Falahi Clinic, Islamabad over a period of 06 months involving 328 patients. The prior permission from the 'Institutional Review Board' was taken. All patients who attend the outpatient department and informed consent were obtained from each patient by convenience purposive sampling on voluntary basis. Patients between the age of 17-70 years, regardless of gender and ethnic origin, were included. Physically handicap persons interfering with anthropometric indices were excluded from the study.

Brief history about patient's identification was taken. The calibrated beam scale was used to measure the weight in the upright position with 0.1 kg calibration error. The calibrated standiometer with a margin of 0.1cm without shoes was used to measure the height. BMI was measured by weight in Kg divided by height in meter square. WC at the midpoint of lower rib cage and iliac crest to the nearest of 0.1 cm was measured. Hip circumference was measured to the nearest of 0.1 cm at the greatest horizontal circumference below the iliac crest at the level of greater trochanter. WHR was calculated by waist circumference divided by hip circumference. All the selected patients were undergo blood pressure determination both in lying & standing position, fasting blood glucose & fasting total lipid profile. All these data was collected on prescribed Performa.

The operational definitions described as normal parameters were as follow. The Waist circumference (WC) in male < or = 102 was normal, while above it considered raised. The WC in female < or = 88 was normal, while above it considered as raised. The WHR in male 0.95 or below as low risk, 0.96 to 1.0 as moderate risk and > 1.0 as high risk. The WHR in female 0.80 or below as low risk, 0.81 to 0.85 as moderate risk and > 0.85 as high risk. The BMI regardless of gender was recorded as <18.5 under weight,18.5 to 24.9 normal, 25.0 to 29.9 overweight, 30.00 to 34.9 mild obese, 35.0 to 39.9 moderate obese and 40.0 or > considered as extremely obese.

The fasting blood sugar < 100mg/dl normal, 100 - 125 mg/dl impaired glucose tolerance and >126 mg/dl diabetes mellitus. The blood pressure (BP) recording < or = 120 mm of Hg systolic and < or = 80 mm of Hg diastolic considered normal. The systolic 120 to 139 mm of Hg and diastolic 80 to 89 mm of Hg considered pre-hypertension. The systolic 140 or > mm of Hg and diastolic 90 or > mm of Hg considered as hypertension. The fasting cholesterol < 200 mg/dl desirable, 200- 240 mg/dl border line and >240 mg/dl considered as high risk. The high density lipoprotein (HDL) normal range in male was 27 – 67 mg/dl, while in female it was 34 – 88 mg/dl. The triglyceride (TG) < or = 165 mg/dl was considered normal, while above it considered abnormal. The low density lipoprotein (LDL) < 130 mg/dl desirable, 130 – 159 mg/dl border line and = or > 160 mg/dl considered as high risk.

The descriptive analysis and frequency distribution of all quantitative and qualitative variables was performed. The statistical significance and correlation between variables were performed by using SPSS version 20.0.

RESULTS AND DISCUSSION

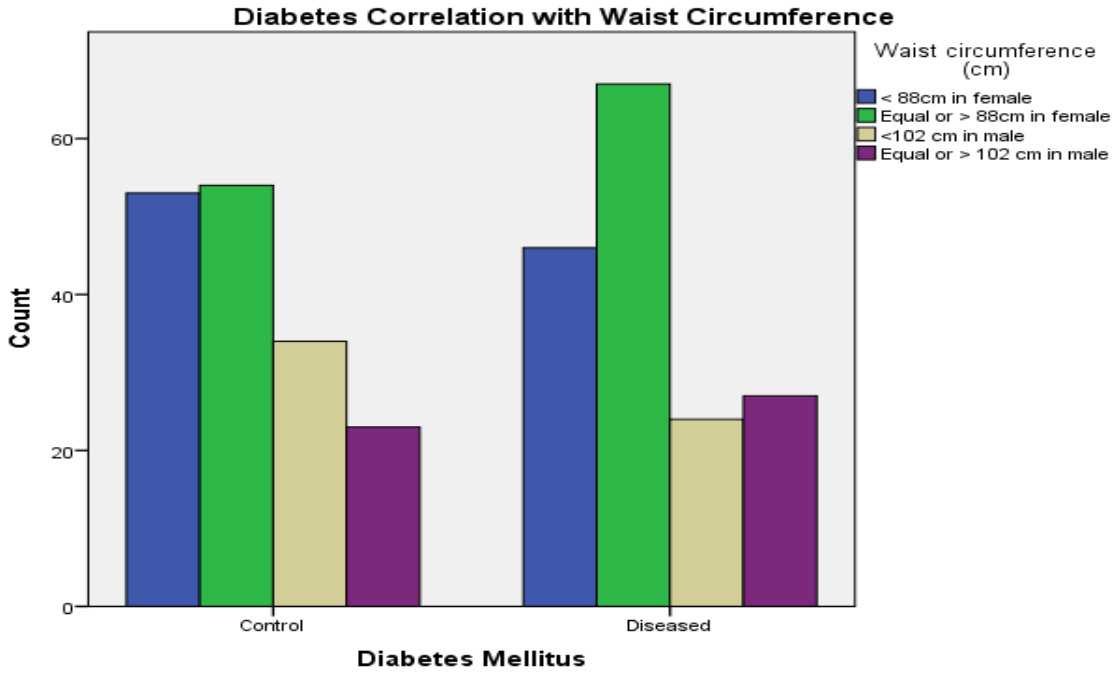
This cross sectional study was conducted in Shifa Foundation Falahi Clinic, Islamabad on 328 patients (n=328). The study results revealed that mean age of the patient was 47.14 $\pm$ 11.07. The age range from 17- 70 years. There was 220 (67.1%) female and 108 male

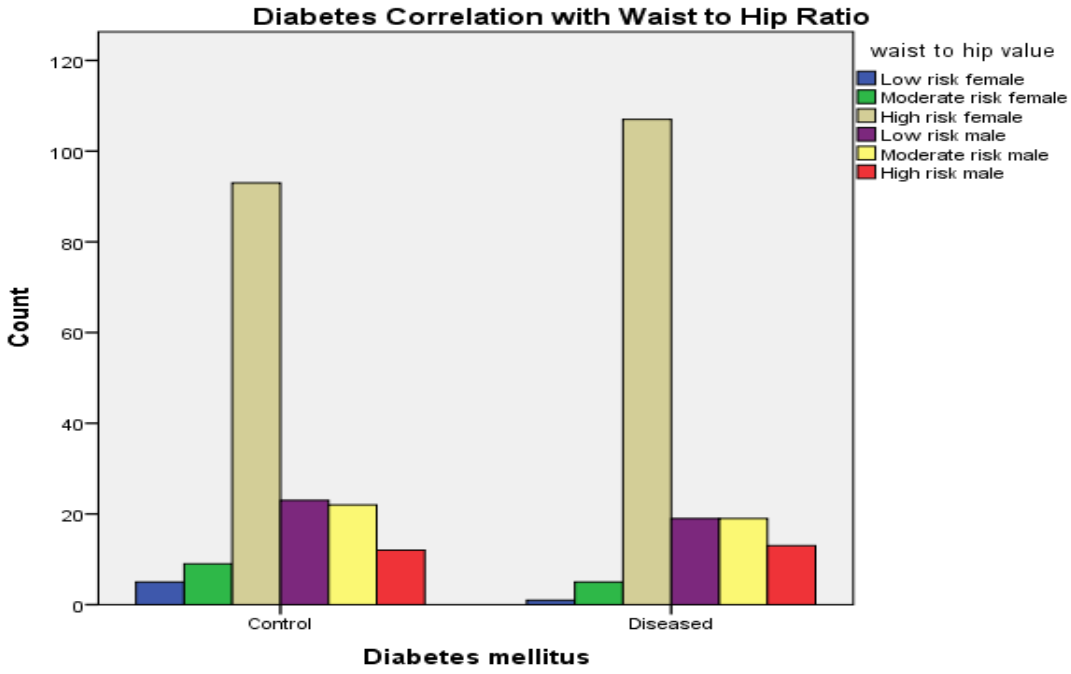
(32.9%). The female to male ratio was 2.03: 1. The mean waist circumference (WC) in female was above normal (101.18), while in male was below normal (98.68). The mean WHR in female (0.95) was in high risk category; while in male (0.97) was in moderate risk category. This indicates that android type of regional obesity was common in our study. The frequency distribution of WHR revealed that only 6 female patients (2.7%) and 42 male (38.9%) were in low risk category. The mean body mass index (BMI) in female (30.35) was in mild obese category, while in male (27.32) was in overweight category. The frequency distribution of BMI revealed that only 37 female patients (16.8%) were normal, while 27 male patients (25%) had normal BMI. (Table1)

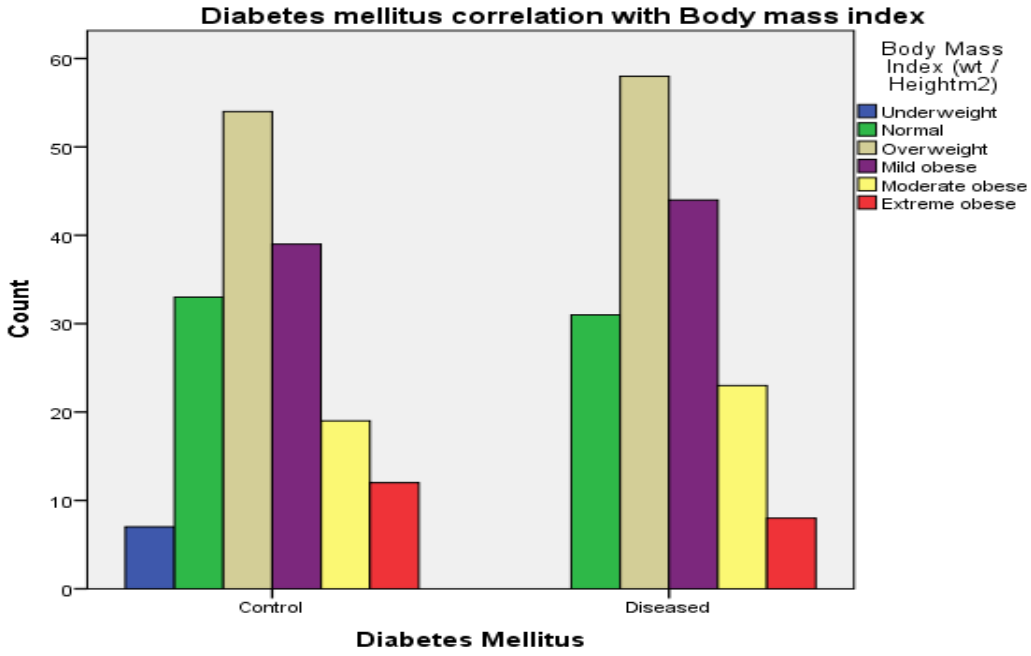
The mean cholesterol was within desirable range both in female (188.99) and male (194.13). The mean high density lipoprotein (HDL) was also within normal limit both in female (42.48) and male (43.67). The mean triglyceride (TG) was normal in female (157.30), while it was raised in male (184.98). The mean low density lipoprotein (LDL) was in desirable range both in female (120) and male (117). (Table1) The diabetes mellitus was present in 164 (50%) of the patients. Patients with controlled diabetes mellitus were 70 (21.34%), while patients with uncontrolled diabetes mellitus were 94 (28.66%). Hypertension was present in 170 (51.82%) patients, while 158 (48.18%) patients had normal blood pressure. (Table 11)

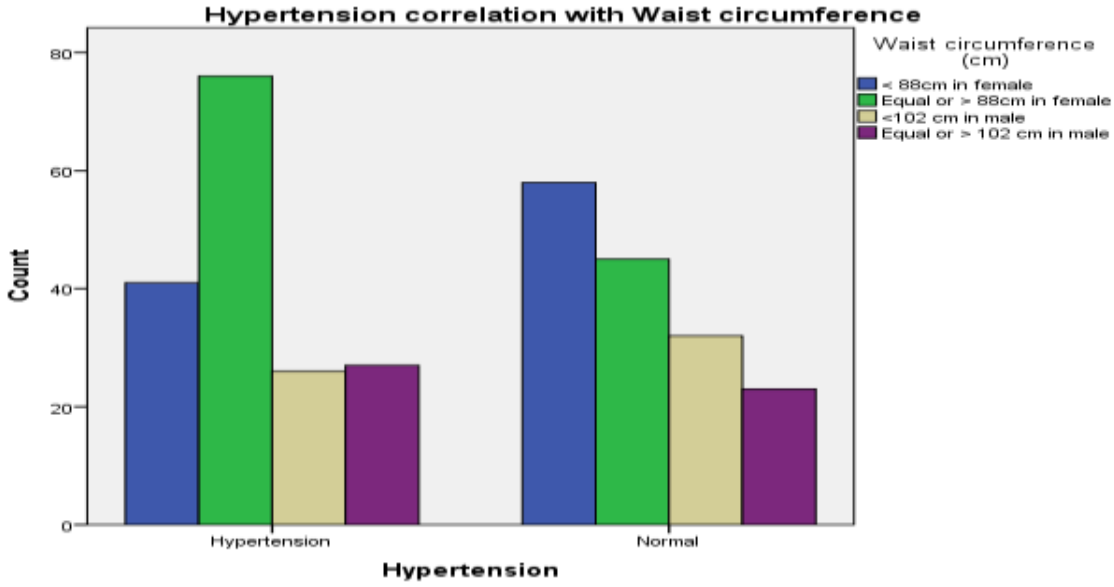
Table 1: Frequency Distribution of Anthropometric Indices and Lipid Profile

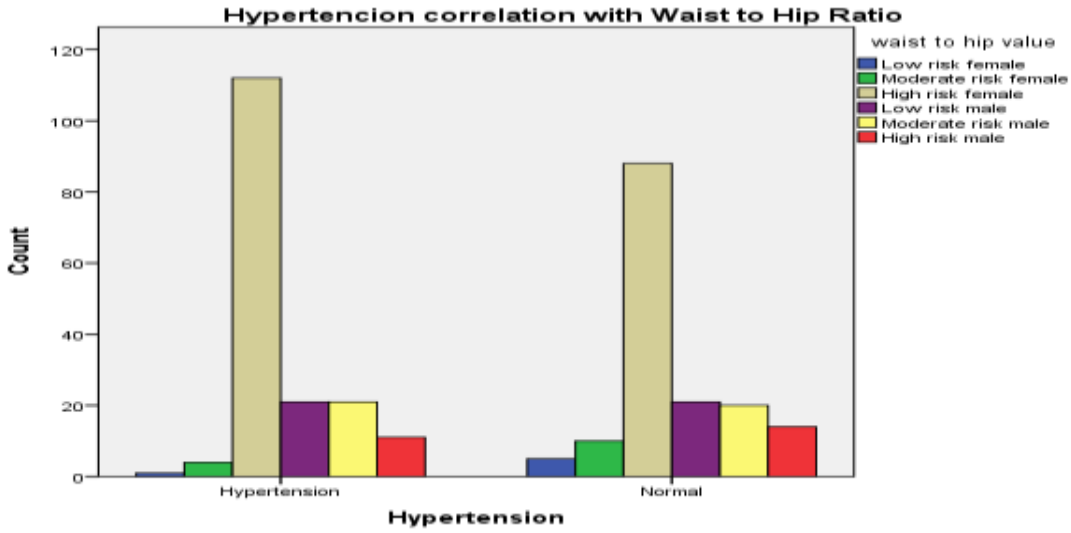
S.No.	Study Variable	Gender	Mean	Standard Deviation	Minimum	Maximum
1	Age (Years)	Female	46.49	10.56	19	70
		Male	48.46	11.98	17	70
2	Waist Circumference	Female	101.18	15.73	25	154
	(WC) (cm)	Male	98.68	14.37	57	130
3	Waist to Hip Ratio	Female	0.95	0.07	0.73	1.19
	(WHR)	Male	0.97	0.10	0.77	1.76
4	Body Mass Index (BMI)	Female	30.35	6.43	15.6	50.40
	(Kg/ m^2)	Male	27.32	5.18	14.0	42.30
5	Cholesterol	Female	188.99	45.07	83	324
	(mg/dl)	Male	194.13	47.47	115	428
6	High Density Lipoprotein	Female	42.48	5.7	24	64
	(HDL)(mg/dl)	Male	43.67	5.1	23	61
7	Low Density Lipoprotein	Female	120	62.07	55	851
	(LDL)(mg/dl)	Male	117	38.04	56	278
8	Triglyceride (TG) (mg/dl)	Female	157.30	69.14	70	491
		Male	184.98	146.93	46	1119
9	Fasting blood sugar	Female	139	65.75	47	387
	(FBS) (mg/dl)	Male	126	52.42	75	369

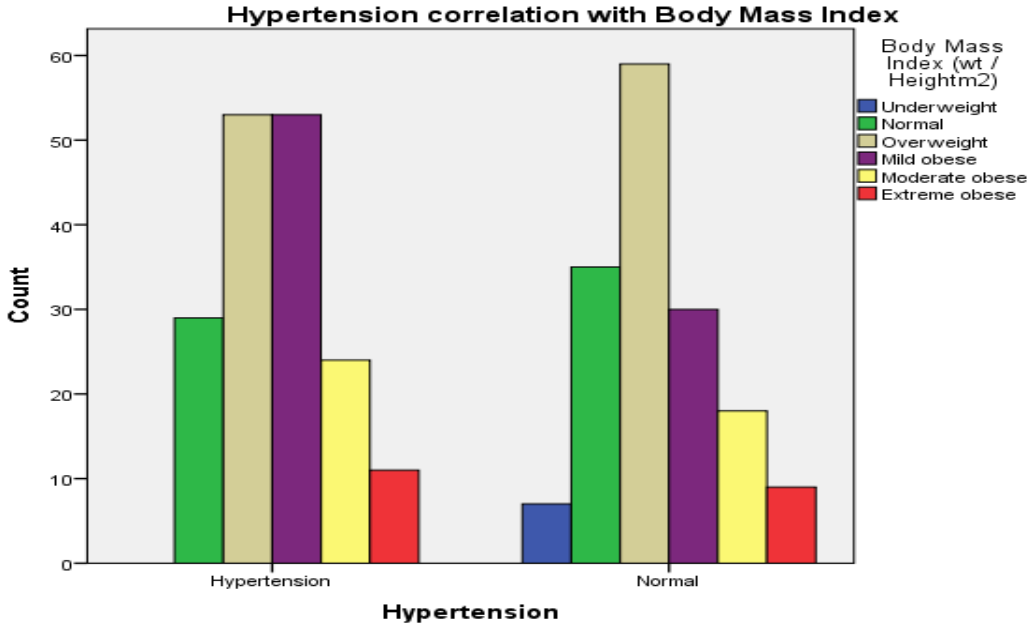

Diabetes Correlation with Waist Circumference
Waist circumference (cm)
< 88cm in female
Equal or > 88cm in female
<102 cm in male
Equal or > 102 cm in male
Count
0
20
40
60
Control
Diseased
Diabetes Mellitus


Diabetes Correlation with Waist to Hip Ratio
waist to hip value
Low risk female
Moderate risk female
High risk female
Low risk male
Moderate risk male
High risk male
Count
0
20
40
60
80
100
120
Control
Diseased
Diabetes mellitus


Diabetes mellitus correlation with Body mass index
Body Mass Index (wt / Heightm2)
Underweight
Normal
Overweight
Mild obese
Moderate obese
Extreme obese
Count
60
50
40
30
20
10
0
Control
Diseased
Diabetes Mellitus


Hypertension correlation with Waist circumference
Waist circumference (cm)
< 88cm in female
Equal or > 88cm in female
<102 cm in male
Equal or > 102 cm in male
Count
80
60
40
20
0
Hypertension
Normal
Hypertension


Hypertencion correlation with Waist to Hip Ratio
waist to hip value
Low risk female
Moderate risk female
High risk female
Low risk male
Moderate risk male
High risk male
Count
120
100
80
60
40
20
0
Hypertension
Normal
Hypertension



The Spearman's rho correlation between WC and type 11 diabetes mellitus was very weak and found non-significant. The Spearman's rho correlation between WC and hypertension was weak but found significant at 0.01 level (2- tailed). The Pearson's correlation of WC and TG was weak but found significant at 0.05 level (2- tailed). The Pearson's correlation of WC and cholesterol, HDL and LDL was found non-significant.

The Spearman's rho correlation between WHR and type 11 diabetes mellitus was very weak but found significant at 0.01 level (2- tailed). The Spearman's rho correlation between WHR and hypertension was also very weak but found significant at 0.01 level (2- tailed). The Pearson's correlation of WHR and cholesterol, HDL, TG and LDL was found non-significant.

The correlation was non-significant between BMI and type 11 diabetes mellitus, but very weak correlation between BMI and hypertension was found with a significant level of 0.01. The Pearson's correlation of BMI and cholesterol, HDL, TG and LDL was found non-significant. (Table 3)

Table 2: Correlation of study variables:

S.No.	Dependent Variable	Independent Variable	Correlation Value	Significance
1.	Diabetes mellitus	WC	0.03	0.57
		WHR	0.178	0.001**
		BMI	0.029	0.598
2.	Hypertension	WC	0.242	0.000***
		WHR	0.164	0.003***
		BMI	0.151	0.006**
3.	Cholesterol	WC	0.1	0.06
		WHR	0.058	0.28
		BMI	0.046	0.40

4.	High Density Lipoproteins (HDL)	WC	-0.01	0.77
		WHR	-0.04	0.40
		BMI	-0.30	0.59
5.	Triglyceride	WC	0.109	0.049*
		WHR	0.003	0.95
		BMI	0.030	0.583
6.	Low Density Lipoproteins (LDL)	WC	0.08	0.13
		WHR	0.012	0.831
		BMI	0.023	0.683

- *Significance level < 0.05
- **Significance level < 0.01
- ***Significance level < 0.001

DISCUSSION:

The ancillary primary prevention measures and adequate control of diabetes mellitus, hypertension and hyperlipidemia could definitely reduce the morbidity and mortality. Thus it is important from the view of public health and clinical practice to find a simple and valid measurement to predict the risk of diabetes mellitus, hypertension and hyperlipidemia. The present study was designed with the same objectives to define the correlation of anthropometric indices with diabetes mellitus, hypertension and lipid profile.

Advances in technology have allowed investigators to distinguish between centrally located visceral and subcutaneous adipose tissue using computed tomography (CT) or magnetic resonance imaging (MRI). However, measurement of visceral adipose tissue by CT or MRI is impractical for health screening. Both BMI and waist circumference are good 'field measures' of adiposity that are easily measured in clinical settings. In a study conducted by Lara M, et al. on 22 to 28 years in Limache, Chile concluded that WC and BMI both were useful for monitoring the consequences of obesity in young adults.[6]

Chei CL et al; conducted a study in Japan (Yao community) revealed that mean age in male 56 +- 6 years, while in female 56 +- 7 years. The mean WC in male was 82.7+- 7.6 cm, while in female it was 81.6+- 8.9cm. The mean WHR in male was 0.92+- 0.05, while in female it was 0.91+- 0.07. The mean BMI in male was 22.8+-2.6 kg/m^2, while in female 22.6+-2.8 kg/m^2.[7] Veghari G, et al; conducted a study in Northern Iran on trends in waist circumference and central obesity in adults revealed average waist circumference 88.1 cm in men and 88.6 cm in women with their mean age 39.2$\pm$14.6 years.[8] In our study the mean age in male was 48.46+-11.98 years, while in female 46.49+-10.56 years. The mean WC in male was 98.6+-14.37 cm, while in female it was 101.18+- 15.73cm. The mean WHR in male was 0.97+-0.10, while in female it was 0.95+- 0.07. The mean BMI in male was 27.32+-5.18 kg/m^2, while in female 30.35+-6.43 kg/m^2.

In a study conducted in Chennai WHR was the best indicator of type II diabetes mellitus, while BMI and WC was the best predictor for hypertension[9]. In another study conducted in Egypt, WC was significantly associated with hypertension and type II diabetes mellitus, while WHR was not associated with hypertension and diabetes, no significant association was seen between BMI and diabetes or hypertension[2]. In a study conducted in Peshawar, WHR at a cut-off point of 0.84 can serve as a sensitive and specific outpatient screening index to detect postmenopausal women with an elevated triglyceride/high density lipoprotein cholesterol.[10] In a study conducted in Nigeria, Jamaica and the United State, WC was positively correlated with Blood Pressure and fasting blood glucose ($P<0.05$).[11] In our study WHR had weak positive correlation with type11 diabetes mellitus and hypertension but it was found statistically significant.

In a study conducted by Jabbar A, et al; 48% of patients had total cholesterol of > 200 mg/dl and 50% had an HDL-cholesterol of < 40 mg/dl.[12] In our study 39.3% had total cholesterol > 200 mg/ dl and HDL below normal in only 3.4%. On comparing the means of total cholesterol to BMI and WHR, it was found that total cholesterol level was statistically significant for WHR above and below 0.9 for males and 0.8 for females, whereas not so for BMI above and below 27 kg/m2.[12] In our study there was no significant correlation of cholesterol and HDL with the WHR and BMI but WC has a weak correlation with TG and statistically significant.

CONCLUSION:

The study results concluded that the anthropometric indices (WC, WHR & BMI) has a positive correlation with hypertension and statistically significant. The WC also has a positive correlation with type 11 diabetes mellitus and Triglyceride. Further larger scale community based studies are required to ascertain the findings of this study.

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