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ORIGINAL RESEARCH

Association of Different Obesity Phenotypes with Sarcopenia in Han Chinese Middle-Aged and Elderly with Type 2 Diabetes Individuals

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Purpose: To investigate the relationship between different obesity phenotypes and sarcopenia in hospitalized Chinese patients with type 2 diabetes mellitus (T2DM).

Methods: This cross-sectional study included 385 men. Anthropometric measurements including applied the determination method of Dual-energy X-ray absorptiometry (DXA) determination of limb skeletal muscle mass index (ASMI) and blood samples were analyzed. The people were divided into four groups according to body mass index (BMI) (≥24kg/m^2) and waist circumference (WC) (female ≥85cm, male ≥90cm). Group A (BMI and WC were normal), Group B (BMI was normal and high WC), Group C (high BMI and WC were normal), and Group D (BMI and WC were abnormal).

Results: The prevalence rates of sarcopenia and abdominal obesity were 32.2% and 74.0%, respectively. The detection rate of lower ASMI decreased gradually from Group A to Group D(74.6% vs 68.3% vs 54.5% vs 51.6%, χ 2 =14.243, P=0.003). Logistic analysis showed that the risk of lower ASMI were decreased by 62.4% (95% CI: 0.149–0.950, P = 0.039) in Group C and 68.8% (95% CI: 0.165–0.593, P = 0.000) in Group D compared with Group A, respectively. The risk of lower ASMI were increased 4.153-fold (95% CI: 2.623–6.576, P = 0.000) in male. Male (OR = 4.065, 95% CI: 2.246–7.356, P = 0.000) and WC (OR = 1.053, 95% CI: 1.004–1.104, P = 0.033) were risk factors for lower ASMI, but the risk of lower ASMI was decreased by 32% (95% CI: 0.5744–0.804, P = 0.000) by elevated BMI in the overweight and obese group (Group C and Group D).

Conclusion: The prevalence of sarcopenia and abdominal obesity was elevated in han Chinese middle-aged and elderly patients with T2DM. Being overweight or obesity as defined by BMI protect against sarcopenia, while abdominal obesity increases the risk of sarcopenia.

Keywords: T2DM, sarcopenia, ASMI, BMI, WC

Introduction

Type 2 diabetes mellitus (T2DM) has reached a common chronic metabolic disease, becoming a key public health and research priorities worldwide. T2DM occurs due to various factors that cause insulin resistance and β-cell dysfunction.[1] The latest research data suggest 18.80% prevalence rate of T2DM in the Chinese individuals aged ≥65 years, and the incidence of diabetes in the elderly is increasing.[2] A total of 41.0% and 24.3% of Chinese diabetic patients are overweight and obesity, respectively.[3]

Sarcopenia is a degenerative disease characterized by loss of skeletal muscle mass, low muscle strength or low physical performance, with the risk of falls, frailty, fractures, disability, hospitalization and death.[4,5] Moreover, it increases the risk of developing chronic metabolic diseases,[6] which seriously affect the health status and quality of life in the elderly. At present, the understanding of sarcopenia is still unclear. Therefore, it is necessary to identify the high-risk groups in the whole life process and seek the opportunity and measures for early prevention and intervention.

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Sarcopenia and T2DM are both common diseases in a growing ageing population, and their interaction and influence have been received growing interest over the last decade.[7] Chronic hyperglycemia causes damage to the skeletal muscles, has been described as a new complication in diabetic patients in the literature.[8] Recent meta-analyses indicated that the prevalence of sarcopenia was significantly elevated in elderly patients with T2DM. Patients showed a greater decline in muscle mass, muscle strength, and functional capacity with aging.[6] Sarcopenic obesity is a new category of obesity in older adults who have high adiposity coupled with low muscle mass. Sarcopenia often coexists with obesity.[9] There is controversy surrounding the effects of obesity as measured by body mass index (BMI) in elderly with sarcopenia.[9] Previous studies reported negative associations between overweight/obesity defined by high BMI and sarcopenia.[10] A Japanese study found elderly diabetes patients with low BMI and high body fat mass may be more likely to develop sarcopenia.[11] However, a previous study in Australia found that the increase of BMI reflected a substantial increase in body fat mass and a decline in lean body mass, which may have adverse implications for future development of sarcopenia.[12] Meanwhile, several findings on the relationship between adipose tissue distribution and sarcopenia indicated that, compared with subcutaneous fat, visceral fat could increase the risk of muscle protein wasting, systematic inflammation, and insulin resistance, then increasing the risk of muscle mass decline and sarcopenia in older people.[13–15]

However, T2DM is more likely to be combined with abdominal obesity, does it also affect muscle mass and function? Therefore, we used a simple method of measuring waist circumference (WC) to assess abdominal obesity and visceral fat[16,17] and explored the relationship between BMI, WC and sarcopenia in different obesity phenotypes by analyzing data from a cross-sectional survey of middle-aged and older patients with type 2 diabetes mellitus over 50 years of age.

Materials and Methods

Subjects

This cross-sectional study analyzed the examination data of 385 hospitalized patients over the age of 50 years with T2DM from October 1, 2019, to May 31, 2022, at the Department of Endocrinology of the First Hospital of Qinhuangdao in Qinhuangdao, Hebei Province, China. The exclusion criteria included the following: 1) acute complications of diabetes mellitus such as diabetic ketoacidosis and hyperosmolar hyperglycemia; 2) acute myocardial infarction; acute cerebrovascular disease; acute inflammation; Gastrointestinal bleeding; Malignant tumor; 3) maintenance hemodialysis; 4) hepatic dysfunction (>3-fold elevation of alanine aminotransferase, aspartate aminotransferase); 5) severe osteoarthropathy or neuromuscular disease; 6) implantation of a pacemaker; 7) inability to understand/perform the exercise tests for this study; and 8) others judged ineligible by the investigators. The study protocol was approved by the Ethics Committee of the First Hospital of Qinhuangdao in accordance with the principles of the Declaration of Helsinki (The number of ethics committee: No.2020B004). All subjects provided written informed consent before study initiation.

Data Collection

With the use of predesigned questionnaires, we collected the following patient data: general data such as age and gender, as well as the results of Dual-energy X-ray absorptiometry (DXA), biochemical and anthropometric measurements. Peripheral venous blood samples were taken at 8:00 AM after at least 8-hours of fasting, and subjected to biochemical measurements, including fasting blood glucose (FBG), postprandial plasma glucose 2 h (PPG-2 h), glycated hemoglobin (HbA1c), albumin (ALB), triglycerides (TG), cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), uric acid (UA). Body composition including total body fat and total body lean were measured by DXA (MEDILINK SARL., France), and skeletal muscle mass index (ASMI) and fat mass index (FMI) were calculated (ASMI = the sum of the lean amount of the bilateral upper limbs and the bilateral lower limbs (kg)/height^2 (m^2); FMI = total body fat content (kg)/height^2(m^2)). Anthropometric measurements, including height, weight, WC, blood pressure, grip strength and gait speed. To measure the height, the person is measured by taking off their shoes and standing on the base of the height meter with the heel, sacrum, and both shoulder blades against the column of the height meter. Thick clothing and shoes were taken off for the weight measurement. BMI was calculated by dividing weight (kg) by height squared (m^2). WC was measured twice and averaged midway between the lower rib margin and the iliac crest in a standing condition. A commonly used gait speed test is called the 6-m usual walking speed

test, with speed measured manually with a stopwatch. We measured grip strength with the Jamar dynamometer (Performance health supply, inc., Cedarburg, WI, USA). Patients initially sat in a chair to keep their upper body straight with their elbow bending 90° and then used either both hands or the dominant hand to squeeze the dynamometer with full force for 3 s. Patients were asked to squeeze twice, recording the maximum number as the final data.

Diagnosis

Sarcopenia was diagnosed by measuring skeletal muscle mass, muscle strength and physical performance according to the recommended diagnostic algorithm of the Asian Working Group for Sarcopenia 2019 consensus (AWGS 2019).[4] Sarcopenia was defined as low ASMI (<7.0 kg/m^2 in males; <5.4 kg/m^2 in females) associated with either low handgrip strength (<28 kg in males; <18 kg in females) or low gait speed (<1.0 m/s). The cut-off points of BMI were 24.0 kg/m^2 and 28.0 kg/m^2 for overweight and obesity that recommended by the Working Group on Obesity in China.[16,18] WC beyond 90 cm for men and beyond 85cm for women were recommended as the cut-off points for central obesity.

Groups

The people were divided into four groups according to BMI and WC: Group A (BMI and WC were normal, n = 67, males: 43.3%, age: 64.43±7.91 years), Group B (BMI was normal and high WC, n = 60, males: 35.0%, age: 66.63±9.01 years), Group C (high BMI and WC was normal, n = 33, males: 42.4%, age: 64.15±7.45 years), and Group D (BMI and WC were abnormal, n = 225, males: 45.8%, age: 64.60±8.35 years).

Statistical Analysis

Data were analyzed using SPSS (version 23.0 for Windows, SPSS Inc., Chicago, IL, USA). Baseline characteristics of the study participants are presented below. Comparisons were conducted from different groups using Two-way ANOVA, data are expressed as mean ± standard deviation (SD). Categorical variables were compared by chi-squared tests, values are indicated by number (percentage). Pearson chi-square was used to test for anomaly detection rate of sarcopenia and its components per group. Additionally, we utilized logistic regression analysis to investigate the associations between low ASMI and different obesity phenotypes in all participants, as well as between low ASMI and abdominal obesity in overweight and obese people. Statistical significance was established at $P < 0.05$.

Results

Participants' Characteristics in Different Groups

There were no significant differences in age stratification, gender, FBG, PPG-2 h, HbA1c, ALB, TC and grip strength among the four groups ($P > 0.05$). When comparisons were made between each groups, the BMI, WC, TG, LDL, UA, ASMI, FMI, SBP and DBP of group D were higher than those of group A, HDL and gait speed were lower than those of group A, BMI, WC, TG, UA, ASMI and FMI were higher than those of group B, BMI, WC, FMI, SBP and DBP were higher than those of group C. And the BMI, WC, TG, LDL, UA, ASMI and FMI in group C were higher than those in group A, HDL was lower than that in group A, BMI and ASMI were higher than those in group B; WC was lower than that in group B. The BMI, WC, UA, FMI and SBP of group B were higher than those of group A, and gait speed was lower than that of group A. There were statistically significant differences, P, Table 1.

The Detection Rate of Sarcopenia and Its Components per Group

The detection rate of sarcopenia was not significantly different among the four groups (χ 2 = 4.868, P = 0.182). The incidence of sarcopenia in group D was lower than that in group A (χ2 = 3.959, P = 0.034), and there was no significant difference between group D and groups B and C (χ 2 = 1.351, P = 0.157; χ 2 = 0.037, P = 0.515). There were statistically significant differences in the incidence of low ASMI among the four groups (χ 2 = 14.243, P = 0.003). The detection rate of low ASMI in group D was lower than that in groups A and B (χ 2 = 11.202, P = 0.001; χ 2 = 5.389, P = 0.014), and there was no significant difference between groups D and C (χ 2 = 0.103, P = 0.447). Low gait speed and low grip strength were not statistically different among the four groups (χ^2 = 1.589, P = 0.662; χ^2 = 1.589, P = 0.662), Table 2.

Table 1 Participants' Characteristics in Different Groups

Variable	Group A (n=67)	Group B (n=60)	Group C (n=33)	Group D (n=225)	F/X^2	P
Age stratification (years) (%)	–	–	–	–	6.968	0.324
50–59	24 (35.8%)	14 (23.3%)	8 (24.2%)	76 (33.8%)		
60–69	22 (32.8%)	20 (33.3%)	16 (48.5%)	72 (32.0%)		
≥70	21 (31.3%)	26 (43.3%)	9 (27.3%)	77 (34.2%)		
Gender n (%)	–	–	–	–	2.255	0.521
Male	29 (43.3%)	21 (35.0%)	14 (42.4%)	103 (45.8%)		
Female	38 (56.7%)	39 (65.0%)	19 (57.6%)	122 (54.2%)		
BMI (kg/m^2)	21.64±1.78	22.61±1.40▲	25.29±1.07▲◆	27.33±2.56▲◆□	156.184	0.000
WC (cm)	79.44±5.49	91.41±6.32▲	83.80±3.04▲◆	96.71±7.26▲◆□	137.33	0.000
FPG (mmol/l)	7.93±3.40	8.47±3.69	7.82±2.29	8.77±3.43	1.552	0.201
PPG-2h (mmol/l)	12.59±4.85	12.55±4.34	12.88±4.46	13.22±4.33	0.535	0.658
HbA_1c (%)	8.72±2.52	9.12±2.55	8.56±1.87	8.67±1.78	0.830	0.478
ALB (g/l)	43.12±4.37	43.04±5.24	44.55±3.89	43.22±4.09	1.062	0.365
TG (mmol/L)	1.48±0.82	1.73±0.98	2.08±1.41▲	2.20±1.56▲◆	5.586	0.001
TC (mmol/L)	5.03±1.61	5.10±1.42	5.48±1.67	5.24±1.41	0.858	0.463
HDL-C (mmol/L)	1.13±0.29	1.06±0.25	1.02±0.26▲	1.02±0.23▲	3.464	0.016
LDL-C (mmol/L)	2.52±0.68	2.81±0.94	3.11±1.21▲	2.85±0.94▲	3.483	0.016
UA (umol/L)	261.58±74.55	314.93±96.42▲	329.45±82.96▲	341.37±91.16▲◆	14.131	0.000
ASMI (kg/m^2)	5.57±0.81	5.45±0.76	5.98±0.79▲◆	6.06±0.84▲◆	12.428	0.000
FMI (kg/m^2)	10.11±2.09	11.61±1.87▲	12.62±1.82▲	14.72±2.69▲◆□	75.522	0.000
SBP (mmHg)	135.41±21.79	142.33±19.65▲	138.06±14.94	145.70±19.65▲★	5.374	0.001
DBP (mmHg)	80.83±10.84	82.32±9.73	80.73±8.82	84.83±11.71▲★	3.270	0.021
Grip strength (kg)	25.86±8.15	25.17±8.27	26.62±8.60	27.94±9.63□	1.980	0.116
Gait speed (m/s)	1.08±0.21	0.96±0.24▲	1.02±0.17	1.00±0.22▲	3.611	0.013

Notes: Values are expressed as means ± SD, count data expressed as percentage. Group A consisted of 67 BMI and WC were normal; group B consisted of 60 BMI was normal and high WC; group C consisted of 33 high BMI and WC was normal; group D consisted of 225 BMI and WC were abnormal. ▲compared with group A; ◆compared with group B; ★compared with group C.

Abbreviations: BMI, body mass index; WC, waist circumference; FPG, fasting plasma glucose; PPG-2 h, postprandial plasma glucose 2 h; HbA1c, glycated hemoglobin; ALB, albumin; TG, triglycerides; TC, cholesterol; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; UA, Uric acid; ASMI, skeletal muscle mass index; FMI, fat mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 2 The Detection Rate of Sarcopenia and Its Components per Group

Variable	Group A (n=67)	Group B (n=60)	Group C (n=33)	Group D (n=225)	X^2	P
Sarcopenia n (%)	28 (41.8%)	22 (36.7%)	9 (27.3%)	65 (28.9%)	4.868	0.182
Low ASMI n (%)	50 (74.6%)	41 (68.3%)	18 (54.5%)	116 (51.6%)	14.243	0.003
Low gait speed n (%)	27 (40.3%)	28 (46.7%)	14 (42.4%)	109 (48.4%) p	1.589	0.662
Low grip strength n (%)	17 (25.4%)	12 (20.0%)	8 (24.2%)	52 (23.1%)	0.543	0.909

Notes: Group A consisted of 67 BMI and WC were normal; group B consisted of 60 BMI was normal and high WC; group C consisted of 33 high BMI and WC was normal; group D consisted of 225 BMI and WC were abnormal.

Abbreviation: ASMI, skeletal muscle mass index.

Relationship Between Low ASMI and Different Obesity Phenotypes for All Participants

The dependent variable was whether middle-aged and elderly patients with T2DM had lower ASMI (normal ASMI = 0, lower ASMI = 1), and the independent variables were gender (female = 0, male = 1), age stratification, HbA1c, duration of T2DM, and different obesity phenotypes (groups A to D). Logistic analysis showed that the risk of lower ASMI were decreased by 62.4% (95% CI: 0.149–0.950, P = 0.039) in Group C and 68.8% (95% CI: 0.165–0.593, P = 0.000) in Group D compared with Group A, respectively. The risk of lower ASMI were increased 4.153-fold (95% CI: 2.623–6.576, P = 0.000) in male, Table 3.

Table 3 Logistic Regression Analysis for Low ASMI

	B	OR	95% CI	P
Male=1	1.424	4.153	2.623–6.576	0.000
Group A	–	–	Ref	0.001
Group B	−0.223	0.800	0.358–1.788	0.587
Group C	−0.977	0.376	0.149–0.950	0.039
Group D	−1.163	0.312	0.165–0.593	0.000

Notes: Group A consisted of 67 BMI and WC were normal; group B consisted of 60 BMI was normal and high WC; group C consisted of 33 high BMI and WC was normal; group D consisted of 225 BMI and WC were abnormal. Ref: reference. Y: ASMI (normal ASMI=0, lower ASMI=1); X: gender (female =0, male =1), age stratification, HbA1c, duration of T2DM, and different obesity phenotypes (groups A to D).
Abbreviation: ASMI, skeletal muscle mass index.

Table 4 Logistic Regression Analysis for Low ASMI in Overweight and Obese People

	B	OR	95% CI	P
WC (cm)	0.052	1.053	1.004–1.104	0.033
BMI (kg/m^2)	−0.386	0.680	0.574–0.804	0.000
Male=1	1.402	4.065	2.246–7.356	0.000

Notes: Y: ASMI (normal ASMI=0, lower ASMI=1); X: gender (female =0, male =1), BMI, and WC. WC was an indicator of abdominal obesity. BMI was an indicator of overweight + obesity.
Abbreviations: ASMI, skeletal muscle mass index; BMI, body mass index; WC, waist circumference.

Predicting the Risk of Low ASMI by BMI and WC in Overweight and Obese People

Dependent variable was whether the overweight and obese patient had lower ASMI (normal ASMI = 0, lower ASMI = 1). Independent variables were gender (female = 0, male = 1), BMI, and WC. A logistic regression analysis revealed that male (OR=4.065,95% CI: 2.246–7.356, P = 0.000) and WC (OR=1.053,95% CI: 1.004–1.104, P = 0.033) were risk factors for lower ASMI, but the risk of lower ASMI was decreased by 32% (95% CI: 0.5744–0.804, P = 0.000) by elevated BMI in Group C and Group D, Table 4.

Discussion

Sarcopenia is an age-related loss of skeletal muscle mass and strength that is strongly associated with obesity, insulin resistance, and T2DM.[19] Sarcopenia has a complex etiology, with multifactorial environmental and genetic factors including low grade chronic inflammation, insulin and anabolic resistance, hormonal changes, mitochondrial dysfunction, oxidative stress, malnutrition, inactivity, and chronic diseases contribute to progressive and adverse changes in ageing muscle.[20] Adequate nutrition and exercise interventions that may maximize the muscle protein synthetic response in elderly, so as to counteract age-related sarcopenia.[20,21] Muscle mass and strength change across throughout a lifetime, with literature showing that leg muscle mass and strength decline by 1–2% and 1.5–5% per year, respectively, over the age of 50.[5] Therefore, we targeted middle-aged and elderly T2DM patients beyond the age of 50 years to investigate the relationship between obesity phenotypes and sarcopenia.

A previous epidemiological study showed that the prevalence of sarcopenia in T2DM ranged from 7% to 29.3% in different populations.[7] Due to the lack of a single diagnostic criterion, the prevalence of sarcopenia varied considerably with different diagnostic criteria and using different methods applied to measure muscle mass and in different study populations. According to the AWGS algorithm, among older Chinese adults, the prevalence was 14% for men and 15% for women.[22] Another study in community-dwelling elderly with T2DM, using AWGS criteria to define sarcopenia, reported a prevalence of 14.8%.[23] In our study, the overall prevalence of sarcopenia in middle-aged and elderly inpatients

with T2DM was as high as 32.2%. These differences may be explained by the different diagnostic criteria used and heterogeneous study populations. In our study, DXA was used to measure muscle mass and the new AWGS algorithm was applied to define sarcopenia.

In the present study, we adopted simple measurement indexes BMI and WC as the diagnosis of obesity and abdominal obesity. The results showed that the prevalence of obesity in middle-aged and elderly inpatients with T2DM was 17.9%, overweight 49.1% and abdominal obesity as high as 74.0%. Trierweiler et al found that the diabetes group had a higher BMI and wc compared to controls, with 78.3% being overweight and 72.3% with wc above normal, indicating high rates of overweight and abdominal obesity.[8] Slightly different from our study, we found that the overall prevalence of overweight and obesity was lower than that of abdominal obesity. The ASMI of group C and D were significantly higher than that of non-overweight and obese groups, and the detection rate of low ASMI decreased gradually from group A to group D. In further logistic regressions analysis, compared with the normal control group A, the risk of lower ASMI in group C and group D decreased by 62.4% and 68.8%, respectively. This result indicated that the risk of low skeletal muscle mass decreased as BMI increased. In China, the associations among obesity and sarcopenia were evaluated in community-dwelling older people. They found high BMI was negatively associated with sarcopenia, while increased visceral fat area was positively associated with it.[13] Thus, different obesity phenotypes might have different effects on muscle mass and muscle function. Our study also confirmed that the 6 m gait speed of abdominal obesity group B and D was lower than that of the normal control group A. Logistic regression analysis was performed to analyze the relationship between BMI and WC with skeletal muscle mass in overweight and obese group C and D. And it was found that skeletal muscle mass was positively correlated with BMI, but negatively correlated with WC. These results suggested that abdominal obesity had an adverse effect on sarcopenia in middle-aged and elderly patients with T2DM.

Previous studies indicated that underweight subjects were at a higher risk of low skeletal muscle.[24] BMI might reflect lean mass.[11] Without taking body fat into account, subjects with high BMI tend to have more lean body mass.[13,14] Some studies conducted in China had shown that a high BMI was associated with a lower incidence of sarcopenia.[13,25,26] BMI is a composite of fat mass and lean body mass, and that cannot assess the changes in body composition during weight gain.[10,13] In the normal progression of obesity, high BMI was generally accompanied by a larger increase in fat mass. Intermuscular adipocytes hypertrophy and intramyocellular lipid overaccumulation caused by high body fat mass might cause dysfunction of skeletal muscle cells and inhibit muscle protein synthesis. In particular, the accumulation of visceral fat could induce systemic inflammation and insulin resistance, and then lead to low skeletal muscle and sarcopenia.[13,27,28] Males in our study had adverse effects on skeletal muscle mass. Earlier study had shown that men have more lean mass, and women have more fat mass. Men are more likely to accumulate adipose tissue around the trunk and abdomen, while women usually accumulate adipose tissue around the hips and thighs.[29] Testosterone levels in men decline with age, adversely affecting the distribution of muscle and adipose tissue.[30]

Sarcopenia is characterized by age-related loss of muscle mass, plus low muscle strength, and/or low physical performance.[4,5] Measuring grip strength is a powerful indicator of muscle strength, and gait speed is considered a quick and highly reliable test for physical performance.[4,5] Several previous studies demonstrated that the strong negative impact of obesity on functional status in old age, especially the functional limitation related to activity ability.[31–33] In the present study, patients with abdominal obesity showed a decline in physical performance, while no significant association was observed between muscle strength and any type of obesity, suggesting that abdominal obesity may be associated with physical performance. Unlike our findings, a study in the Turkish community has reported that low BMI was associated with muscle function status in older men.[34] During aging, the infiltration of fat in skeletal muscle, as well as the redistribution of subcutaneous fat into visceral fat, could result in decreased overall strength and functionality.[35] Grip strength, which represents muscle strength, could be influenced by many influencing factors. In addition to BMI and body fat, physical activity, living status, blood pressure, smoking, stress, chronic disease, and renal function were also associated with handgrip strength and those factors appear to be more important than obesity phenotypes in grip strength decline.[13,36]

The present study was not without any limitations. First, due to the absence of a uniform criteria of sarcopenia, criteria recommended by AWGS 2019 was used in this study. Second, this study was a cross-sectional study that

precluded the establishment of causal relationships between events. Meanwhile, the subjects of this study select the inpatients who are under intensive management due to poor glycemic control. Since these subjects are more clinically severe T2DM subjects than community dwelling ones, thus a higher number of comorbidities, could be influencing the appearance of sarcopenia. Future studies should discuss the relationship between obesity and sarcopenia in community dwelling older people.

Conclusion

The prevalence of sarcopenia and abdominal obesity was elevated in hospitalized middle-aged and elderly patients with T2DM. Being overweight or obesity as defined by BMI protect against sarcopenia, while abdominal obesity increases the risk of sarcopenia. Thus, attention should be paid to the obesity phenotypes of middle-aged and elderly patients with T2DM and the improvement of body fat distribution, which may contribute to the prevention and treatment of sarcopenia.

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Disclosure

The authors state that there are no conflict of interest in the publication of this article.

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