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ORIGINAL ARTICLE

Prevalence of sarcopenia in patients with geriatric depression diagnosis

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Abstract

Aim In this study, the aim was to identify the prevalence of sarcopenia among patients with geriatric depression (GD) diagnosis and to collect data to illuminate precautions to reduce disease load.

Method The study was completed with 116 patients (GD group) aged 65 years or older with possible or definite depression diagnosis according to the Geriatric Depression Scale (GDS) criteria and 301 volunteers aged from 18 to 39 years (control 1) and above 65 years (control 2). Our prospective and cross-sectional study applied the Hamilton Depression Rating Scale (HDRS) to control 1 group and the GDS and Mini Mental Test (MMSE) to control 2 and GD groups. All groups had skeletal muscle mass index (SMMI), muscle strength, and physical performance assessed with sarcopenia diagnosis according to the European Working Group on Sarcopenia in Older People (EWGSOP) diagnostic criteria.

Results In our study, in parallel with the severity of disease in patients with GD diagnosis, the prevalence of sarcopenia (led by severe sarcopenia) was observed to be high compared to the control group. The prevalence of sarcopenia was 12.7%/24.2% among women and 13.8%/44.0% among men and 13.4%/32.8% in total in the control 2 and GD groups, respectively. There was a significant increase observed in the prevalence of sarcopenia, led by severe sarcopenia with a definite depression diagnosis.

Conclusion For GD patients, diagnosis of sarcopenia in the early stages and precautions like improving muscle functions with protein support in diet and resistance exercises will make it possible to contribute to improving clinical results of the disease.

Keywords 4-m walking test · Geriatric depression · Hand grip test · Sarcopenia · Skeletal muscle mass index

Introduction

Sarcopenia was first described by Irwin Rosenberg in 1989 and is a term used to describe the age-associated reduction in muscle mass [1, 2]. The first functional definition was made by Baumgartner et al. as being muscle mass below the mean muscle mass for the young adult population [3].

Sarcopenia may be observed at early ages secondary to situations like chronic diseases, sedentary lifestyle, and malnutrition, but it is primarily observed with the aging process above the age of 65 years. It is defined as a geriatric syndrome characterized by negative results like falling, physical and cognitive capacity reductions, low quality of life, increased dependence, and death due to progressive loss (dynapenia) of muscle mass and muscle strength functions [4–11]. The prevalence of sarcopenia is 5–13% from 60 to 70 years while it varies from 11 to 50% above the age of 80 [12]. The World Health Organization estimates the population affected by sarcopenia currently is 50 million and predict this number will reach 200 million within the next 40 years [6, 13, 14].

EWGSOP divides sarcopenia into three groups as presarcopenia, sarcopenia, and severe sarcopenia. In the presarcopenia stage, muscle strength and physical performance are not affected; however, muscle mass is reduced. In the sarcopenia stage, muscle strength or performance reduce together with a reduction in muscle mass. In severe sarcopenia, there is a reduction in all three criteria (muscle mass, muscle strength, and performance) [6].

Another geriatric syndrome producing similar negative results at advanced age is depression and it is commonly observed. Sarcopenia and depression have some clinical, etiologic, and prognostic similarities and there is a two-way correlation between them. Sarcopenia may cause depression due to reasons such as frequent falls, lack of independent living, disrupted personal care, reduced nutritional intake, and physical inactivity. As a result, the prevalence of sarcopenia among

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patients with GD diagnosis is higher compared to the normal older persons population. Similarly, symptoms such as weakness, loss of appetite, reluctance, and reduced motivation linked to depression may contribute to sarcopenia development [15, 16]. For GD patients, identification of sarcopenia in the early stages and precautions such as administration of protein supplementation in diet and resistance exercises to improve muscle functions make it possible to contribute to improved disease clinical results.

In our study, the aim was to assess the geriatric depression-sarcopenia correlation using SMMI cut-off values identified in the healthy control group aged 18–39 years, to compare data from the control group aged over 65 years and the geriatric depression patients and to collect data to reduce the disease load by identifying the prevalence of sarcopenia.

Material and method

Research population and sample

The sample for the research comprised healthy volunteers from among Ordu University Education and Research Hospital and Ordu State Hospital employees (doctors, nurses, assisting health personnel, security guards, medical secretaries) and their relatives who agreed to participate in the research with normal neurological examination, without known chronic disease history apart from hypertension or chronic medication use, with no loss of more than 10% body weight within the last 6 months, and with HDRS score below 7 (control 1) or GDS points below 10 (control 2). The study group comprised patients with geriatric depression score monitored in the neurology clinics with GDS points above 10 and MMSE score above 24. GD patients additionally abided by the same exclusion criteria as healthy volunteers, apart from using at least one antidepressant.

Patients with pacemaker or any implant and those with diseases severely affecting mobility (cerebrovascular events causing confinement to bed, advanced muscle disease, hip dislocations, decompensated heart failure, acute and chronic renal failure with fluid load, etc.) were not included in the study.

Data collection tools

All individuals participating in the study had detailed neurological examination performed. Healthy volunteers in control 1 group had HDRS applied, while the control 2 and GD groups had GDS and MMSE tests applied by the same researcher.

Patient and control groups had SMMI (BIA), muscle strength (Jamar hand dynamometry), and physical performance (4-m walking test) measured.

Standardized Mini Mental Test

The standardized Mini Mental Test (mental state examination) (MMSE) was first published by Folstein et al. [17]. The test is a short, useful, and standardized method used to identify global cognitive level. It comprises 11 items collected under five main headings of orientation, recording memory, attention, calculation, recall, and language and total points are 30. The Turkish validity and reliability study was performed by Güngen et al. [18].

Hamilton Depression Rating Scale

The Hamilton Depression Rating Scale (HDRS) was developed by Hamilton and contains 17 items [19]. It is used to determine the severity of depression. It has subscales of depressive mood, suicide, loss of work and functions, mental retardation, agitation, gastrointestinal symptoms, general psychosomatic symptoms, hypochondriac symptoms, loss of insight in the individual, loss of appetite and weight loss, insomnia, and anxiety [19, 20]. Total points of 0–7 indicate no depression, 8–12 points are mild levels of depression in the individual, 13–17 points are moderate levels of depression, 18–29 points are major depression, and 30–52 points are accepted as severe major depression in the individual [19]. The validity and reliability studies for our country were completed by Akdemir et al. [20].

Geriatric Depression Scale

The Geriatric Depression Scale (GDS) developed by Yesavage et al. (1982) with validity and reliability studies was performed [21]. It is a self-report-based scale aimed at the elderly comprising 30 easily answered questions. It includes somatic symptoms like sleep disorders, sexual function disorder, pain, and discomfort in the body but does not include symptoms that may be caused by non-depression reasons with answers in the form of "yes" or "no." Each response in favor of depression receives one point, while other responses are given zero points. Points of 0–10 are accepted as "no depression," 11–13 points are "possible depression," and points of 14 or more are accepted as "definite depression." In Turkey, the validity and reliability studies were completed by two separate groups [22, 23].

Sarcopenia and dynapenia For evaluation of sarcopenia, the BIA to determine body composition, hand grip strength, and 4-m walking speed were examined. Sarcopenia diagnosis was made using the European Working Group on Sarcopenia in Older People (EWGSOP) diagnostic criteria [6].

Height (cm) and weight (kg) were measured in light clothing and without shoes. Body mass index was obtained by dividing body weight by the square of height (kg/m^2).

Measurements were performed with a TANITA TBF-300 brand bioimpedance device with the aim of determining "muscle mass" in the patient and control groups abiding by the inclusion criteria. Measurements were performed in the morning after at least 4 h of starvation, lying down after 4–5-min rest and with bare feet. Skeletal muscle mass was calculated automatically by the device. According to this result, the skeletal muscle mass index was calculated. Skeletal muscle mass index (SMMI) according to BIA was accepted as low muscle mass if it was more than 2 standard deviations below that of a young healthy group (below 8.87 kg/m^2 in females and 10.52 kg/m^2 in males).

A Jamar brand hand dynamometer was used for the hand grip test with the aim of assessing muscle strength. Patients had the dominant hand determined by asking which hand was actively used. Measurements were completed in accordance with the literature with the same assisting research [24]. Patients sat in a chair with elbows on the table and arms parallel in 90-degree flexion. Both right and left arm had measurements taken three times after 1-min rest periods. The highest value of the three measurements was taken. Measurements below 30 kg in males and below 20 kg in females were accepted as "low muscle power (dynapenia)" [6].

Physical performance was assessed with general walking speed. Mobile patients walked for 4 m on foot for the 4-m walking test and this duration was recorded in seconds with a chronometer. Walking speed above 0.8 m/s was accepted as normal for both males and females, while speed of 0.8 m/s or lower was accepted as at risk of sarcopenia [6].

Ethical aspect of the research

To complete this study with the aim of determining the prevalence of sarcopenia among GD patients monitored at Ordu University Education and Research Hospital and Ordu State Hospital neurology clinics, permission was obtained from General secretary of Ordu Provincial Union of Public Hospitals and Ordu University Education and Research Hospital ethics committee with 2018/85 decision number. Participation in the research was on a voluntary basis, with no names written on data collection forms. Patients and patient relatives were informed that information collected would not be used apart from the aims of the research. Written informed consent was obtained from all participants included in the study.

Statistical assessment

The Kolmogorov-Smirnov test was used to check normal distribution of data, with the Levene test used to check homogeneity of group variance. Variables abiding by these assumptions were compared with the Student t test for 2 groups and with the one-way ANOVA for more than 2 groups. After variance analysis, differing groups were determined with the Tukey multiple comparison test and results are stated with letters. Variables not abiding by the assumptions were compared with the Mann-Whitney U test for two groups and the Kruskal-Wallis test for more than two groups. After the Kruskal-Wallis test, differing groups were determined with Dunn's multiple comparison test and results are shown with letters. Diagonal tables were created with the aim of investigating the correlations between the calculated frequency values and determined variables and independence checks of the diagonal tables used the chi-square test (χ^2). For chi-square tests, if the expected frequencies were above 5, Pearson's chi-square value (χ^2) was calculated; while for frequencies below 5, the Likelihood ratio chi-square value (LR χ^2) was calculated. When dependence was determined between variables as a result of the chi-square test, the amount of dependence was determined with the contingency coefficient. The significance level (α) in calculations and interpreting results was noted as 5%. For all calculations, the SPSS v.25 (IBM Inc., Chicago, IL, USA) statistical program was used.

Results

In our study, there were 67 healthy female volunteers in the 18–39-year age group and mean age was 33.388 ± 5.129 years. The BMI, SMMI, HGT, and 4MWT values were 27.531 ± 4.456; 11.40 ± 1.270; 28.821 ± 4.954; 1.542 ± 0.302, respectively. The cut-off value for SMMI in females was 8.87 (mean-2SD).

In our study, there were 69 healthy male volunteers in the 18–39-year age group and mean age was 33.594 ± 4.103 years. The BMI, SMMI, HGT, and 4MWT values were 27.549 ± 3.127; 12.375 ± 0.924; 44.014 ± 7.381; 1.879 ± 0.372, respectively. The cut-off value for SMMI in males was 10.52 (mean-2SD).

There were significant differences in terms of all parameters (age, BMI, SMMI, HGT, and 4MWT) for both females and males according to study group (control 1, control 2, and GD group) ($p < 0.001$). There were similar age intervals in females and males in control 2 and GD groups. The BMI, HGT, SMMI, and 4MWT values were identified to be lowest among females and males in the GD group ($p < 0.001$) (Table 1).

The study found variations in the sarcopenia prevalence severity (normal, presarcopenia, sarcopenia, and severe sarcopenia) in all groups. The sarcopenia prevalence rate was identified as 12.7%/24.2% among females, 13.8%/44/0% among males, and 13.4%/32.8% in total in the control 2 and GD groups, respectively. The study found that the sarcopenia severity prevalence (normal, presarcopenia,

Table 1 Control and GD group data for females and males

Trait In females	Control 1 ($n = 136$) ($n = 67$)	Control 2 ($n = 165$) ($n = 71$)	GD ($n = 116$) ($n = 66$)	p value
Age	33.388c ± 5.129	72.408b ± 6.464	75.848a ± 6.986	0.000*** ($F = 960.370$)
BMI(kg/m$^{2)}$	27.531ab ± 4.456	29.212a ± 4.667	26.053b ± 3.286	0.000*** ($F = 9.733$)
SMMI(kg/m$^{2)}$	11.407a ± 1.270	11.413a ± 1.344	9.961b ± 1.162	0.000*** ($F = 29.388$)
HGT(kg)	28.821a ± 4.954	21.704b ± 5.478	18.712c ± 5.434	0.000*** ($F = 64.178$)
4MWT(m/s)	1.542a ± 0.302	1.109b ± 0.380	0.871c ± 0.309	0.000*** ($F = 69.529$)
HDRS	1.985 ± 1.571	–	–	–
DD	–	–	4.318 ± 2.425	–
GDS	–	*4 ± 3(36.19)*	*18 ± 7(104.30)*	0.000*** ($Z = 10.053$)
In males	($n = 69$)	($n = 94$)	($n = 50$)	
Age	33.594b ± 4.103	72.255a ± 6.520	74.140a ± 7.921	0.000*** ($F = 927.877$)
BMI(kg/m$^{2)}$	27.549a ± 3.127	28.113a ± 3.609	24.880b ± 3.129	0.000*** ($F = 15.851$)
SMMI(kg/m$^{2)}$	12.375a ± 0.924	12.293a ± 1.160	10.898b ± 0.983	0.000*** ($F = 35.765$)
HGT(kg)	44.014a ± 7.381	32.511b ± 9.042	27.380c ± 6.901	0.000*** ($F = 69.982$)
4MWT(m/s)	1.879a ± 0.372	1.200b ± 0.337	1.018c ± 0.248	0.000*** ($F = 122.299$)
HDRS	2.478 ± 1.836	–	–	–
DD	–	–	4.120 ± 2.135	–
GDS	–	3 ± 4(47.78)	16 ± 8(118.97)	0.000*** ($Z = 9.776$)

– statistical assessment could not be performed, *GDS* Geriatric Depression Scale, *HDRS* Hamilton Depression Rating Scale, *DD* disease duration (year)

Mean ± SD; *Median* ± *IQR* *Z* Mann-Whitney *U* test; *F* one-way ANOVA; *NS* statistically not significant ($p > 0.05$); Means that do not share a letter are significantly different ($p < 0.05$)

* Statistically significant ($p < 0.05$)

*** Statistically significant ($p < 0.001$)

sarcopenia, and severe sarcopenia) was different in control and GD group individuals in the same age group ($p < 0.001$). In GD patients, the prevalence of all sarcopenia stages, led by severe sarcopenia, was clearly higher compared to the control group (especially in males) (Table 2).

According to disease severity, there were significant differences identified in SMMI values in males and females, with patients with definite depression diagnosis identified to have lower SMMI values ($p < 0.05$). No statistically significant difference was found in other parameters in females ($p > 0.05$). In males, all parameters (BMI, SMMI, HGT, 4MWT), apart from age, were observed to have significant reductions with definite depression diagnosis ($p < 0.05$) (Table 3).

In this study, the sarcopenia severity prevalence (normal, presarcopenia, sarcopenia, and severe sarcopenia) in both females, males, and in general (total) varied according to disease severity in all GD patients ($p < 0.01$). Together with definite depression diagnosis, there was a significant increase observed in sarcopenia prevalence, led by severe sarcopenia (Table 3).

Discussion

Nutritional situation is negatively affected due to factors such as physiological changes together with aging, use of multiple

Table 2 Control 2 and GD group data in terms of sarcopenia stages in females and males [*n* (%)]

Trait	Control 2 $n = 165$ (%)	GD $n = 116$ (%)	*p* value
In females			
Normal	62[87.3)	50[75.8]	0.306^{NS}
Presarcopenia	2[2.8)	3[4.5]	(LR χ^2:3.613)
Sarcopenia	2[2.8)	2[3.0]	
Severe sarcopenia	5[7.1)	11[16.7]	
In males			
Normal	81[86.2)	28[56.0]	0.001**
Presarcopenia	2[2.1)	3[6.0]	(LR χ^2:16.343; CC = 0.324)
Sarcopenia	7[7.4)	9[18.0]	
Severe Sarcopenia	4[4.3)	10[20.0]	
Total			
Normal	143[86.6)	78[67.2]	0.001**
Presarcopenia	4[2.4)	6[5.2]	(LR χ^2:16.355; CC = 0.235)
Sarcopenia	9[5.5)	11[9.5]	
Severe sarcopenia	9[5.5)	21[18.1]	

n [%]; *LR* χ^2 Likelihood ratio chi-square test; *CC* contingency coefficient; *NS* statistically not significant ($p > 0.05$)

** Statistically significant ($p < 0.01$)

medications linked to additional diseases, dental-oral health problems, and dependence in completing daily life activities. Negative results occur in terms of muscle function, immune system, cardiopulmonary system, and motor and cognitive functions linked to factors like insufficient nutrition and sarcopenia, insufficient energy and protein intake, weight loss, changes in body components, and increased inflammation risk. Similarly, sarcopenia may occur with depression observed with advanced age due to inactivity, and disrupted quality of life and functioning. As a result, the two-way relationship between sarcopenia and depression has been intensely studied in recent times [25–28].

As sarcopenia prevalence varies according to sex, age, living area, ethnic background, assessment scales, and cut-off values, a healthy control group comprising 136 individuals, 67 females and 69 males, aged 18–39 years, was created with the aim of finding definite SMMI cut-off values in our population. The cut-off values for SMMI of 8.87 kg/m^2 for females and 10.52 kg/m^2 for males were obtained. Bahat et al. in a study of 301 participants aged 18–39 years and 406 participants above the age of 65 in the Turkish population identified the SMMI cut-off values as 7.4 kg/m^2 for females and 9.2 kg/m^2 for males [29, 30]. In the literature, the cut-off values for SMMI are found in the interval 8.51–10.75 kg/m^2 for males and 5.76–6.75 kg/m^2 for females [31, 32]. The cut-off values for SMMI for our population from the study data are close to those of Bahat et al., but are above the values in the literature. This may be explained by the 18–39 age control group comprising individuals with high socioeconomic level, who are active workers (a significant portion are security guards with active sporting hobbies) and have normal or upper limit of normal BMI values.

To ensure the ability to compare data with GD patients, a control group in the same age interval as the patients (71 females, 94 males) was created and assessments were performed by the same researcher and BIA device under standard conditions, which are strong aspects of our study. The lowest BMI, SMMI, HGT, and 4MWT values were identified among female and male patients in the GD group in our study. In three prospective studies in the literature, there were significant correlations found between sarcopenia parameters like hand grip strength and walking speed with depression, in accordance with our data [15, 33–35]. Similarly, another study with diagnosis placed according to DSM-IV diagnostic criteria found a correlation between hand grip strength and depression [36].

An advantage of our study is that the sarcopenia stages were assessed in detail among GD patients. Sarcopenia stages displayed differences in individuals from the control and GD groups. GD patients had higher prevalence of sarcopenia compared to the control group. The sarcopenia prevalence rate was identified as 12.7%/24.2% among females, 13.8%/44/0% among males, and 13.4%/32.8% in total in the control 2 and GD groups, respectively. Among GD patients, the prevalence of all sarcopenia stages, led by severe sarcopenia, was clearly higher compared to the control group. A systematic review by the International Sarcopenia Initiative of sarcopenia studies stated that sarcopenia was observed in at least one person in 20 among living individuals. In conclusion, the sarcopenia prevalence varies from 1 to 29% in society associated with regional and age-linked variations, and is 14–33% among the

Table 3 Data for female and male GD patients according to severity of disease

Gender	Disease severity		*p* value
	Possible depression ($n = 21$)	Definite depression ($n = 93$)	
In females	($n = 9$)	($n = 56$)	
Age	73.667 ± 8.456	76.375 ± 6.668	0.280^{NS} ($t = 1.090$)
BMI(kg/m$^{2)}$	27.577 ± 2.297	25.909 ± 3.318	0.153^{NS} ($t = 1.448$)
SMMI(kg/m$^{2)}$	11.164 ± 1.191	9.774 ± 1.055	0.001** ($t = 3.607$)
HGT(kg)	21.667 ± 7.176	18.143 ± 5.014	0.071^{NS} ($t = 1.838$)
4MWT(m/s)	0.953 ± 0.270	0.847 ± 0.307	0.333^{NS} ($t = 0.975$)
Sarcopenia			
Normal	9 [100.0%]	40 [71.4%]	0.136^{NS} (LR χ^2=5.543)
Presarcopenia	0 [0.0%]	3 [5.4%]	
Sarcopenia	0 [0.0%]	2 [3.6%]	
Severe	0 [0.0%]	11 [19.6%]	
MMSE	26.778 ± 1.202	26.286 ± 1.155	0.243^{NS} ($t = 1.180$)
GDS	*12 ± 1(5.0)*	*19 ± 7(37.5)*	0.000*** ($Z = 4.802$)
In males	($n = 12$)	($n = 37$)	
Age	74.667 ± 6.583	74.189 ± 8.379	0.858^{NS} ($t = 0.180$)
BMI(kg/m$^{2)}$	26.894 ± 2.755	24.228 ± 3.036	0.010** ($t = 2.699$)
SMMI(kg/m$^{2)}$	11.583 ± 0.685	10.656 ± 0.970	0.004** ($t = 3.063$)
HGT(kg)	30.583 ± 4.179	26.054 ± 7.047	0.044* ($t = 2.073$)
4MWT(m/s)	1.128 ± 0.201	0.970 ± 0.244	0.050* ($t = 2.015$)
Sarcopenia			
Normal	11 [91.7%]	16 [43.2%]	0.003** (LR χ^2=14.235)
Presarcopenia	1 [8.3%]	2 [5.4%]	(CC = 0.414)
Sarcopenia	0 [0.0%]	9 [24.3%]	
Severe	0 [0.0%]	10 [27.1%]	
MMSE	26.667 ± 1.371	26.054 ± 3.786	0.588^{NS} ($t = 0.546$)
GDS	*12 ± 1(6.5)*	*18 ± 6(31.0)*	0.000*** ($Z = 5.178$)

Mean ± SD; *Median* ± *IQR*; *n* [%]; *t* Student's *t* test; *Z* Mann-Whitney *U* test; *LR* χ^2 Likelihood ratio chi-square test, *CC* contingency coefficient, *NS* statistically not significant ($p > 0.05$); Means that do not share a letter are significantly different ($p < 0.05$); *MMSE* Standardized Mini Mental Test (Mental State Examination), *GDS* Geriatric Depression Scale

* Statistically significant ($p < 0.05$)

** Statistically significant ($p < 0.01$)

*** Statistically significant ($p < 0.001$)

long-term care population, and rates are in accordance with our control 2 group data (healthy volunteers above 65 years) [37].

The study showed that sarcopenia stages varied according to severity of disease in all GD patients. Together with the definite depression diagnosis, the prevalence of sarcopenia, led by severe sarcopenia, significantly increased. In the literature, two studies by Hsu et al. and İshii et al. with 353 subjects in the first and 1731 subjects in the second with sarcopenia diagnosis according to international definitions reported the association of sarcopenia and depression was common in old age [26, 38]. Important results of our study include that possible depression and definite depression diagnosis were assessed in detail with sarcopenia severity and that with definite depression diagnosis, the prevalence of sarcopenia was observed to increase, led by severe sarcopenia.

The most important limitation of our study is that possible effects of anthropometric (height, weight, waist, hip, thigh and forearm circumference, etc.), demographic and nutritional characteristics, educational status, and whether they did regular exercise and medications used (for depression treatment) were not assessed in the patient and control groups within the scope of this study. Another limitation was the fact that factors such as frailty, malnutrition, and vitamin D deficiency were not evaluated in association with sarcopenia. The cross-sectional nature of the study limits our ability to determine any causative relationship between variables. Additionally, the relatively small sample size is another limitation. As a result, there is a need for more comprehensive, advanced

studies with larger populations assessing the depression and sarcopenia relationship.

Conclusion and recommendations

It is not clear whether those with sarcopenia have higher possibility of combined cognitive-physical weakness on physical performance and cognition tests than controls with lower age. We assessed the effect of sarcopenia, with relative contribution to muscle mass and resistance, on both aspects of disruption and components of functionality.

The etiologies of sarcopenia and depression are not fully explained and are geriatric syndromes with mainly unsatisfactory treatments. As a result, identification of sarcopenia in the early stages among patients with GD diagnosis and precautions like providing protein support in diet and applying resistance exercises to improve muscle functions are important to contribute to improving clinical results of the disease.

As sarcopenia and depression follow a probable common pathophysiological route, it is considered that both geriatric syndromes affect each other. There is a need to plan broader, prospective studies using appropriate tools and techniques to prove the correlation between sarcopenia and depression.

Authors' contribution All authors contributed to writing the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

To complete this study with the aim of determining the prevalence of sarcopenia among GD patients monitored at Ordu University Education and Research Hospital and Ordu State Hospital neurology clinics, permission was obtained from General secretary of Ordu Provincial Union of Public Hospitals and Ordu University Education and Research Hospital ethics committee with 2018/85 decision number. Participation in the research was on a voluntary basis, with no names written on data collection forms. Patients and patient relatives were informed that information collected would not be used apart from the aims of the research. Written informed consent was obtained from all participants included in the study.

Conflict of interest The authors declare that they have no competing interest.

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References

1. Rosenberg I (1989) Summary comments: epidemiological and methodological problems in determining nutritional status of older persons. Am J Clin Nutr 50:1231–1233
2. Rosenberg IH (1997) Sarcopenia: origins and clinical relevance. J Nutr 127:990S–991S
3. Baumgartner RN, Koehler KM, Gallagher D, Romero L, Heymsfield SB, Ross RR, Garry PJ, Lindeman RD (1998) Epidemiology of sarcopenia among the elderly in New Mexico. Am J Epidemiol 147(8):755–763
4. Cruz-Jentoft AJ, Landi F, Topinková E, Michel JP (2010) Understanding sarcopenia as a geriatric syndrome. Curr Opin Clin Nutr Metab Care 13(1):1–7
5. Yadigar S, Yavuzer H, Yavuzer S, Cengiz M, Yürüyen M, Döventaş A, Erdinçler DS (2016) Primary sarcopenia in older people with normal nutrition. J Nutr Health Aging 20:234–238. https://doi.org/10.1007/s12603-015-0562-4
6. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, Martin FC, Michel JP, Rolland Y, Schneider SM, Topinkova E, Vandewoude M, Zamboni M (2010) Sarcopenia: European consensus on definition and diagnosis: report of the European Working Group on Sarcopenia in Older People. Age Ageing 39(4):412–423
7. Tichet J, Vol S, Goxe D, Salle A, Berrut G, Ritz P (2008) Prevalence of sarcopenia in the French senior population. J Nutr Health Aging 12(3):202–206
8. Alexandre Tda S, Duarte YA, Santos JL, Wong R, Lebrao ML (2014) Sarcopenia according to the European Working Group on Sarcopenia in Older People (EWGSOP) versus dynapenia as a risk factor for mortality in the elderly. J Nutr Health Aging 18(8):751–756. https://doi.org/10.1007/s12603-014-0450-3
9. Bianchi L, Ferrucci L, Cherubini A, Maggio M, Bandinelli S, Savino E, Brombo G, Zuliani G, Guralnik JM, Landi F, Volpato S (2016) The predictive value of the EWGSOP definition of sarcopenia: results from the InCHIANTI study. J Gerontol A Biol Sci Med Sci 71:259–264
10. Barichella M, Pinelli G, Iorio L, Cassani E, Valentino A, Pusani C, Ferri V, Bolliri C, Pasqua M, Pezzoli G, Frazzitta G, Cereda E (2016) Sarcopenia and dynapenia in patients with parkinsonism. J Am Med Dir Assoc 17(7):640–646
11. Yürüyen M, Yavuzer H, Yavuzer S et al (2017) Comparison of nutritional risk screening tools for predicting sarcopenia in hospitalized patients. Turk J Med Sci 47:1362–1369
12. Morley JE (2008) Sarcopenia: diagnosis and treatment. J Nutr Health Aging 12(7):452–456
13. Janssen I (2011) The epidemiology of sarcopenia. Clin Geriatr Med 27(3):355–363
14. Wang C, Bai L (2012) Sarcopenia in the elderly: basic and clinical issues. Geriatr Gerontol Int 12(3):388–396
15. Fukumori N, Yamamoto Y, Takegami M, Yamazaki S, Onishi Y, Sekiguchi M, Otani K, Konno SI, Kikuchi SI, Fukuhara S (2015) Association between hand-grip strength and depressive symptoms: Locomotive Syndrome and Health Outcomes in Aizu Cohort Study (LOHAS). Age Ageing 44(4):592–598
16. Karan A (2006) Exercise and sports in the elderly. Turk J Phys Med Rehab 52(Suppl A):A53–A56
17. Folstein MF, Folstein SE, McHugh PR (1975) Mini-mental state: a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 12:189–198
18. Güngen C, Ertan T, Eker E et al (2002) Reliability and validity of the standardized Mini Mental State Examination in the diagnosis of mild dementia in Turkish population. Turk Psikiyatri Derg 13(4):273–281
19. Hamilton M (1960) A rating scale for depression. J Neurol Neurosurg Psychiatry 23(1):56–62
20. Akdemir A, Örsel SD, Dağ I, Türkçapar MH, İşcan N, Özbay H (1996) Clinical use and the reliability and validity of the Turkish version of the Hamilton Depression Rating Scale (HDRS). 3P Dergisi 4:251–259

21. Yesavage JA, Brink TL, Rose TL et al (1982–1983) Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 17(1):37–49
22. Ertan T, Eker E, Şar V (1997) Geriatrik Depresyon Ölçeğinin Türk Yaşlı Nüfusunda Geçerlilik Ve Güvenilirliği. Nöropsikiyatri Arşivi 34(1):62–71
23. Sağduyu A (1997) Yaşlılar için depresyon ölçeği: Hamilton depresyon ölçeği ile karşılaştırmalı güvenilirlik ve geçerlilik çalışması. Türk Psikiyatri Dergisi 8:3–8
24. Lauretani F, Russo CR, Bandinelli S, Bartali B, Cavazzini C, di Iorio A, Corsi AM, Rantanen T, Guralnik JM, Ferrucci L (2003) Age-assosiated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol (1985) 95(5):1851–1860
25. Pasco JA, Williams LJ, Jacka FN, Stupka N, Brennan-Olsen SL, Holloway KL, Berk M (2015) Sarcopenia and the common mental disorders: a potential regulatory role of skeletal muscle on brain function? Curr Osteoporos Rep 13(5):351–357
26. Hsu YH, Liang CK, Chou MY, Liao MC, Lin YT, Chen LK, Lo YK (2014) Association of cognitive impairment, depressive symptoms and sarcopenia among healthy older men in the veterans retirement community in southern Taiwan: a cross-sectional study. Geriatr Gerontol Int 14(Suppl 1):102–108
27. Kim NH, Kim HS, Eun CR, Seo JA, Cho HJ, Kim SG, Choi KM, Baik SH, Choi DS, Park MH, Han C, Kim NH (2011) Depression is associated with sarcopenia, not central obesity, in elderly Korean men. J Am Geriatr Soc 59(11):2062–2068
28. Byeon C, Kang K-Y, Kang S, Kim H, Bae E (2016) Sarcopenia is not associated with depression in Korean adults: results from the 2010–2011 Korean National Health and Nutrition Examination Survey. Korean J Fam Med 37(1):37
29. Bahat G, Tufan A, Tufan F, Kılıc C, Akpinar S, Kose M (2016) Cut-off points to identify sarcopenia according to European Working Group on Sarcopenia in Older People (EWGSOP) definition. Clin Nutr 2(6):35
30. Bahat G, Tufan A, Tufan F, Karan MA (2017) Significance of population differences and the methodology in determining the muscle mass cut-off points for sarcopenia. Geriatr Gerontol Int 17(3):521–522
31. Kim H, Hirano H, Edahiro A, Ohara Y, Watanabe Y, Kojima N, Kim M, Hosoi E, Yoshida Y, Yoshida H, Shinkai S (2016) Sarcopenia: prevalence and associated factors based on different suggested definitions in community-dwelling older adults. Geriatr Gerontol Int 16(Suppl 1):110–122
32. Rodriguez-Rejon AI, Artacho R, Puerta A, Zuñiga A, Ruiz-Lopez MD (2018) Diagnosis of sarcopenia in long-term care homes for the elderly: the sensitivity and specificity of two simplified algorithms with respect to the EWGSOP Consensus. J Nutr Health Aging 22: 796–801. https://doi.org/10.1007/s12603-018-1004-x
33. Hamer M, Batty GD, Kivimaki M (2015) Sarcopenic obesity and risk of new onset depressive symptoms in older adults: English Longitudinal Study of Ageing. Int J Obes 39:1–4
34. Demakakos P, Cooper R, Hamer M et al (2013) The bidirectional association between depressive symptoms and gait speed: evidence from the English Longitudinal Study of Ageing (ELSA). PLoS One 8(7):14–18
35. Brooks JM, Titus AJ, Bruce ML, Orzechowski NM, Mackenzie TA, Bartels SJ, Batsis JA (2018) Depression and handgrip strength among U.S. adults aged 60 years and older from Nhanes 2011-2014. J Nutr Health Aging 22:938–943. https://doi.org/10.1007/s12603-018-1041-5
36. Lino VTS, Rodrigues NCP, O'Dwyer G, Andrade MKN, Mattos IE, Portela MC (2016) Handgrip strength and factors associated in poor elderly assisted at a primary care unit in Rio de Janeiro, Brazil. PLoS One 11(11):e0166373
37. Cruz-Jentoft AJ, Landi F, Schneider SM, Zuniga C, Arai H, Boirie Y, Chen LK, Fielding RA, Martin FC, Michel JP, Sieber C, Stout JR, Studenski SA, Vellas B, Woo J, Zamboni M, Cederholm T (2014) Prevalance of and interventions for sarcopenia in ageing adults: a systematic review. (EWGSOP and IWGS). Age Ageing 43(6):748–759
38. Ishii S, Chang C, Tanaka T et al (2016) The association between sarcopenic obesity and depressive symptoms in older Japanese adults. PLoS One 11(9):1–12