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Study on Body Composition of Patients with Diabetes Mellitus by Dual-Energy X-Ray Absorptiometry: A Morphological Study

Estudio sobre la Composición Corporal de Pacientes con Diabetes Mellitus Mediante Absorciometría de Rayos X de Energía Dual: Un Estudio Morfológico

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SUMMARY: Diabetes is a form of endocrine disease. Dual-energy X-ray Absorptiometry (DXA) provides a detailed view of the body composition to find out what makes people with diabetes different from those with other diseases. We scanned 371 patients with DXA to analyze their body composition parameters. Three hundreds and seventy one patients (178 women/193 men), who with different diseases, with a mean±SD Body Mass Index (BMI) of 25.32±8.3 kg/m2 were included. The body composition of 371 patients was assessed. Bone Mineral Density (BMD), Fat Weight, Lean Weight, waist-to-hip ratio, Lean Mass Index (LMI), Fat Mass Index (FMI), the relationship between Fat percentage and BMI were analyzed. The 371 patients included 156 diabetics and 215 non-diabetics. Non-diabetic patients also included 5 obesity patients, 9 patients with fatty liver, 39 patients with hypertension, 22 patients with hyperlipidemia, 18 patients with cardiovascular disease, 11 patients with chest and lung disease, 4 patients with chronic disease, 14 patients with brain disease and 93 patients with other diseases. Among 156 diabetic patients, 129 had VAT > 100 cm2 and 27 had VAT ≤100 cm2. The lean weight (LW) of male diabetic patients was significantly higher than that of female diabetic patients. The fat weight (FW) of female patients with diabetes was significantly higher than that of male patients. The waist-hip ratio (WHR) was 1.37 ± 0.25 in male diabetic patients and 1.18 ± 0.21 in female diabetic patients. Among the 215 non-diabetic patients, the obese and fatty liver patients, which the weight (WT) (obesity: 83.87 ± 8.34 kg fat liver: 85.64±28.60 kg) , FW (obesity: 28.56 ± 4.18 kg fat liver: 28.61 ± 10.79 kg) , LW (obesity: 52.62 ± 9.64 kg fat liver: 54.29±17.58 kg) , BMI (obesity: 28.76 ± 1.88 kg/m2 fat liver: 29.10 ± 5.95 kg/m2), was much higher than other patients. Diabetes patients had less fat mass than non-diabetic patients; the difference was around 2 kg. BMI is also a modest number. BMD doesn't differ all that much. Non-diabetic patients with fatty liver obesity and cardiovascular disease had higher fat mass and BMI than patients with other illnesses. Body composition can provide precise information on the makeup of different body areas, but further in-depth exams are required to ascertain the body's endocrine profile.

KEY WORDS: Body composition; Dual-energy X-ray Absorptiometry; Bone mineral density; Fat mass index; Lean mass index.

INTRODUCTION

In today's physical examination, body composition is given more and more consideration. It is possible to prevent some diseases brought on by obesity and cardiovascular conditions by measuring body composition. In the interim, body composition can also be used to track the success of treatments for conditions like diabetes (Cândido *et al*., 2014; Botella Martínez *et al*., 2016; Ben-Joseph *et al*., 2021). A chronic metabolic condition called diabetes mellitus (DM) is brought on by a variety of circumstances (Chen *et al*., 2020; Cipriani *et al*., 2020). It typically starts around the age of 35 to 40 and later. About 90 % of people with DM belong to this segment of the population (Foos *et al*., 2019; Giudici *et al*., 2021; de Tejada-Romero *et al*., 2022). Diabetes is a more serious type of the disease, which is spreading rapidly throughout the world. 537 million persons worldwide, or 10.5 % of the population, have diabetes as of 2021 (Alfadhli *et al*., 2022; He *et al*., 2022). IDF (International Diabetes Federation) estimates that by 2045,

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there will be 783 million people worldwide who have diabetes, or 12.2 % of the world's population. China saw a 56 % growth in the number of diabetics from 90 million in 2011 to 140 million in 2021. In 2045, there would be 174 million diabetics in China, according to predictions (Ren *et al*., 2017; Tian & Yu, 2017; Speight *et al*., 2020). Early detection and treatment of diabetes are significant issues in the effort to prevent diabetes.

Numerous research conducted in recent years have revealed that osteoporosis is a potential consequence for diabetes people (Lee *et al*., 2017; Weisman *et al*., 2018; Wu *et al*., 2019; Wang *et al*., 2020). Increased blood sugar in diabetic people causes an endocrine imbalance, which inhibits calcium absorption and results in a loss of bone mass, which results in osteoporosis (Xing *et al*., 2019; Misnikova *et al*., 2021; Alfadhli *et al*., 2022; Xing & Chai, 2022). Osteoporosis and diabetes have a complicated interaction (Lovic *et al*., 2020; Lee *et al*., 2022). Patients with diabetes have a higher risk of fractures, according to numerous studies that have demonstrated a connection between the condition and fractures.

Diabetes frequently results in consequences including osteoporosis and reduced fat mass, and clinical criteria for obesity are typically described in terms of BMI (Ponti *et al*., 2017; Maïmoun *et al*., 2021). But BMI is not a reliable predictor of obesity on its own. In comparison to BMI, the International Society for Clinical Densitometry (ISCD) claims that fat percentage is a more reliable indicator of obesity (Pratley & Gilbert, 2012; Raska Jr. *et al*., 2017). However, there is no general agreement on how to define obesity using the proportion of total body fat.

MATERIAL AND METHOD

Subjects. 371 patients' medical examination reports from Shanghai Pudong Hospital were gathered by them. 156 of the 371 individuals had diabetes, while 215 did not. These patients' basic bodily statistics were compiled and graphed. With more precise breakdowns by age and sex in each category, all patients were divided into diabetes and non-diabetic groups. Comparing the patients' BMD, fat mass, lean mass, and waist-to-hip ratios allowed for assessment.

Clinical methods. Discovery Wi bone densitometry were used to measure clinical data. The patient's numerous bodily values were gathered during the scans. Including the makeup and ratio of various body parts. To offer a more accurate evaluation of the participants' physical condition, the obtained data were statistically evaluated and compared with the International Society for Clinical Densitometry (ISCD).

Group of clinical parameters. Each patient received a DXA scan to collect information on their entire body composition, including their limbs, torso, head, and entire body. Age, height, weight, bone density, lean mass, and fat mass were all included in the data. Table I includes all of the outcomes.

Assessment of body composition using several indices. After gathering information on the patients' body composition, the necessary BMI, FMI, and LMI were determined using the algorithm and recorded in Table I.

BMI=Whole Weight/Height^2 **FMI**=Fat Weight/Height^2; **LMI**=Lean Weight/Height^2 **Fat%**=(Fat Weight/Whole Weight)*100

RESULTS

Comparison of parameters associated to DM and NDM. The 371 patients were divided into groups based on the various disorders. Patients with diabetes and those who have cardiovascular illness have comparatively low BMD, as can be observed from the data plots made (Fig. 1a). Then, compared to those with other conditions, those with obesity and fatty liver had much greater FW. Diabetes patients showed an FW that was rather low (Fig. 1b). Diabetes patients also had comparatively reduced LW (Fig. 1c). The patients' waist-to-hip ratio was examined. The ratio of the waist to the hip is larger in obese and fatty liver patients. These two patient groups' adipose tissue was primarily located in the belly (Fig. 1d). Subcutaneous fat, which accounts for 80 % of body fat, serves primarily as an energy reserve. The fat that covers the abdominal muscles and subcutaneous fat is referred to as visceral adipose tissue. For men, visceral adipose tissue makes up 10-20 % of total body fat and 5-8 % for women. The best way to describe visceral adipose tissue is in terms of its area rather than its volume, mass, or both. According to the ISCD's criteria, the splanchnic fat area was normal between 10 and 100 cm^2, somewhat higher between 100 and 160 cm^2, and higher between 160 and 300 cm^2. The collected results show that 87.0 % of patients without diabetes and 82.7 % of patients with diabetes had visceral adipose tissue areas more than 100 cm^2 each (Table II).

The correlation between FMI and LMI in people with diabetes and the correlation between FMI and LMI in those without diabetes were also contrasted (Figs. 1e, f). Patients who were not diabetic tended to group together more frequently.

A patient's BMI and fat percentage combined can provide a more precise assessment of their obesity status.

Table I. Basic information of 371 patients.

	Diabetes N=156	Obesity N=5	Fatty liver N=9	Hypertension N=39	Hyperlipemia N=22	Cardiovascular N=18	Chest and lung N=11	Chronic disease N=4	Brain disease N=14	Others N=93
Years±SD (year)	58.09±14.90	47.4±16.46	41.44±16.69	66.08±12.04	51.68±12.58	70.89±9.83	68.09±14.17	80.25±8.07	66.21±13.78	59.24±17.48
Weight±SD (Kg)	**67.76±12.54**	**83.87±8.34**	**85.64±28.60**	**65.78±8.00**	**69.87±12.20**	**71.83±13.88**	**66.50±11.73**	**72.96±6.53**	**60.73±12.07**	**68.88±15.58**
Height±SD (m)	1.65±0.08	1.71±0.10	1.69±0.13	1.63±0.09	1.66±0.07	1.64±0.07	1.66±0.08	1.68±0.09	1.63±0.06	1.64±0.08
BMD±SD (Kg/m^2)	1.163±0.155	1.215±0.109	1.251±0.207	1.161±0.182	1.156±0.117	1.125±0.170	1.208±0.122	1.160±0.077	1.169±0.143	1.159±0.166
Fat weight±SD (Kg)	**21.20±6.87**	**28.56±4.18**	**28.61±10.79**	**21.28±5.73**	**22.33±5.70**	**26.37±7.81**	**19.62±7.56**	**23.62±2.27**	**18.65±7.87**	**23.75±8.55**
Lean weight±SD (Kg)	**44.25±9.19**	**52.62±9.64**	**54.29±17.58**	**42.26±6.73**	**45.20±9.09**	**43.22±9.35**	**44.45±7.83**	**46.94±7.59**	**39.85±5.91**	**42.87±9.23**
BMI±SD (Kg/m^2)	**24.94±3.92**	**28.76±1.88**	**29.10±5.95**	**24.94±3.07**	**25.35±3.58**	**26.67±4.57**	**24.20±3.50**	**25.76±1.08**	**22.72±3.71**	**25.50±4.75**
FMI±SD (Kg/m^2)	7.93±2.76	10.01±2.45	9.75±2.88	8.21±2.63	8.18±2.20	9.90±3.19	7.21±3.09	8.44±1.46	6.99±2.80	8.85±3.01
LMI±SD (Kg/m^2)	16.16±2.31	17.84±1.50	18.44±3.33	15.95±1.70	16.37±2.19	15.94±2.64	16.10±1.57	16.48±1.58	14.90±1.43	15.80±2.47
Left arm										
BMD±SD (Kg/m^2)	0.769±0.139	0.766±0.109	0.828±0.131	0.739±0.136	0.810±0.251	0.734±0.128	0.783±0.085	0.741±0.069	0.749±0.106	0.736±0.107
Fat weight± SD (Kg)	1.46±0.57	1.90±0.48	1.91±0.73	1.47±0.46	1.42±0.47	1.85±0.59	1.29±0.63	1.71±0.24	1.38±0.64	1.64±0.68
Lean weight±SD (Kg)	2.26±0.62	2.73±0.66	2.76±0.88	2.12±0.49	2.31±0.66	2.14±0.53	2.35±0.45	2.42±0.52	1.98±0.34	2.15±0.63
Right arm										
BMD±SD (Kg/m^2)	0.752±0.122	0.778±0.108	0.823±0.136	0.746±0.140	0.752±0.105	0.720±0.129	0.769±0.077	0.743±0.077	0.778±0.147	0.731±0.117
Fat weight± SD (Kg)	1.42±0.60	1.84±0.46	1.80±0.75	1.40±0.48	1.38±0.38	1.69±0.61	1.19±0.58	1.51±0.35	1.21±0.54	1.59±0.64
Lean weight±SD (Kg)	2.52±0.70	2.94±0.53	3.11±1.14	2.38±0.61	2.60±0.70	2.43±0.68	2.50±0.53	2.63±0.63	2.24±0.50	2.38±0.68
Left ribs										
BMD±SD (Kg/m^2)	0.641±0.096	0.656±0.103	0.677±0.124	0.636±0.101	0.642±0.080	0.612±0.086	0.691±0.080	0.576±0.039	0.622±0.089	0.632±0.098
Right ribs										
BMD±SD (Kg/m^2)	0.641±0.089	0.663±0.085	0.677±0.123	0.659±0.099	0.638±0.086	0.634±0.080	0.717±0.106	0.616±0.053	0.632±0.076	0.640±0.102
T lumbar										
BMD±SD (Kg/m^2)	0.916±0.175	0.904±0.124	0.950±0.197	0.929±0.192	0.900±0.123	0.964±0.166	1.019±0.149	0.925±0.112	0.935±0.189	0.927±0.213
Fat weight± SD (Kg)	12.05±4.16	16.10±2.44	16.45±6.19	12.28±3.66	12.81±3.65	14.48±4.63	11.89±4.82	13.03±1.72	10.37±4.80	13.30±4.74
Lean weight±SD (Kg)	22.81±4.62	25.77±6.08	27.04±8.98	21.92±3.32	23.08±4.49	21.68±4.21	23.84±4.15	24.74±3.39	20.79±3.00	22.07±4.72
Left lumbar										
BMD±SD (Kg/m^2)	1.007±0.185	1.130±0.080	1.097±0.235	1.040±0.270	0.992±0.123	1.075±0.226	1.107±0.216	0.999±0.096	1.053±0.175	1.036±0.239
Pelvis										
BMD±SD (Kg/m^2)	1.099±0.213	1.515±0.470	1.176±0.258	1.131±0.281	1.068±0.261	1.165±0.507	1.068±0.117	1.018±0.102	1.063±0.180	1.131±0.308
Left leg										
BMD±SD (Kg/m^2)	1.154±0.176	1.198±0.166	1.310±0.293	1.146±0.190	1.157±0.142	1.130±0.165	1.208±0.122	1.152±0.047	1.162±0.159	1.143±0.201
Fat weight± SD (Kg)	2.71±0.98	3.85±1.31	3.75±1.71	2.64±0.85	2.95±0.85	3.70±1.27	2.24±0.91	3.38±0.61	2.47±1.17	3.20±1.49
Lean weight±SD (Kg)	6.61±1.62	8.555±1.30	8.74±3.01	6.22±1.34	6.84±1.52	6.66±1.91	6.14±1.45	6.89±1.54	5.60±1.09	6.44±1.61
Right leg										
BMD±SD (Kg/m^2)	1.167±0.188	1.236±0.169	1.326±0.306	1.145±0.182	1.167±0.153	1.126±0.168	1.196±0.119	1.166±0.038	1.178±0.178	1.147±0.193
Fat weight± SD (Kg)	2.66±0.96	3.85±1.31	3.64±1.66	2.60±0.83	2.86±0.77	3.64±1.21	2.12±0.80	3.06±0.45	2.36±1.04	3.15±1.43
Lean weight±SD (Kg)	6.69±1.62	8.87±1.39	8.80±3.12	6.29±1.32	6.94±1.55	6.65±1.79	6.32±1.67	6.75±1.52	5.96±1.27	6.53±1.63
Partially										
BMD±SD (Kg/m^2)	0.948±0.138	1.016±0.107	1.043±0.210	0.944±0.154	0.952±0.104	0.939±0.158	0.985±0.097	0.930±0.049	0.952±0.127	0.941±0.152
Fat weight± SD (Kg)	20.30±6.82	27.53±4.20	27.54±10.60	20.39±5.70	21.42±5.66	25.36±7.59	18.74±7.47	22.68±2.37	17.78±7.77	22.87±8.49
Lean weight±SD (Kg)	40.84±8.97	48.87±9.44	50.46±16.99	38.94±6.51	41.76±8.73	39.51±8.51	41.15±7.52	43.43±7.29	36.58±5.53	39.57±8.93
Head										
BMD±SD (Kg/m^2)	2.598±0.539	2.679±0.382	2.722±0.404	2.655±0.588	2.588±0.413	2.434±0.488	2.805±0.490	2.841±0.316	2.612±0.497	2.624±0.576
Fat weight± SD (Kg)	0.90±0.12	1.03±0.06	1.06±0.22	0.89±0.12	0.92±0.12	1.01±0.41	0.88±0.13	0.94±0.11	0.87±0.14	0.89±0.12
Lean weight±SD (Kg)	3.53±2.32	3.74±0.28	3.83±0.70	3.32±0.43	3.43±0.42	3.71±1.38	3.30±0.41	3.51±0.37	3.27±0.48	3.27±0.50

Table II. Visceral adipose tissue of 371 patients.

	Diabetes N=156	Obesity N=5	Fatty liver N=9	Hypertension N=39	Hyperlipemia N=22	Cardiovascular disease N=18	chest and lung disease N=11	Chronic disease N=4	Brain disease N=14	Others N=93
VAT_100	129	5	8	34	18	14	9	4	8	85
VAT≤100	27	0	1	5	4	4	2	0	6	8

Obesity cannot be determined solely by BMI. BMI > 30 kg/m^2 is obesity, BMI< 30 kg/m^2 is non-obesity. Blue for the male standard and pink for the female standard in the vertical coordinates. The chart is divided into four quadrants by the standard line. In terms of BMI and fat percentage, the upper right quadrant denotes obesity, whereas the lower left quadrant denotes non-obesity. The great majority of patients would be incorrectly classified as non-obese if obesity were simply determined by BMI (Figs. 1g, h).

Comparing relevant DM parameters

Comparison of DM parameters associated to men and women. The male and female groups of diabetes patients were separated, and the differences in several parameters between the sexes were compared. The compiled data plots demonstrate that, when the lean quality parameters were compared between men and women, the lean quality of women was significantly lower (Fig. 2a). Figure 2b shows

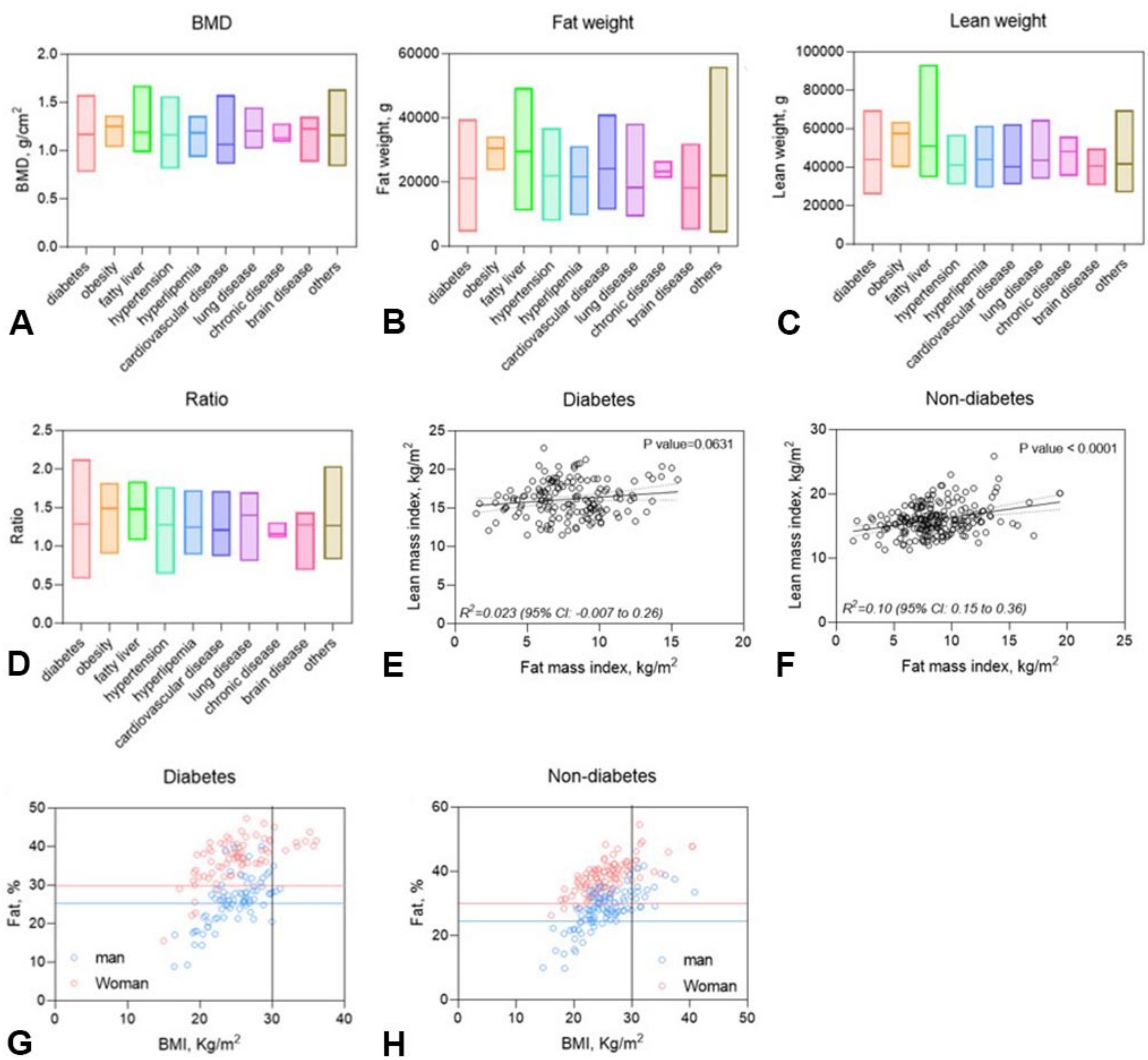

Fig. 1. A. Comparison of BMD in patients of several kinds. The line is the median. B. Comparison of fat weight in patients of several kinds. The line is the median. C. Comparison of lean weight in patients of several kinds. The line is the median. D. Comparison of waist-hip ratio in patients of several kinds. The line is the median. E. The relationship between FMI and LMI in diabetes mellitus. The graph contains estimated linear regression with 95 % confidence intervals. F. The relationship between non-diabetic FMI and LMI in diabetes mellitus. The graph contains estimated linear regression with 95 % confidence intervals. G. BMI and fat percentage in men and women with diabetes. h. BMI and fat percentage in men and women without diabetes.

that women's fat mass was much higher than men's, indicating that men and women may not view obesity in the same ways. Women's BMD was significantly lower overall than men's BMD (Fig. 2c), and women's BMD was similarly lower than men's BMD in all other parts of the body. It suggests that women are more likely than men to get fractures and osteoporosis. In 84.0 % of subjects in the female group and 81.5 % of subjects in the male group, visceral adipose tissue area was greater than 100 cm^2 (Table II).

In addition to fat percentage, males and women have different fat distributions. In order to assess how fat is distributed generally between men and women, we determined the waist-hip ratio for both sexes. The findings indicated that men's bodies had more concentrated amounts of fat in the upper body, waist, and belly, giving them an apple-shaped form. Women have a pear-shaped form due to the concentration of fat in the lower body, particularly in the area around the thighs and buttocks (Fig. 2d).

Men and women were compared in terms of the link between FMI and LMI. The median FMI and LMI for men and women are shown as a dotted line in Figures 2e and 2f.

Comparison of relevant metrics between DM participants over 50 and under 50. According to their ages, diabetes patients' variances in the parameters by gender were compared. Parameters were compared between patients who were over 50 and those who were under 50 after patients were classified based on their age. Lean mass analyses revealed that individuals under the age of 50 had considerably higher lean mass than those over the age of 50 (Fig. 3a). Patients above the age of 50 had lower fat mass than patients under the age of 50 (Fig. 3b). Patients over 50 had less BMD. Those over 50 had lower total BMD than those under 50 (Fig. 3c), who had higher BMD overall. When the waist-to-hip ratio of subjects aged 50 and over was compared to that of subjects aged 50 and under, it was discovered that the subjects aged under 50 had more fat distributed in their waist

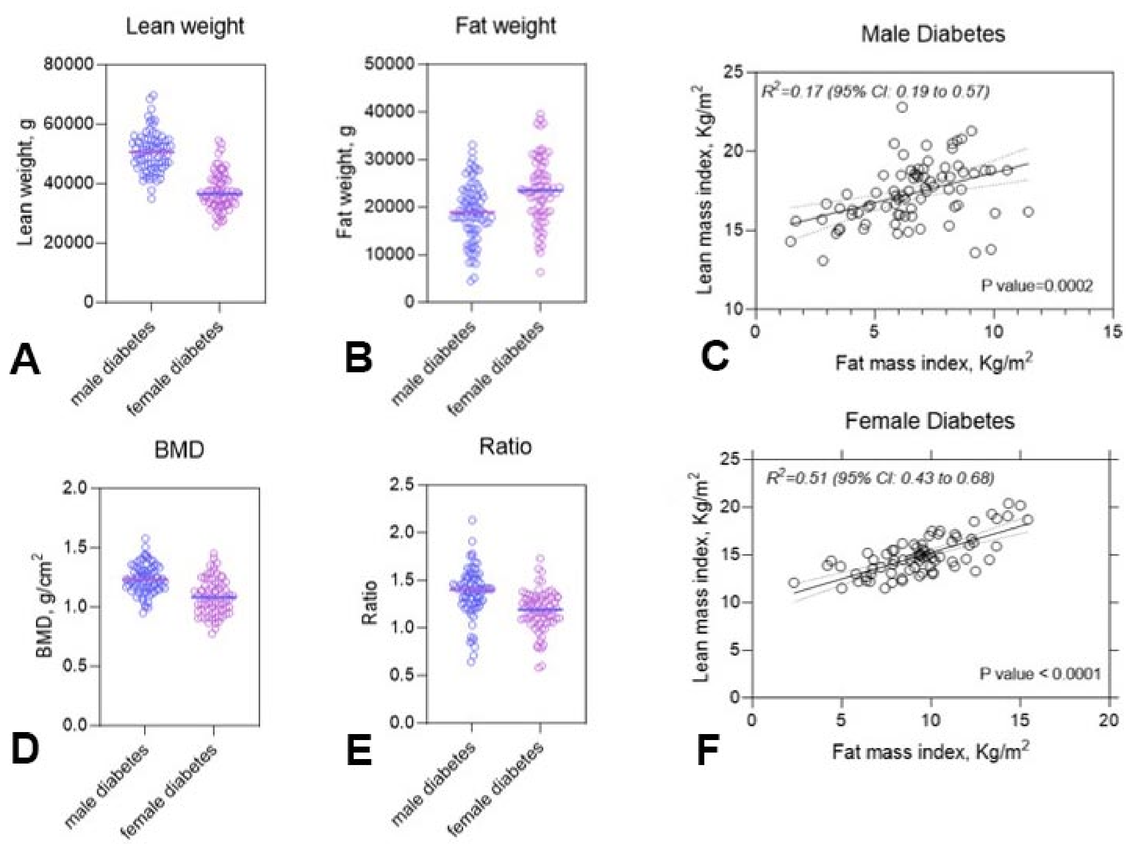

Fig. 2. A. Lean weight of diabetic men and women. The left line is the median of men, and the right line is the median of women. B. Fat weight of diabetic men and women. The left line is the median of men, and the right line is the median of women. C. BMD of diabetic men and women. The left line is the median of men, and the right line is the median of women. D. Waist-hip ratio of diabetic men and women. The left line is the median of men, and the right line is the median of women. E. Relationship between FMI and LMI in patients with diabetes mellitus in men. The graph contains estimated linear regression with 95 % confidence intervals. F. Relationship between FMI and LMI in patients with diabetes in women. The graph contains estimated linear regression with 95 % confidence intervals.

and abdomen, while the subjects aged over 50 had most of their fat distributed in their buttocks and thighs (Fig. 3d). In terms of visceral adipose tissue area, roughly 85.4 % of participants under 50 and 81.7 % of subjects 50 and older were larger than 100 cm2 respectively (Table II).

The dotted line in Figures 3e and 3f, represents the median of FMI and LMI, and it shows the link between LMI and FMI for those 50 years of age or older and younger.

Comparison of associated variables in patients with NDM. Other diseases are present in non-diabetic patients, such as obesity, fatty liver, hypertension, hyperlipidemia, cardiovascular disease, lung and chest disease, chronic illnesses, brain disease, and others. Therefore, it is impossible to tell them apart only on sex or age. Cardiovascular disease, obesity, and fatty liver were shown to have higher fat mass than other diseases in non-diabetic patients when these groups were separated. Patients with obesity and fatty livers also have relatively high lean quality, whereas patients with cardiovascular disease do not. Additionally, BMI was higher in patients with obesity, fatty livers, and cardiovascular disease. Patients with obesity and fatty liver disease typically had fat deposits in their trunk and lower limbs, while those with cardiovascular disease typically had deposits in their lower limbs. There is not much of a difference in the BMD of these types of disorders, with the exception of distinct regions of the BMD that change significantly.

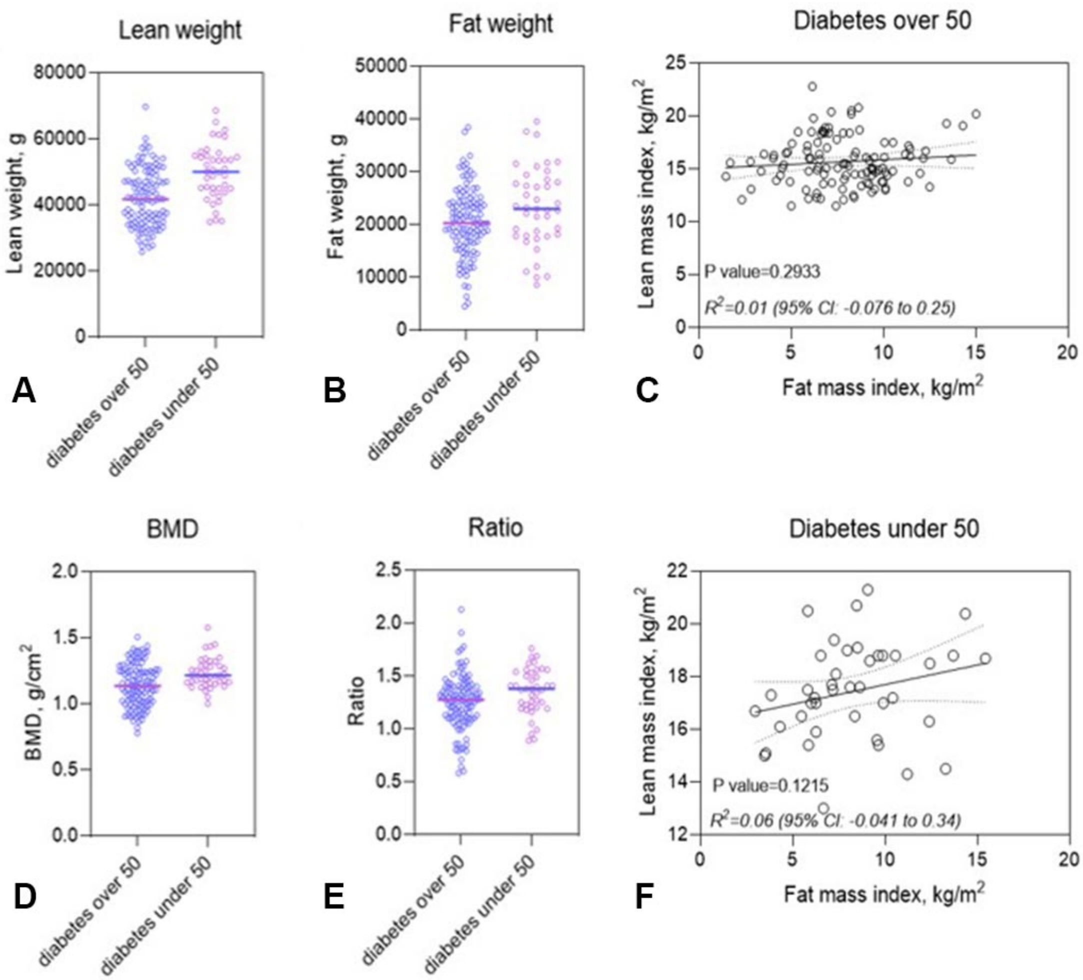

Fig. 3. A. The lean mass of diabetic patients aged over 50 years was compared with that aged under 50 years. The left line is the median of lean mass over 50 years old, and the right line is the median of lean mass under 50 years old. B. Fat mass was compared between the patients over 50 years old and those under 50 years old. The left line is the median of fat mass over 50 years old, and the right line is the median of fat mass under 50 years old. C. BMD was compared between patients over 50 years old and those under 50 years old. The median bone mineral density was above 50 years old in the left line and below 50 years old in the right line. D. The waist-hip ratio was compared between patients over 50 years old and those under 50 years old. The median waist-to-hip ratio was above 50 years old on the left and below 50 years old on the right. E. Relationship between FMI and LMI in patients with diabetes mellitus over 50 years old. The graph contains estimated linear regression with 95 % confidence intervals. F. Relationship between FMI and LMI in patients with diabetes under 50 years old. The graph contains estimated linear regression with 95 % confidence intervals.

DISCUSSION

Predicting a subject's physical condition by physical analysis has become an essential component of physical examination. DXA scanning of the patients' entire bodies may make it easier to understand how their body composition is distributed (Andreoli *et al*., 2009; Bazzocchi *et al*., 2016; Jawhar *et al*., 2020). It was stated that the prevalence of osteoporosis was significantly higher in the diabetic group (RR: 1.2, 95 %CI: 1.1, 1.2). Among the results, BMD and T-score values were similar in the diabetic and control groups, and Z-score values of the Lumbar spine, L1 and L3 were significantly higher in the diabetic group. Obese patients had significantly higher BMD than non-obese patients in both groups studied. They found significantly higher BMD, T-score, and Z-score values in the left femoral total hip of a young diabetic patient (Jawhar *et al*., 2020). In a study, although DXA is increasingly used to measure body composition, data in the literature highlight the need for caution when using DXA to compare patients with control subjects or to assess changes in body composition in subjects whose relative weight varies significantly between measurements. It was also noted that future research is needed to investigate the application of DXA in different fields (chronic diseases and sports medicine) (Andreoli *et al*., 2009).

In a study evaluating the DXA method, they stated that it may be useful to introduce in clinical practice additional DXA parameters and indexes of adiposity representative of central and peripheral distribution of fat mass such as visceral adipose tissue and subcutaneous adipose tissue and their ratio, gynoid and android fat mass and their ratio, trunk/leg fat mass, and visceral adipose tissue/ gynoid fat mass (Bazzocchi *et al*., 2016). It is more accurate to assess the participants' obesity through analysis and calculation of their various body compositions than through BMI alone (Rathinavelu *et al*., 2018; Rehunen *et al*., 2021; Sheu *et al*., 2022). It has been stated that the causes of fractures can be explained by the interaction of signaling pathways that modulate bone and glucose metabolism in type II diabetic patients. They emphasized that a combination of bone mineral density, fracture risk assessment tool and biochemical markers should be used to assess fracture risk. So, they stated that the bone health of patients with type II diabetes should be checked regularly and that the bone status of patients with type II diabetes should be evaluated as a complication of diabetes (Rathinavelu *et al*., 2018). Contrary to popular belief, it has been stated that having excess muscle mass does not protect against type 2 diabetes. It has been argued that a high fat mass index combined with a high lean mass index appears to predict the later development of type 2 diabetes (Rehunen *et al*., 2021).

Hyperglycemia is a characteristic of diabetes mellitus, a chronic condition that affects many people. Because the disease is chronic and irreversible, patients may require long-term or even life-long care (Hygum *et al*., 2019). The rate of calcium absorption and utilization will be lessened as a result of high blood sugar, hormone secretion and substance metabolism disorders, and the fact that diabetes patients are typically middle-aged and old (Siddapur *et al*., 2015; Siddique *et al*., 2020; Shevroja *et al*., 2021; Kim & Kim, 2022). Since osteoporosis is a frequent side effect of diabetes, it can be used in clinical studies as a consequence of the disease. There may not be a substantial difference in BMD between people with and without diabetes because the non-diabetes group is susceptible to other illnesses, such as obesity. The outcomes of BMD measurements in diabetes, osteoporosis diagnostic criteria, and lumbar spine BMD measurements vary according to the existing body of literature. There might not be any distinction in the analysis's findings. However, this does not imply that lumbar BMD and osteoporosis status are useless in the research of diabetes. It may also open up new avenues of investigation for the treatment of diabetes mellitus in the future.

For examining the relationship between diabetes patients' physical characteristics, such as osteoporosis and fat mass, as well as other factors, such diabetes duration, region, sex, and other factors. The relatively short amount of data and the small number of patients included in this study, together with the fact that it is still in the exploration and refining phase, all contribute to the study's limitations.

CONCLUSION

The fact that only one disease was employed as a criterion for classifying the subjects may explain why there was no discernible variation in BMD between diabetic and non-diabetic patients in this sample of 371 patients.

SONG, L.; LOU, J. & LIU, X. Estudio sobre la composición corporal de pacientes con diabetes mellitus mediante absorciometría de rayos X de energía dual: un estudio morfológico. *Int. J. Morphol., 42(2)*:261-269, 2024.

RESUMEN: La diabetes es una enfermedad endocrina. La absorciometría de rayos X de energía dual (DXA) proporciona una vista detallada de la composición corporal para descubrir qué diferencia a las personas con diabetes de aquellas con otras enfermedades. Escaneamos a 371 pacientes con DXA para analizar sus parámetros de composición corporal. Se incluyeron 371 pacientes (178 mujeres/193 hombres), con diferentes enfermedades, con un Índice de Masa Corporal (IMC) medio ± DE de 25,32 ± 8,3 kg/m^2. Se evaluó la composición corporal de 371 pacientes. Se analizaron la densidad mineral ósea (DMO), el peso graso, el peso magro, la relación cintura-cadera, el índice de masa magra (LMI), el índice de masa grasa (FMI), y la relación entre el porcentaje de grasa y el IMC. De los 371 pacientes 156 eran diabéticos y 215 no diabéticos. Los pacientes no diabéticos también incluyeron 5 con obesidad, 9 con hígado graso, 39 con hipertensión, 22 con hiperlipidemia, 18 con enfermedad cardiovascular, 11 con enfermedad torácica y pulmonar, 4 con enfermedad crónica, 14 con enfermedad cerebral y 93 pacientes con otras enfermedades. Entre los 156 pacientes diabéticos, 129 tenían un IVA > 100 cm^2 y 27 tenían un IVA ≤100 cm^2. El peso magro (PV) de los hombres diabéticos fue significativamente mayor que el de las mujeres diabéticas. El peso graso (FW) de las mujeres diabéticas fue significativamente mayor que el de los hombres diabéticos. El índice cintura-cadera (ICC) fue de 1,37 ± 0,25 en hombres diabéticos y de 1,18 ± 0,21 en mujeres diabéticas. Entre los 215 pacientes no diabéticos, los pacientes obesos y con hígado graso, cuyo peso (WT) (obesidad: 83,87 ± 8,34 kg hígado graso: 85,64 ± 28,60 kg), FW (obesidad: 28,56 ± 4,18 kg hígado graso: 28,61 ± 10,79 kg), PV (obesidad: 52,62 ± 9,64 kg, hígado graso: 54,29 ± 17,58 kg), IMC (obesidad: 28,76 ± 1,88 kg/m^2, hígado graso: 29,10 ± 5,95 kg/m^2), fue mucho mayor que otros pacientes. Los pacientes diabéticos tenían menos masa grasa que los pacientes no diabéticos; la diferencia fue de alrededor de 2 kg. La DMO no difiere mucho. Los pacientes no diabéticos con obesidad debido al hígado graso y enfermedades cardiovasculares tenían mayor masa grasa e IMC que los pacientes con otras enfermedades. La composición corporal puede proporcionar información precisa sobre la composición de diferentes áreas del cuerpo, pero se requieren exámenes más profundos para determinar el perfil endocrino del cuerpo.

PALABRAS CLAVE: Composición corporal; Absorciometría dual de rayos X; Densidad mineral del hueso; Indice de masa grasa; Índice de masa magra.

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