



SARCOPENIA EVALUATION IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Abstract

Aim: The aim of our study was to investigate changes in muscle mass with especially the comparison between people DM patients.

Method: This randomized, prospective, controlled, single blind study was conducted in Physical medicine and Rehabilitation department of Bezm-i Alem Vakıf University, faculty of Medicine. The patient group individuals taken from patients with type 2 diabetes mellitus. Healthy individuals were enrolled as the control group patients. A total of 126 patients completed the study (63 study group, 63 control group). The patients were between the ages of 40 and 65 included in this study. Body composition of the subjects was measured by Bioelectrical impedance analysis method.

Muscle mass distribution of subjects with skeletal muscle index (SMI %): Diabetic and nondiabetic patients evaluated with using total skeletal muscle mass (kg)/weight (kg) x100) formula.

Results: A total of 126 patients completed the study (63 study group, 63 control group). The clinical and demographic characteristics of the patients and the healthy controls are listed in Table 1. The mean age was 59.31 ± 8.17 years. The mean disease duration was 11.42±2.82 years. The most important finding of our study in patients with type 2 diabetic SMI values were significantly lower than the control group. In addition, BMI, fat mass and fat percentage was significantly higher in type 2 diabetic patients.

Conclusion: In conclusion, type 2 diabetes is associated with the excessive loss of skeletal muscle mass in older adults. Older adults with undiagnosed diabetes are at particularly high risk for the loss of skeletal muscle mass.

Keywords: Sarcopenia, Type 2 Diabetes Mellitus, body muscle mass

INTRODUCTION

Diabetes mellitus is a metabolic disorder resulting from a defect in insulin secretion, insulin action, or both. A consequence of this is chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism. Diabetes mellitus (DM) is a common disorder of carbohydrate, fat and protein metabolism reflected by an inappropriate fasting and postprandial high blood glucose levels (hyperglycaemia). This ailment results from the absence or scantiness of insulin secretion with or without concurrent impairment of insulin action. Consequently, the disease was classified into two types known as type I (insulin dependent, IDDM) and II (non-insulin dependent, NIDDM) according to the degree of the pancreatic defect. This classification has been even recognized since the time of Ibn Sinaa who mentioned it in his book "The Canon of Medicine".

DM is not confined to abnormal blood glucose level, but it progresses to affect other body systems. This fact was confirmed by several epidemiological studies and clinical trials that linked hyperglycemia to several complications at the macrovascular (coronary artery disease and cerebrovascular disease), as well as the microvascular levels (renal failure, blindness, limb amputation, neurological complications and premature death)¹.

Skeletal muscle (SM) plays a central role in many biological functions, such as movement and metabolism, so disruptions in this component of body composition can have a marketed influence on health and disease².

At one time, the age-related loss of skeletal muscle was called sarcopenia, but now its definition is not limited only to the loss of muscle mass. Sarcopenia comprised the loss both muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life, and even death³.

Muscle is the main tissue responsible for insulin mediated glucose disposal, sarcopenia and related conditions can then promote insulin resistance⁴, type 2 diabetes^{5,6}, dyslipidemia, hypertension and metabolic syndrome. Furthermore, sarcopenia is associated with of cardiovascular disease, independent of other cardiovascular risk factors⁷.

The aim of our study was to investigate changes in muscle mass with especially the comparison between people DM patients.

METHODS

This randomized, prospective, controlled, single blind study was conducted in Physical medicine and Rehabilitation department of Bezm-i Alem Vakıf University, faculty of Medicine. Hasta grubu olarak tip 2 diabetes mellituslu hastalar alındı. Kontrol grubu olarak sağlıklı hasta bireyler alındı. In addition to their demographic characteristics [age, gender, weight, height, body mass index (BMI)], waist circumference, hip circumference, waist-hip ratio, used drugs, body muscle mass, fat mass, percent fat ratio were taken. Health Assessment Questionnaire (HAQ) The patients were between the ages of 40 and 65 included in this study.

The most commonly used, low cost and accessible methods to assess SMI include dual energy X-ray absorptiometry (DXA), magnetic resonans images(MRI), anthropometry and bioelectrical impedance analysis (BIA). Skeletal muscle mass was estimated from bioimpedance analysis measurements and expressed as skeletal muscle index (SMI= Skeletal muscle mass/body massX100).

Body composition

Body composition of the subjects was measured by Bioelectrical impedance analysis method. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm using standardized equipment and procedures. Bioelectrical impedance analysis resistance (ohms, Ω) was obtained using a Tanita BF-300A Body Composition with an operating frequency of 50 kHz at 800 μ A. Whole-body bioelectrical impedance analysis measurements were taken between the right wrist and ankle with the subject in a supine position after the subjects completed a minimum 6-hour fast⁸.

Skeletal muscle mass measurements

Muscle mass distribution of subjects with Skeletal muscle index (SMI (%): Diabetic and nondiabetic patients evaluated with using total skeletal muscle mass (kg)/weight (kg) x100) formula⁹.

The calculations were performed using the Statistical Package for Social Sciences for Windows software version 16.0 (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov test was used to confirm that data within the ranges of normal distribution in both

groups. A non-parametric test was employed for the variables outside the normal distribution. The comparison of the data between the groups was carried out through the Mann-Whitney U-test. The Wilcoxon Signed Ranks test was used to examine the preand post exercise differences within groups. Statistical significance was based on a value of $p < 0.05$ with a 95% confidence interval.

RESULTS

A total of 126 patients completed the study (63 study group, 63 control group). The clinical and demographic characteristics of the patients and the healthy controls are listed in Table 1. The mean age was 59.31 ± 8.17 years. The mean disease duration was 11.42 ± 2.82 years. Body compositions of the subjects are given in table 2. In the laboratory tests of the patients are given in table 3.

**Table 1. Demographic characteristics of the patients with DM and control groups
(mean $\pm$ SD or n, %)**

	DM group (n=63)	Control group (n=63)	p
Age	60.17 $\pm$ 8.51	58.45 $\pm$ 7.83	>0.05
Male patients (n, %)	29 (%46)	30(%47)	>0.05
BMI (cm/kg ²)	32.48 $\pm$ 4.82	28.44 $\pm$ 5.55	>0.05

DM: Diabetes Mellitus; SD: Standard Deviation.

DISCUSSION

Our main goal in this study in patients with type 2 diabetes the body muscle mass ratio between normal healthy individuals was to compare the proportion of muscle mass. The most important finding of our study in type 2 diabetic patients with SMI values were significantly lower than the control group. In addition, BMI, fat mass and fat percentage was significantly higher in type 2 diabetic patients.

Table 2. Body compositions of the patients with DM group and control patients (mean $\pm$ SD or n, %)

	DM group (n=63)	Control group (n=63)	p
Body Fat Percentage (%)	37.00 $\pm$ 9.64	32.07 $\pm$ 9.46	0.004
Body Fat Mass (kg)	30.10 $\pm$ 11.03	24.56 $\pm$ 10.56	0.005
Body Muscle Mass (kg)	48.50 $\pm$ 5.97	49.46 $\pm$ 10.27	>0.05
Waist / hip ratio	0.92 $\pm$ 0.13	0.88 $\pm$ 0.09	>0.05
SMI	60.99 $\pm$ 11.69	68.31 $\pm$ 10.20	0.001

DM: Diabetes Mellitus; SD: Standard Deviation; SMI: Skeletal muscle index.

Table 3. Clinical parameters of patient and control groups (mean $\pm$ SD or n, %).

	DM group (n=63)	Control group (n=63)	p
Ca (mg/dl)	8.83 $\pm$ 0.22	8.53 $\pm$ 0.28	>0.05
P (mg/dl)	4.2 $\pm$ 0.82	4.33 $\pm$ 0.80	>0.05
ALP (U/l)	85.94 $\pm$ 26.77	84.47 $\pm$ 32.33	>0.05
Fasting Blood Sugar (mg/dl)	162.48 $\pm$ 44.82	98.44 $\pm$ 15.55	<0.05
24-hour Urine Ca (mg/dl)	143.89 $\pm$ 81.18	133.84 $\pm$ 55.41	>0.05
Creatine (mg/dl)	0.9 $\pm$ 0.31	0.72 $\pm$ 0.2	>0.05
ESR	15.60 $\pm$ 8.22	18.15 $\pm$ 7.52	>0.05
CRP	0.21 $\pm$ 0.41	0.18 $\pm$ 0.54	>0.05
24-hour Urea (mg/dl)	48 $\pm$ 11.25	42 $\pm$ 8.2	>0.05

DM: Diabetes Mellitus; SD: Standard Deviation. P < 0.05 is significant

The reason for an accelerated loss of muscle mass in older adults with type 2 diabetes is not clear. It can be postulated that metabolic abnormalities in type 2 diabetes may negatively affect muscle mass. Although the effect on protein metabolism is not as clear as it is in type 1 diabetes, the net balance of body protein metabolism is diminished in type 2 diabetes. Insulin resistance in type 2 diabetes may also result in the reduced synthesis of whole-body proteins¹⁰.

Skeletal muscle is one of the target tissues, on which insulin inside human body acts. For patients with obesity and type 2 DM, skeletal muscles become the main target position of peripheral insulin resistance. Studies indicated that, 75% perfused glucose would be taken up by skeletal muscles, and microcirculation disturbance might trigger or worsen insulin resistance, which deteriorated metabolic disorders in advance, making the condition uncontrollable. Due to its impact on exercise capacity of DM patients and glucose metabolism, microcirculation perfusion of skeletal muscles has now become a research hotspot¹¹.

Patients with type 2 diabetes exhibited increases in both lean body mass and body fat mass compared with subjects without diabetes, because, compared with nondiabetic subjects, those with diabetes were more obese and had higher BMI¹². In our study, the diabetic group compared to non-diabetic fat mass increased significantly more.

Clinical studies have shown defects in the ability of insulin to stimulate muscle protein synthesis in older individuals than in younger ones, possibly because of lower muscle blood flow. Furthermore, the ability of insulin to inhibit protein breakdown is impaired in older adults¹³. Further studies are needed in insulin-resistant older men to examine the potential defects of insulin signaling that contribute to a net loss of muscle protein and lean mass.

A potential explanation for this finding may be poorer suppression of lipolysis by insulin in insulin-resistant individuals than in those who are not insulin resistant. Clinical studies have also demonstrated greater basal and catecholamine stimulated lipolysis in patients with insulin resistance. Higher rates of lipolysis in insulin-resistant individuals with high total and truncal adiposity may serve as a homeostatic mechanism to prevent further total and truncal fat gain. Other homeostatic effects of high insulin levels on adiposity may involve signaling in the central nervous system to alter appetite and energy expenditure¹⁴.

Excessive loss of muscle mass in older adults with type 2 diabetes may result in poor muscle strength, functional limitations, and physical disability. Future research should find the factors responsible for excessive loss of lean mass in older adults with type 2 diabetes and develop strategies to prevent the adverse outcomes of sarcopenia in this high-risk population¹⁵.

There are several limitations in our study. Although we have shown the temporal relationship between baseline diabetes status and longitudinal changes in muscle mass, it does not confirm causality. We could not identify the factors associated with the rapid loss of muscle mass in older adults with type 2 diabetes other than those in the early stages of diabetes, as evidenced in cases of undiagnosed diabetes. Our study was not designed to examine the effect of glycemic control, specific treatments, comorbidities, and other hormones, etc. These would be better addressed in a study of diabetes with a detailed characterization of diabetic management over time.

In conclusion, type 2 diabetes is associated with the excessive loss of skeletal muscle mass in older adults. Older adults with undiagnosed diabetes are at particularly high risk for the loss of skeletal muscle mass.

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