Annals of Medical Research

The role of dynapenia and abdominal obesity in determining fall risk in the elderly

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Abstract

Aim: Dynapenia (D) and abdominal obesity (AO) are associated with many adverse health outcomes in the elderly. In our study, we aimed to evaluate the role of dynapenia and abdominal obesity in determining the risk of falling in the elderly.

Materials and Methods: A total of 400 (71.6±5.9) elderly, 228 of whom were women, were included in the study. All participants were evaluated with anthropometric measurements as well as hand grip strength, gait speed and Tinetti Balance and Gait Assesment (TBGA). AO was defined by waist circumference (WC) (WC≥102 cm in men and WC≥88 cm in women). Hand grip strength (HGS) was measured by hand dynamometry. Those with HGS <27 kg for men and <16 kg for women were defined as dineapenic (D). All participants were classified as ND/NAO, D/NAO, ND/AO, and D/AO.

Results: Gait speed was found to be lower in the ND/AO and D/AO groups (p<0.001). According to TBGA scores, 25 (35.2%) of 71 patients with high fall risk were D/AO, while 27 (38%) were ND/AO (p=0.018). While the risk of high falls was 14.4% in the ND/AO group, this rate increased to 24% in the D/AO group. WC (p<0.001, OR= -0.01 [-0.01-0.01]), HGS (p=0.025, OR= 0.03 [0.00-0.01]) and TBGA (p<0.001, OR= 0.066 [0.06-0.07]) high were determined as predictors of fall risk.

Conclusion: Our study showed that WC and HGS measurements, as well as TBGA, are effective in detecting high fall risk in the elderly. It may be possible to prevent falls and fall-related injuries by early detection of abdominal obesity and decreased muscle strength, which are among the correctable risk factors in the elderly, and by performing the necessary interventions.

Introduction

Falls are an important geriatric syndrome that can cause hospitalization and accidental death in the elderly [1]. Many factors are involved in the etiology of falls, including balance and gait disturbances, muscle weakness, and previous fall events [2]. A decrease in aging-related muscle strength, dynapenia, is closely related to physical functions in the elderly [3]. It has been emphasized that dynapenia, which has been studied especially recently, can be used in the determination and management of fall risk in the elderly [4, 5].

Another health problem that should be considered in determining the fall risk in the elderly is abdominal obesity (AO). Waist circumference (WC) is considered an important clinical criterion to define AO and provides valuable information about falls [4, 6]. The coexistence of dynapenia and abdominal obesity has been defined as dynapenic-abdominal obesity (D/AO). Recent studies have shown that D/AO patients have a higher prevalence of metabolic syndrome, as well as a faster decline in gait speed, higher risk of functional decline, disability, death, falls, and hospitalization, and a higher rate of death [5, 7, 8].

As it is known, falls in older adults have a greater impact on clinical prognosis. In addition, both D and AO have a significant effect on physical functions. Previous studies have investigated the relationship between D/AO and the risk of falling, but there is no study on this subject in our country. Thus, this article attempts to evaluate the relationship between D/AO and fall risk to find potential ways to prevent falls in the elderly.

Materials and Methods

Participants

Our cross-sectional study included patients aged 65 and over who followed to the İnönü University Turgut Özal

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Medical Center Internal Medicine and Geriatrics outpatient clinic between October and December 2021. Those who had the ability to walk independently were included in the study. Patients with severe acute/chronic infection, Parkinson's disease, cerebellar disease, vision and hearing loss, and acute cerebrovascular disease were excluded from the study.

Study measures

Anthropometrics and body composition assessments

Waist circumference (WC) was measured at the level of the navel. According to this measurement, those with WC≥102 cm in men and WC≥88 cm in women were defined as abdominally obese (AO) [9]. Hand grip strength (HGS) was measured by hand dynamometry. According to the European Sarcopenia Working Group, HGS <27 kg for men and <16 kg for women was defined as dynapenic (D) [10]. Participants walked the 3-meter distance at their daily walking speed and came back to their starting points. Meanwhile, walking speeds were calculated (m/s) [11]. Participants were divided into four groups as ND/NAO, D/NAO, ND/AO, and D/AO according to waist circumference and hand grip strength grouping criteria:

Group 1: Non-dynapenic, Non-abdominal obesity (ND/NAO)

Group 2: Dynapenic, Non-abdominal Obese (D/NAO)

Group 3: Non-dynanepnic, Abdominal Obese (ND/AO)

Group 4: Dynapenic Abdominal Obese (D/AO)

Fall risk assessment

The risk of falling was evaluated by applying the Tinetti balance and gait assessment (TBGA) to the participants. According to TBGA scores; ≤18 was defined as high fall risk, 19-23 points as moderate fall risk, and ≥24 as low fall risk [12].

Comprehensive geriatric evaluation

In our study, Katz Activities of Daily Living Index (ADL) and Lawton Brody Instrumental Activities of Daily Living Index (IADL) were used in the functional evaluation of the participants [13,14]. High scores for both tests were accepted as an indicator of independence. Mini Nutritional Assessment Short Form (MNA-SF Test) was used for nutritional status assessment, Geriatric Depression Scale (GDS-15) for mood assessment, and Mini Mental Status Examination (MMSE) for cognitive assessment [15-17]. According to MNA-SF test results, 0-7 was defined as malnutrition, 8-11 as malnutrition risk and ≥12 points as normal nutritional status. According to the GDS-15 test results, ≥5 points were considered as depression. With the MMSE, the patients' ability to register, pay attention and calculate, recall, language, follow simple commands, and orientation were evaluated. Accordingly, the cut-off point ≤23 was used for the diagnosis of mild dementia.

Statistical analysis

IBM SPSS for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. It was tested with Shapiro-Wilk to test the normality of the distribution of continuous variables. The relationship between categorical variables was evaluated using the x^2 test, and the significance of the difference between groups was evaluated using the ANOVA and Kruskal–Wallis H tests. Numerical variables were presented as mean ± standard deviation. Correlation analysis and linear regression models were used to evaluate the relationship between variables.

Results

A total of 400 (mean age 71.6±5.9) patients, 228 (57%) of whom were women, were included in the study. Participants were divided into four groups according to the measurement results of HGS and WC. The characteristics of the study population are shown in Table 1. The mean age of the D/NAO and D/AO groups was higher. There was a significant difference between BMI and waist circumference in the ND/AO and D/AO groups. Gait speed was found to be significantly lower in the ND/AO and D/AO groups compared to the non-AO groups (p<0.001). While there was no difference in ADL scores between the groups in the evaluation of functional capacity, IADL scores were found to be statistically low in the ND/AO and D/AO groups.

Participants were divided into 3 groups as high-intermediate and low-fall risk according to TBGA score results (Table 2). While 25 (35.2%) of 71 patients with high fall risk were D/AO, 27 (38%) were ND/AO (p=0.018). On the other hand, while the high risk of falling was 14.4% in the ND/AO group, this rate increased to 24% in the D/AO group.

Logistic regression analysis was performed to determine the parameters affecting the occurrence of high fall risk in the participants. Accordingly, WC (p<0.001, OR= -0.01 [-0.01-0.01]), HGS (p=0.025, OR= 0.03 [0.00-0.01]) and TBGA (p<0.001, OR= 0.066 [0.06-0.07])) were found to be independent predictors of falling (Table 3).

Discussion

In our study, we aimed to investigate the effect of decrease in muscle strength and increase in waist circumference on the risk of falling in the elderly. According to our results; Walking speed and IADL scores were significantly lower in the ND/AO and D/AO groups. A high fall risk was found in one of every four elderly people in the D/AO group and in one out of seven elderly people in the ND/AO group, this value was significantly higher than the other groups. Also, in our study, it was found that WC, HGS and TBGA scores were effective in determining the risk of falls.

Changes in muscle and fat distribution with advancing age cause an increase in the frequency of truncal obesity. It has been demonstrated in previous studies that in addition to abdominal obesity in the elderly, decreased muscle strength is associated with worse IADL [18, 19]. Possible mechanisms have been suggested to explain these findings. The most important of these is the increase in adipose tissue in muscle tissue with increasing age, causing deterioration in muscle anatomy and function [20, 21]. Alexandre et al analyzed data from two broad-based studies and found that the D/AO group was associated with worse

Table 1. Characteristics of participants by abdominal obesity and dynapenia status.

		ND/NAO n=61	D/NAO n=41	ND/AO n=194	D/AO n=104	p
Age		69 (65-90)	75 (69-91)*	70 (65-89)	71(65-90)*	<0.001
Sex n (%)	Female	27 (11.8%)	130 (57.0%)	19 (8.3%)	52 (22.9%)	<0.001
Marital status	Maried	50 (17.2%)	33 (11.4%)	139 (47.9%)	68 (23.4%)	0.254
Comorbidities	DM	14 (13.3%)	15 (14.3%)	45 (42.8%)	41 (29.6)	
	HT	11 (12.6%)	8 (9.2%)	31 (35.6%)	37 (42.6%)	0.045
	KVH	5 (5.5%)	11 (12.2%)	42 (46.6%)	32 (35.5%)	
	Others	14 (12.5%)	22 (19.6%)	31 (27.7%)	45 (40.2%)	
Cigaret	Yes	16 (22.9%)	12 (17.1%)	24 (34.3%)	18 (25.7%)	0.014
Alchol	Yes	2 (15.4%)	5 (38.5%)	3 (23.1%)	3 (23.1%)	0.067
Number of drugs		3 (0-14)	2 (0-13)	4 (0-13)	4 (0-20)	0.152
Waist circumference (cm)		92 (67-102)	91(75-101)	110 (93-141)	108 (93-136)	<0.001
Gait speed		0.95±0.3	0.94±0.3	0.74±0.2*	0.69±0.2*	0.001
BMI		25 (17.8-33.1)	24.7(17.9-32.4)	31.3 (18.9-42.3)*	30.7 (26.1-45.7)*	0.014
ADL		70 (15-90)	65 (10-95)	65 (5-100)	65 (10-95)	0.255
IADL		5 (1-8)	5 (1-8)	4 (1-8)*	4 (1-8)*	<0.001
MMSE		28 (21-30)	27 (19-30)	26 (20-30)	27 (19-30)	0.120
GDS-15		2 (0-15)	4 (0-15)	4 (0-15)	5 (0-15)	0.695
MNA-SF		15 (5-14)	15 (3-14)	13 (4-16)	12 (5-15)	0.082
TBGA		25 (13-28)	24 (8-28)	25 (8-28)	25 (7-28)	0.014

BMI; Body Mass Index, ADL; Activity of Daily Living, IADL; Instrumental Activities of Daily Living, MMSE; Mini Mental State Examination, GDS-15; Geriatric Depression Scale, MNA-SF; Mini Nutritional Assessment-Short Form, TBGA; Tinetti Balance and Gait Assessment. All data were analyzed by the chi-square test Values are expressed as the median(min-max) or n%, gait speed is exressed as mean ± standard deviation. *p<0.005

Table 2. Evaluation of fall risk according to groups.

	Risk of Fall				
	Low (n=239)	Mıld (n=88)	High (n=73)	Total	p
ND/NAD n (%)	44[a] (72.1%)	6[b] (9.8%)	11[a,b] (18.0%)	61 (100.0%)	
D/NAO n (%)	26 [a] (63.4%)	6 [a] (14.6%)	9 [a] (22.0%)	41 (100.0%)	0.014*
ND/AO n (%)	120 [a] (61.9%)	46 [a] (23.7%)	28 [a] (14.4%)	194 (100.0%)	
D/AO n (%)	49 [a] (47.1%)	30[b] (28.8%)	25 [b] (24.0%)	104 (100.0%)	

ND/NAO: Nondynapenic Nonabdominal obese; D/NAO: Dynapenic Nonabdominal obese; ND/AO: Nondynanepnic Abdominal obese; D/AO: Dynapenic Abdominal obese. *p<0.005.

Table 3. Logistic regression analysis results of the independent variables for falls.

Variables	p	OR [%95CI]
Age	0.515	-0.001 [-0.01-.01]
Sex	0.827	0.006 [-0.06-0.05]
Gait Speed	0.436	-0.025 [-0.09-0.04]
WC	<0.001	-0.007 [-0.01-0.01]
HGS	0.025	0.003[0.00-.01]
TBGA	<0.001	0.066 [0.06-0.07]

WC; Waist Circumference, HGS; Hand Grip Strength, TBGA; Tinetti Balance and Gait Assessment.*p < 0.05 according to multivariate binary logistic regression analysis. CI, confidence interval; OR, odds ratio.

IADL [18]. Yang et al. the prevalence of both ADL and IADL disability was found to be higher in the D/AO group compared to the others in the elderly who were evaluated after a two-year follow-up [19]. In our study, IADL scores of both groups (D/AO and ND/AO) with abdominal obesity were found to be significantly lower. From this point of view, it is of great importance to screen for abdominal obesity, which is a modifiable risk factor, and to make necessary interventions without losing time, in preventing potential addiction that may develop in the elderly.

Falls in the elderly cause a heavy economic burden due to increased health costs [22]. In order to take preventive measures in this regard, it is necessary to investigate the factors associated with the development of falls first. Previous studies have shown that increased WC causes postural balance to deteriorate in the elderly, making them more prone to falls [23]. On the other hand, studies focusing on falls have shown the relationship between decreased muscle strength and recurrent falls in the elderly [24, 25]. From this point of view, the effect of both abdominal obesity and dynapenia on falling has inspired new studies. In studies on this subject, TBGA, walking speed, the Timed Up and Go test and fall events (falls, recurrent falls, and fall-related injury) were used to determine the risk of falling [5, 8, 23]. In our study, we used TBGA to assess the fall

risk of the participants. Consistent with the literature, we found a high risk of falling in one out of every four patients with D/AO. In addition, WC, HGS and TBGA were independent predictors of fall in our study group. In the study of LV et al., in which more than 500 older adults were evaluated, it was also shown that there was a higher risk of falling in the D/AO group [26]. Similarly, in another broad-based study using the same cut-off values as our study, the frequency of falls was found to be higher in the D/AO group [5]. Our study results emphasize that waist circumference measurement and hand grip strength should be evaluated in addition to balance tests to be performed in the prediction of falls in the elderly.

In studies on falling, the difference between the sexes is another research topic. It has emerged that the differences in fat distribution between men and women may be effective in the emergence of the risk of falling. Based on this, Dowling et al.'s study found that the presence of D/AO predicted falls only in men, and the presence of dynapenia in women without obdominal obesity was associated with the risk of falling [5]. On the other hand, in a study in which 201 elderly female patients living in the community were evaluated, it was found that dynapenia or abdominal obesity were associated with an increased incidence of falls rather than their coexistence (D/AO) [27]. In our study, there was no difference between genders regarding the effect of the presence of D/AO on the risk of falling. However, the small number of cases may have been insufficient to demonstrate this relationship. The difference between genders should be evaluated with studies that reach higher case numbers. This is important in terms of raising awareness among clinicians about the correctable factors for the prevention of falls, especially in women who experience more fall-related comorbidities such as advanced age osteoporosis.

It is recommended to evaluate gait speed as the most effective and rapid method in the evaluation of existing physical capacity in the elderly [27]. Impairment in gait speed in the elderly causes an increase in the fall risk [28]. The mechanical effect of the combination of D and AO on falling in the elderly has not been fully explained, but current studies have shown that the D/AO group has worse gait speed [26, 29]. Zhang et al., in which nearly five thousand elderly people were followed for more than ten years, it was reported that the D/AO group had worse gait speed results, as well as recurrent falls and fall-related injuries more frequently in this group [29]. In another study, in which elderly people living in the community were evaluated at a 6-year follow-up, a greater decrease in gait speed was found in the D/AO group. Another important point of this study is that the risk of developing movement restriction was found to be higher in the D/AO group [30]. In another observational study with high participants, the decrease in gait speed was significant in the D/AO group, but neither D nor AO was associated with a decrease in gait speed [31]. In our study, gait speed was found to be lower in the D/AO and ND/AO groups. With the evaluation of gait speed in elderly patients, future dependency, falls and fall-related disabilities can be predicted.

There are some limitations of our study. The first and most important of these is the cross-sectional design of the employee. For this reason, it may have been insufficient to establish a causal relationship. This study may be the pioneer of future prospective studies with follow-up. Another limitation of ours was the elderly who applied to the outpatient clinic. Community-based studies with larger case numbers can be planned. Despite all these limitations, our study is valuable because it is the first study conducted in our region.

Conclusion

Our study showed that, in addition to the tests used in the assessment of fall risk, WC and hand grip strength measurement were effective in detecting the elderly with high fall risk. It may be possible to prevent falls and fall-related injuries by early detection of abdominal obesity and decreased muscle strength, which are among the correctable risk factors in the elderly, and by performing the necessary interventions.

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