ORIGINAL ARTICLE

High Body Fat and Visceral Fat in Type II Diabetes Mellitus: a review of one hundred patients at Fatima Memorial Hospital

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ABSTRACT

Background: Diabetes mellitus is a significant and an emerging problem, most commonly encountered in general practice. Diabetes mellitus affects the quality of life of a patient if not controlled and complications associated with the diabetes mellitus impose a threat to the health of the sufferer .Body fat and visceral fat are an independent risk factors for ischemic heart disease and most of the diabetic patients are overweight and usually have higher body fat percentages along with higher visceral fat percentages which in turn enhances the risk of vascular events.

Aim: To measure the body fat and visceral fat through bioelectric impedance analysis which is easier, quick, on invasive and cheap way of assessing the both parameters and correlate both these two with each other as well.

Study design: Observational, cross sectional study.

Setting: Carried out in diabetic camp held at Fatima Memorial Hospital under Department of Medicine, Lahore.

Results: Among those one hundred patients 61 patients were males and 39 were females. The age range of patients was between 20 to 80 years of age. Majority of the patients belonged to ages 40-60 years. The maximum number of patients (57%) belonged in the weight range of 51-80kgs. The height of the most patients (35%) fell in the range of 161-170cm. The maximum number of the patients (39%) fell in the category of Obese having BMI of > 30kg/m^2 Body fat and visceral fat was abnormally elevated in both the genders but it was found to be very high in female patients especially the body fat. Body fat was abnormal ranging between a minimum of (12%) to maximum of (55%). Visceral fat was also abnormal ranging between a minimum of (5%) to a maximum of (16%).

Keywords: Body fat, visceral fat, bioelectrical impendence, Type II diabetes mellitus

INTRODUCTION

Prevalence of overweight and obesity has increased at alarming rates around the world.[1] because obesity is linked with the development of risk factors for metabolic syndrome, elevated health care costs and reduction of life expectancy[2-5] this increase has been an eye opener to health care professionals and must be monitored closely in routine practice. Because anthropometry (ANT) and bioelectrical impedance analysis (BIA) are relatively simple techniques that show significant correlations with body fat[6,7,8].

Diabetes mellitus is the most frequently occurring non communicable chronic disorder. Most of Diabetics live in south east Asia and that number is expected to increase at rate of 2% per year with rise of 69% people with diabetes in next 20 years[9]. The World Health Organization (WHO) estimates that approximately 300 million people will develop diabetes by 2025. Prevelance is rapidly rising in developing countries of the world and will affect the people in their most productive years of life (45-64) years (WHO 2002). Pakistan is affected by this chronic illness with prevalence of around 8% and that is also expected to increase in near future as the diagnostics' facilities and awareness flourish among the public[9]. As it has been observed that most of the diabetic patients are overweight with dyslipidemia and are at increased risk for cardiovascular diseases and other complications. Abdominal fat that is accumulated is visceral fat which has been strongly linked with the insulin resistance.[10] Zimmet P et al, introduced a fancy term called as Diabesity which reflects the presence of Diabetes along with obesity in an individual.[11]

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MATERIALS AND METHODS

This study was approved by institutional Ethical review committee of Fatima Memorial Hospital, Lahore (Number: FMS-1-2015-IRB-M-119). It is a cross sectional study design conducted in the

diabetic camp held at Fatima Memorial Hospital under Department of Medicine. A total number of one hundred patients were included in the study according to the pre designed inclusion and exclusion criteria. All the participants who fulfilled the inclusion criteria were asked to sign written and informed consent. Patients with type 2 Diabetes mellitus and age between 20 -80 years were included in the study. Pregnant females, physically or mentally disabled, bed ridden, people having chronic disease like malignancy, Rheumatoid arthritis, patients who were on steroid therapy for more than 2 weeks, Patients with type I diabetes mellitus, gestational diabetes and secondary diabetes were excluded. Height, weight and body composition measurements were carried out by a group of medical graduates after supervised training. Inter-observer/operator reliability was assured. Confidentiality was maintained during the storage and analysis of data.

Measurements were taken using standardized equipment. Heights of all participants were measured using a stadiometer (seca 206, Germany) in standing position without footwear. Weight was measured with minimum clothes using a calibrated electronic scale with digital readout BMI was calculated by weight (kg) divided by height (m) squared (kg/m2).

Total body fat percentage (BF %) and total visceral fat percentage (VF%) was estimated by using a commercially available single-frequency, 8 electrode bio impedance analyzer system (OMRON BF 508--- Japan???). The reliability and validity of this system in measuring BF% has been previously verified and validated in multiple ethnicities.[12,13] Two parameters were measured: total body fat percentage (%BF) indicating percentage of fat in human body (normal is less than 25%) and central or visceral fat percentage (%VF) indicating percentage of fat deposited in abdomen (normal less than 9%). Bio-impedance analysis (BIA) provides good estimates of BF% and has been validated in previous studies.

All measurements were taken during morning hours (0830–1200) and the subjects didn't have any vigorous activity during the preceding 12 hours of the measurement. The system consisted of two handgrips with two electrodes each and a footplate with four electrodes. All procedures carried out according to manufacturer instructions. The electrodes between the left and right grips were short-circuited, along with those for the left and right feet. Study subjects stood on the footplate and gently grasped the two handgrips with arms held straight forward at 90 degrees. During the measurement, the instrument recorded whole body impedance from the hands to the feet by applying an electric alternating current flux of 0.8 mA at an operating frequency of 50 kHz. Finally, BF% was calculated from the whole body impedance value and the pre-entered personal data (age, gender, height and weight) of the corresponding subject. Inter-observer /operator reliability and precision of impedance measurements in the same subjects under standard condition were monitored. Whole-body composition was estimated using standard equations provided by the BIA manufacturer.

Two parameters were measured: total body fat percentage (%BF) indicating percentage of fat in human body (normal is less than 25%) and central or visceral fat percentage (% VF) indicating percentage of fat deposited in abdomen (normal less than 9%).

Bio-impedance analysis provides good estimates of BF% and has been validated in previous studies[8,14]. Group of medical students were sufficiently trained and demonstrated by the distributors for taking the measurements and meter use.

Statistical analysis: The data was entered in SPSS version 24.0. The respondents were male and female in this study. Mean and standard deviation was used for quantitative variables and frequency with percentage for qualitative variable. Age was divided into five categories with equal interval of 10 years. BF was divided into four categories like Low, Normal, High and Very High and VF into three major categories Normal, High and very high. The mean with standard deviation calculated for male and female separately.

Pearson chi-Square was used to identify the association between Age and BF, Age and VF and BF and VF. The decision of significance was considered at 5% level of significance.

RESULTS

The total number of patients enrolled in the study was 100 out of which 61 were males and 39 were females. All the patients who were included in the study had Type II diabetes mellitus. Age range of the male patients included in the study was 29 to 78 years with a mean age of 51.3 years and standard deviation 10.48. Age range of the female patients included in the study was 24 to 71 years with a mean age of 49.05 years and standard deviation 11.89. Most of the male patients 22/61(36%) fell in the age range of 51-60 years. Most of the female patients 12/39(31%) fell in the age range of 41-50 years. The height range was 156 to 189 cm with mean height of 171.52 cm for the male patients. The height range was 146 to174cm with mean height of 157.3 for the female patients. The weight range was 54.60 to 131.2kgs for males and 52.20 to 138.80kgs for female with mean weight of the male and female

patients was 81.79kgs and 72.95kgs respectively. The Body mass index (BMI) range was 21.40 to 48.80 kg/m^2 with mean BMI of 27.89 kg/m^2 and 19.80 to 40.70kg/m^2 with mean BMI of 29.42 kg/m^2 for male and the female patients respectively

A complete history was obtained about diabetes and physical examination was performed. Body fat in percentage and visceral fat in percentage of all the diabetic patients were measured using especially designed instrument (model number OMRON BF 508) monitor using bioelectric impedance. The body fat(%) range was 12 to 55 with mean±SD of 28±0.08 and 19 to 53 with mean±SD of 43±0.06 for male and female patients respectively. Most patients (35%) including male and female patients, fell in very high category of body fat, followed by 34% falling in normal category, 16% falling in low category of body fat and 15% fell in high category of body fat. Most of the male patients 33/61(54%) fell in the normal category of body fat and 15/61(25%), 10/61(16%) and 3/61(5%) males fell in low, high and very high category of body fat respectively. Most of the female patients 32/39(82%) fell in very high category of body fat. 1/39(3%), 1/39(3) % and 5/39 (12%) female patients fell in low, normal and high category of body fat respectively. The p-value (0.000) of body fat according to gender is highly significant.

The visceral fat(%) range was 3 to 26 with mean±SD of 11.48±5.71 for male patients and 5 to 16 with mean±SD of 9±2.24 for female patients. Most patients (48%) including male and female patients, fell in normal category of visceral fat, followed by 34% falling in high category and 18% falling in very high category of visceral fat. Most of the male patients 25/61(41%) fell in the normal category of visceral fat and 19/61 (31%) fell in high category and 17/61(28%) males fell in very high category of visceral fat. Most of the female patients 23/39 (59%) fell in normal category, 15/39(38%), 1(3%) fell in high and very high categories of visceral fat respectively. The p-value (0.005) of visceral fat according to gender is highly significant.

When body fat was analyzed with visceral fat and it showed significant dependence on eachother.16% of the patients with low body fat had normal visceral fat and none of the patient falling in low category of body fat had high or very high visceral fat which again shows linearity between these two factors. 9% of the patients had normal body fat as well as normal visceral fat.6% of the patients had high body fat so as the 8% had very high visceral fat which again shows the linearity between the two factors.17% of the patients fell in very high category of body fat so as 16% had high visceral fat in the same category. As p- value (0.000) is highly significant. Shows if there is change in body fat either increase or decrease will also affect the visceral fat

Table: 1: Gender wise distribution of age, height, weight, BMI, Body fat and Visceral fat

Gender	Age		Height(cm)		Weight(kg)		BMI		BF(%)		VF(%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	51.43	10.48	171.52	7.10	81.79	15.66	27.89	5.15	0.28	.08	11.48	5.17
Female	49.05	11.89	157.33	5.55	72.95	16.08	29.42	5.24	0.43	.06	9.00	2.24

Table: 2: Gender wise distribution of Body fat and Visceral fat

Gender	Body Fat				Visceral Fat		
	Low (<21)	Normal (21-32.9)	High (33-38.9)	Very high (> 39)	Normal (1-9)	High (10-14)	Very High (15-30)
Male	15	33	10	3	25	19	17
Female	1	1	5	32	23	15	1
Total	16	34	15	35	48	34	18
P-Value	0.000				0.005		

Table: 3: Distribution of body fat with regard to age and gender

Gender			Body Fat				Total	P-Value
			Low (<21)	Normal (21-32.9)	High (33-38.9)	Very high (> 39)		
M	Age	20-30	0	0	0	1	1	0.014
		31-40	1	6	2	1	10	
		41-50	4	10	4	1	19	
		51-60	5	13	4	0	22	
		61-70	4	2	0	0	6	
		71-80	1	2	0	0	3	
	Total		15	33	10	3	61	
		20-30	0	0	0	3	3	
		31-40	1	0	1	6	8	

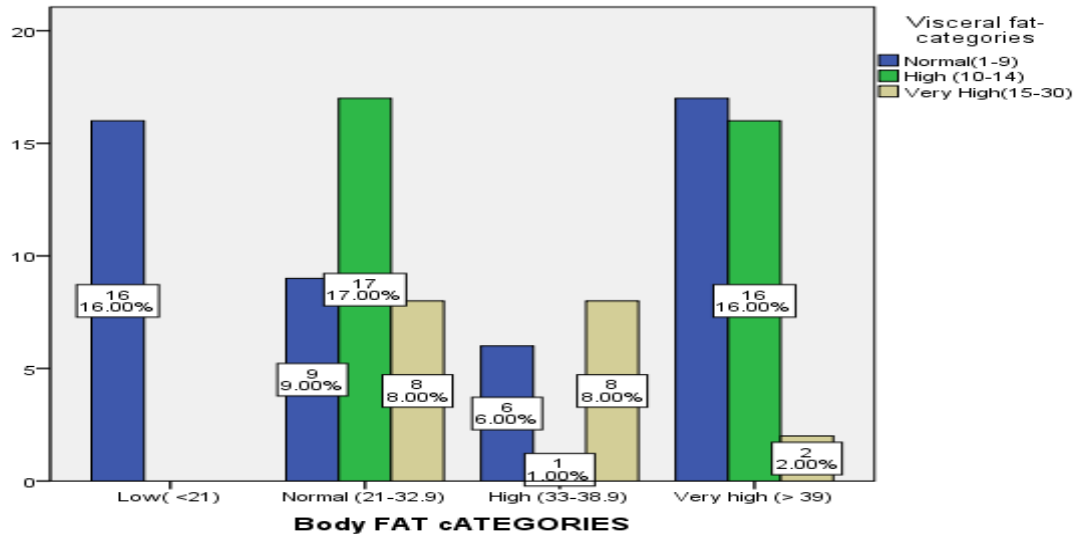
F	Age	41-50	0	0	1	11	12	0.339
		51-60	0	1	0	8	9	
		61-70	0	0	3	3	6	
		71-80	0	0	0	1	1	
	Total		1	1	5	32	39	
Total	Age	20-30	0	0	0	4	4	0.394
		31-40	2	6	3	7	18	
		41-50	4	10	5	12	31	
		51-60	5	14	4	8	31	
		61-70	4	2	3	3	12	
		71-80	1	2	0	1	4	
	Total		16	34	15	35	100	

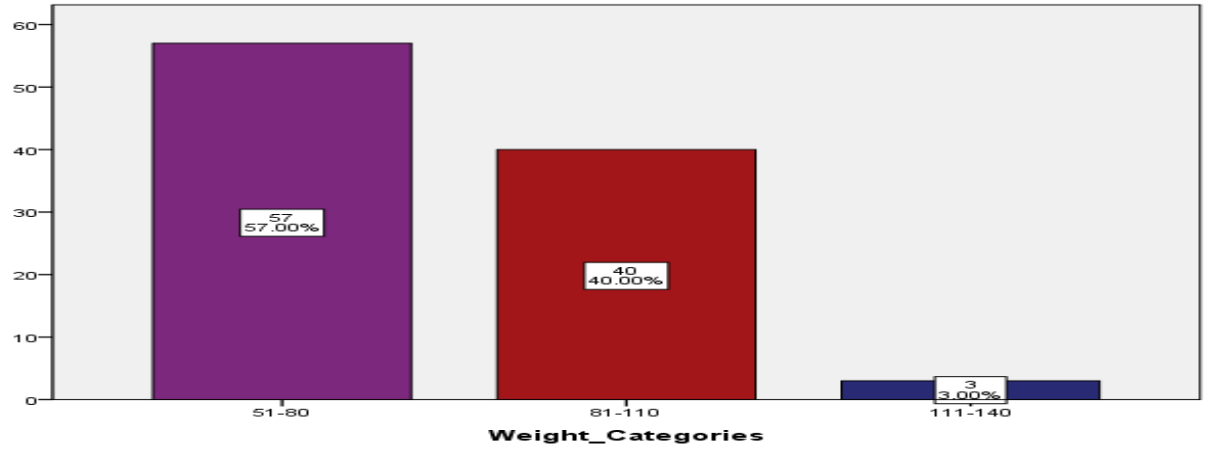
Table: 4: Distribution of visceral fat with regard to age and gender

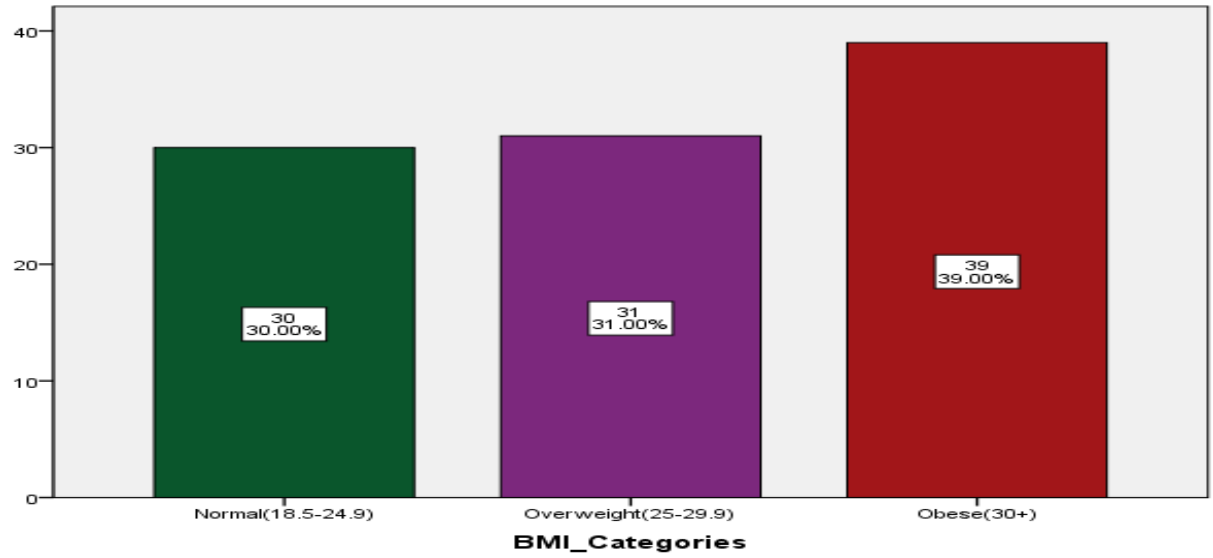
Gender			**Visceral Fat**			**Total**	**P-Value**
			Normal (1-9)	**High (10-14)**	**Very High (15-30)**		
M	Age	20-30	1	0	0	1	0.202
		31-40	2	4	4	10	
		41-50	6	8	5	19	
		51-60	9	6	7	22	
		61-70	6	0	0	6	
		71-80	1	1	1	3	
	Total		25	19	17	61	
F	Age	20-30	3	0	0	3	0.000
		31-40	6	2	0	8	
		41-50	7	5	0	12	
		51-60	4	5	0	9	
		61-70	3	3	0	6	
		71-80	0	0	1	1	
	Total		23	15	1	39	
Total	Age	20-30	4	0	0	4	0.216
		31-40	8	6	4	18	
		41-50	13	13	5	31	
		51-60	13	11	7	31	
		61-70	9	3	0	12	
		71-80	1	1	2	4	
	Total		48	34	18	100	

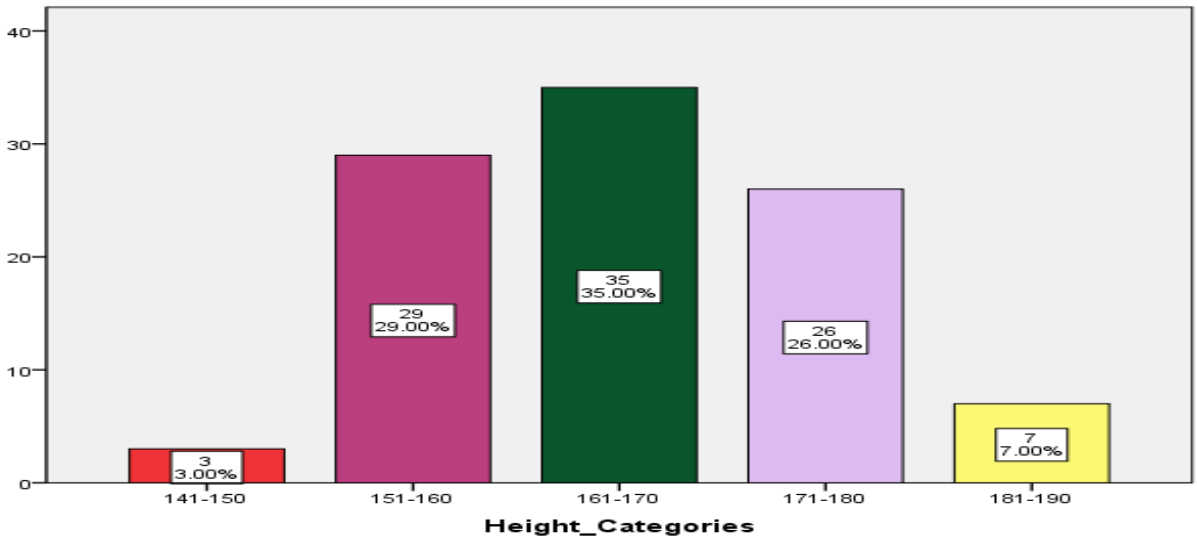
Table: 5: Relationship between Body Fat and Visceral Fat

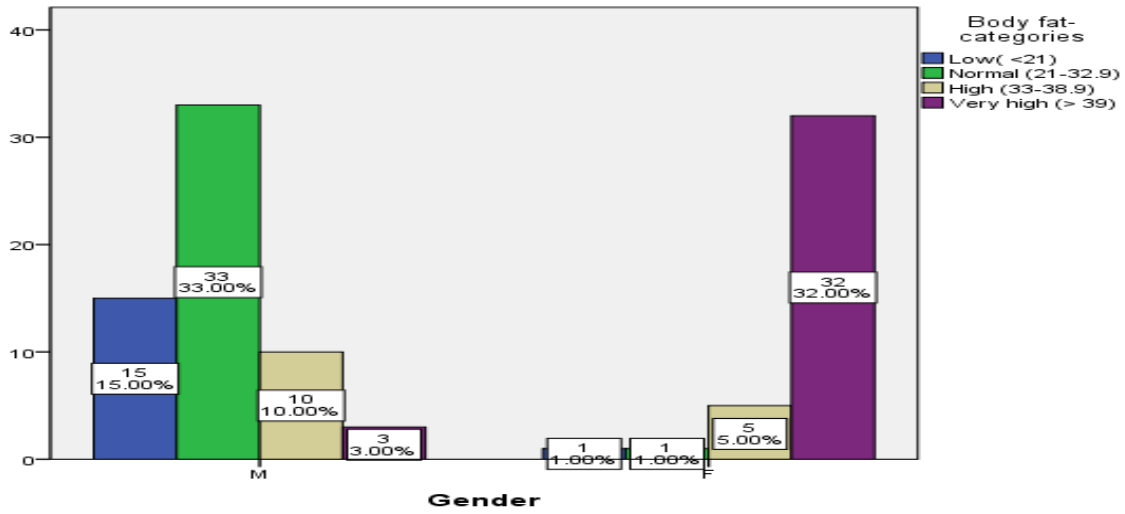
Relationship between Body Fat and Visceral Fat						
		Visceral Fat			**Total**	**P-Value**
		Normal (1-9)	**High (10-14)**	**Very High (15-30)**		
Body Fat	Low(<21)	16	0	0	16	0.000
	Normal (21-32.9)	9	17	8	34	
	High (33-38.9)	6	1	8	15	
	Very high (> 39)	17	16	2	35	
Total		48	34	18	100	

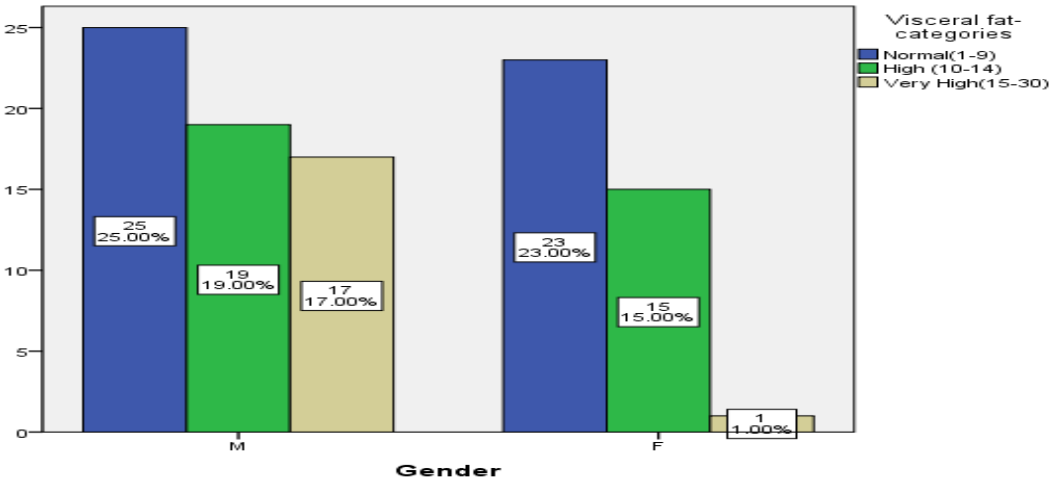

Visceral fat-categories
Normal(1-9)
High (10-14)
Very High(15-30)
16 16.00%
9 9.00%
17 17.00%
8 8.00%
6 6.00%
1 1.00%
8 8.00%
16 16.00%
2 2.00%
Low(<21)
Normal (21-32.9)
High (33-38.9)
Very high (> 39)
Body FAT cATEGORIES


57 57.00%
40 40.00%
3 3.00%
51-80
81-110
111-140
Weight_Categories


30 30.00%
31 31.00%
39 39.00%
Normal(18.5-24.9)
Overweight(25-29.9)
Obese(30+)
BMI_Categories


40
30
20
10
0
3
3.00%
29
29.00%
35
35.00%
26
26.00%
7
7.00%
141-150
151-160
161-170
171-180
181-190
Height_Categories


Body fat-categories
Low(<21)
Normal (21-32.9)
High (33-38.9)
Very high (> 39)
40
30
20
10
0
15
15.00%
33
33.00%
10
10.00%
3
3.00%
1
1.00%
1
1.00%
5
5.00%
32
32.00%
M
F
Gender


Visceral fat-categories
Normal(1-9)
High (10-14)
Very High(15-30)
25
20
15
10
5
0
25
25.00%
19
19.00%
17
17.00%
23
23.00%
15
15.00%
1
1.00%
M
F
Gender

DISCUSSION

Diabetes mellitus along with high percentages of body fat and visceral fat has a major impact on human body which can lead to serious complications if not identified early. Obesity is considered as one of the most emerging public health problems reducing life expectancy and quality of life[14]. Many factors influence the obesity epidemic, including genetic susceptibility, socioeconomic, cultural, behavioral, environmental factors, imbalance between food intake and lack of physical activity[15].

As it has been observed that most of the diabetic patients are overweight with dyslipidemia and are at increased risk for cardiovascular diseases and other complications. Diabetes mellitus along with high percentages of body fat and visceral fat has a major impact on human body which can lead to serious complications, if not identified early. Obesity is considered as one of the most emerging public health problems reducing life expectancy and quality of life[14]. Many factors influence the obesity epidemic, including genetic susceptibility, socioeconomic, cultural, behavioral, environmental factors, imbalance between food intake and lack of physical activity[15].

There has always been a need in tertiary care hospitals of Pakistan to have this instrument using bioelectric impedance analysis (BIA) measuring body fat and visceral fat. It is easy, simple, convenient, cheap, portable and non invasive and quick way of assessing the body fat and visceral fat. This method requires no advanced skills on the part of operator and subject cooperation is minimal too.[16] Unfortunately Pakistan with a population of about 220 million, there are only few institutes mainly concentrated in Karachi and Lahore which are using this method for measuring body fat and visceral fat. A recently published local study by Akhter O et al[17] compared BMI with body fat but also measured visceral fat and found out that female subjects had higher visceral fat percentages than male subjects which is comparable with the results of our study. There are many local and international studies done comparing and analyzing BMI with body fat, so this was a unique study in regard to comparing body fat with visceral fat.

Study done by Lakka HM et al[18] concluded that higher percentages of visceral fat has strong association with early cardiovascular diseases. Ehtisham S et al.[19] concluded that the ethnic differences in body fat and visceral fat and insulin resistance do exist among different ethnicities, Like South east Asians have higher percentages of visceral fat and so the higher insulin resistance which is also comparable with our study. Another study by Heshka S et al[20] that when visceral fat is present in higher percentages in an individual, it is an strong risk factor for insulin resistance and hyperinsulinemia. So early detection of higher percentages of body fat and visceral fat will help us to advise the patients to adopt life style modifications and probably appropriate treatment to reduce the complications associated with the abnormal percentages of body fat and visceral fat like insulin resistance and development of early cardiovascular diseases.

Limitations: We only included diagnosed type 2 diabetic patients in our study, and most of them were either overweight or obese. So this study cannot be generalized to Type 1 diabetics, patients with secondary diabetes and also younger and lean subjects.

Future recommendations: We recommend further studies need to be conducted in tertiary care hospitals to see linear regression model between body fat and visceral fat and BMI.

CONCLUSION

Bioelectrical impedance analysis (BIA) is a Simple, easy, convenient, quick, cheap, portable, non invasive way of assessing the body fat and visceral fat with minimum skills required on operator part and little cooperation required by subjects. . Early detection of higher percentages of body fat and visceral fat will help us to advise the patients to adopt life style modifications and probably appropriate treatment to reduce the complications associated with the abnormal percentages of body fat and visceral fat so as the morbidity and mortality associated with abnormally increased in percentages of both the parameters in the individuals. Body fat was higher in most of the diabetics especially more prevalent in women. And there was linearity between the BF and VF which means if there is change in body fat either increase or decrease will also affect the visceral fat. So reductions in weight, waist circumference and in turn maintain an ideal BMI for the given age and gender and also reducing the central body fat percentage should be the integral part of management in patients with type 2 diabetes mellitus.

Competing interest: The author has declared that no conflict of interest exists.

Authors' contributions: AZKC designed the study, data collection, examining the participants, performed the statistical analysis and drafted the manuscript. NJ, AF did review of the manuscript. KMA helped in statistical analysis. AZKC edited and approved the final manuscript.

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