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Muscle Strength, Mobility, Activities of Daily Living and Depression in Relation to Frailty in Older Adults

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ABSTRACT

Objective: Examining the relationship between frailty and lower extremity muscle strength, functional mobility, activities of daily living (ADL), and depression in older adults was the goal of this study. **Materials and Methods:** There were 69 older adults in the cross-sectional study (35 male and 34 female). The Clinical Frailty Scale (CFS), 5-Repetition Sit-to-Stand (STS) Test, Timed Up and Go (TUG) Test, Lawton Instrumental Activities of Daily Living (L-IADL) Scale and Geriatric Depression Scale-Short Form (GDS-SF) were used for evaluations. **Results:** The mean and standard deviation age value of the older adults was 85.48±3.67 years and the body mass index was 25.73 ± 3.01 kg/m^2. In older adults, the CFS was positively and moderately associated with the 5-STS Test (rho=0.418, $p < 0.001$) and TUG Test (rho=0.573, $p < 0.001$), negatively associated with the L-IADL Scale at good level (rho=-0.637, $p < 0.001$), and positively correlated with GDS-SF at fair level (rho=0.281, p=0.019) in older adults. **Conclusion:** Our research shows that frailty is associated with lower extremity muscle strength, functional mobility, ADL and depression in older adults. Therefore, even in the absence of frailty symptoms, lower extremity muscle strength, functional mobility, instrumental-ADL, and depression should be evaluated at regular intervals in order to prevent the emergence of frailty or stop its progression in older adults, and we think that treatment approaches to improve these parameters should be included in geriatric rehabilitation practices.

Keywords: Muscle Strength, Walking Speed, Depression, Elderly, Frail.

Yaşlı Yetişkinlerde Kas Kuvveti, Mobilite, Günlük Yaşam Aktiviteleri ve Depresyonun Kırılganlıkla İlişkisi

ÖZ

Amaç: Bu çalışmanın amacı yaşlı bireylerde kırılganlık ile alt ekstremite kas kuvveti, fonksiyonel mobilite, günlük yaşam aktiviteleri (GYA) ve depresyon arasındaki ilişkiyi incelemektir. **Gereç ve Yöntem:** Bu kesitsel çalışmaya 69 yaşlı birey (34 kadın ve 35 erkek) dahil edildi. Değerlendirmeler için Klinik Kırılganlık Ölçeği (KKÖ), 5-Tekrarlı Otur-Kalk Testi (5-OKT), Süreli Kalk ve Yürü (TUG) Testi, Lawton Enstrümantal Günlük Yaşam Aktiviteleri (L-EGYA) Ölçeği ve Geriatrik Depresyon Ölçeği-Kısa Formu (GDÖ-KF) kullanıldı. **Bulgular:** Yaşlı bireylerin ortalama ve standart sapma yaş değeri 85.48±3.67 ve vücut kütle indeksi 25.73 ± 3.01 kg/m^2 idi. Yaşlı bireylerde KKÖ, 5-OKT (rho=0.418, $p < 0.001$) ve TUG Testi (rho=0.573, $p < 0.001$) ile pozitif yönde ve orta düzeyde ilişkili, L-EGYA Ölçeği ile iyi düzeyde ve negatif yönde ilişkili (rho=-0.637, $p < 0.001$) ve GDÖ-KF ile orta düzeyde ve pozitif yönde ilişkili (rho=0.281, p=0.019) bulunmuştur. **Sonuç:** Çalışmamız, yaşlı bireylerde kırılganlığın alt ekstremite kas kuvveti, fonksiyonel mobilite, GYA ve depresyon ile ilişkili olduğuna dair kanıtlar sunmaktadır. Bu nedenle, yaşlı bireylerde kırılganlık belirtileri olmasa bile, kırılganlığın ortaya çıkmasını önlemek veya ilerleyişini durdurmak amacıyla, yürüyüş, alt ekstremite kas kuvveti, depresyon ve enstrümental günlük yaşam aktiviteleri düzenli aralıklarla değerlendirilmelidir ve bu parametreleri iyileştirmeye yönelik tedavi yaklaşımlarının geriatrik rehabilitasyon uygulamalarına dahil edilmesi gerektiğini düşünmekteyiz.

Anahtar Kelimeler: Kas Kuvveti, Yürüyüş Hızı, Depresyon, Yaşlı, Kırılgan.

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INTRODUCTION

The aging process leads to deterioration across all bodily systems, resulting in numerous adverse effects in older adults. One of the systems impacted by this decline is the balance control system (Baysal & Saka, 2024; Navarrete-Villanueva et al., 2021). Balance disorders that may occur due to deterioration of afferent and efferent pathways affect the mobility of older adults. As people age, their balance often deteriorates, increasing the risk of falls, fractures, and a significant reliance on daily tasks (ADL) (Baysal & Saka, 2024; Provencher et al., 2017; Tornero-Quiñones, Sáez-Padilla, Espina Díaz, Abad Robles, & Sierra Robles, 2020). Another problem, older adults deal with issues related to psychological and physical changes caused by aging (Buigues et al., 2015). Depressed older adults have rapid deterioration in function due to a lack of motivation to engage in particular activities and socialize, leading to loss of ADL. At the same time, ADL reduced with age, caused by difficulties such as diminished function and increasing difficulty integrating into surroundings that change over time (Baysal & Saka, 2024; Soysal et al., 2017). Furthermore, it is known that with advancing age, muscle strength in the lower extremities diminishes more significantly than in the upper extremities (Batista et al., 2014; Navarrete-Villanueva et al., 2021). Mentioned dysfunctions in several physiological systems that occur with aging cause geriatric syndromes, which can be difficult to treat effectively.

Geriatric syndrome refers to a group of health issues that are widespread in older persons but cannot be categorized clearly into illness categories. The most common geriatric symptoms are falls, urinary incontinence, delirium, dizziness, and frailty (Navarrete-Villanueva et al., 2021; Provencher et al., 2017).

Frailty syndrome represents a condition of susceptibility to stressors resulting from diminished physiological reserves, necessitating a comprehensive assessment that encompasses psychological, social, and functional dimensions (Batista et al., 2012). Frailty causes many health problems. The risk of depression is known to be high in frail older people, suggesting an association between frailty and depressive symptoms (Soysal et al., 2017). Additionally, another study discovered that pre-frail older adults walked more slowly than non-frail elderly individuals and that frail older adults had poorer balance (Hartley, Keevil, & Romero-Ortuno, 2017; Navarrete-Villanueva et al., 2021; Papiol et al., 2016). Frailty are highly associated with healthcare burdens, such as increased falls and comorbidities, polypharmacy, hospital readmissions, falls, and the need for caregivers. As older population increases, the need to protect and improve health, functionality and quality of life and reduce health care costs becomes more evident. Identifying factors related with frailty is important to prevent functional loss due to frailty, maintain independence, and plan geriatric care programs (Provencher et al., 2017; Tornero-Quiñones et al., 2020). Therefore, determining the relationship between frailty and lower extremity muscle strength, functional mobility, ADL, and depression was aimed at in this study.

MATERIALS AND METHODS

Study design and participants

This cross-sectional study was conducted in the Giresun Training and Research Hospital Healthy Aging Center. The older adults were recruited in March and April of 2025. The study adhered to the intent and principles of the Helsinki Declaration. We obtained written informed consent from all participants.

Inclusion criteria were: (1) Being 65 years of age or older, (2) Mini Mental State Examination score ≥ 24 points (Folstein, Folstein, & McHugh, 1975) (3) Being able to walk with an assistive device or independently.

Exclusion criteria were: (1) Having serious neurological, orthopedic or cardio-pulmonary findings that may adversely affect balance and gait, (2) Taking medication such as benzodiazepines, psychotropic drugs that may adversely affect balance and gait.

Measurements

Age, height, and weight were recorded. Assessments were performed in collaboration with physicians, physiotherapists and gerontologists. Two-minute rest breaks were given during the evaluation. During the tests, the patient was stood next to for safety.

The most widely used test for dementia screening is the Standardized Mini-Mental State Examination, which was created in 1975 by Folstein and associates. This test is scored out of 30 points and has eleven questions. Normal is between 24 and 30 points; mild dementia is between 18 and 23 points; and severe dementia is compatible with 17 points or less. It has the benefit of being simple and quick to administer and assesses memory, orientation, attention, recall, calculation, motor function, language, perception, and visuospatial ability. Although the test has limited specificity in terms of distinguishing clinical syndromes, it is a brief, convenient and standardized method that can be used to determine cognitive level globally (Folstein et al., 1975).

Frailty of older adults was assessed with the Clinical Frailty Scale (CFS). The CFS, developed in 2305 patients enrolled in the Canadian Health and Aging Study, is a scale in which the dependency of patients' daily activities is questioned. The Clinical Frailty Scale is a 9-point scale ranging from “very fit” to “terminal illness”. It is one of the most commonly used frailty assessment tools. The CFS allows healthcare providers to quickly categorize older patients with the help of visuals and clinical descriptors. The CFS takes less than one minute to complete and is simple and easy to use (Church,

Rogers, Rockwood, & Theou, 2020; Rockwood et al., 2005).

Lower extremity muscle strength was evaluated with 5-Repetition Sit-to-Stand (STS) Test. The 5-Repetition STS Test is a performance test in which a person's ability to sit and stand on a chair 5 times serially is recorded in terms of time. The test is considered unsuccessful if five repetitions cannot be completed without help or upper extremity support. The test is started with the start command and ended when the hip completely touches the chair after the 5th repetition. The test's duration is measured from the beginning to the end and recorded with a stopwatch (Tsekoura, Anastasopoulos, Kastrinis, & Dimitriadis, 2020; Muñoz-Bermejo et al., 2021).

Functional mobility assessment was conducted using the Timed Up and Go (TUG) Test. For the test, a regular chair is utilized. The older adults are instructed to get up, walk a set three meters in normal steps, and then return to the chair after the three meters. The time started with the command "get up" is stopped when the patient sits on the chair. During the test, the patient's walking time is measured in seconds with a stopwatch (Beauchet et al., 2011; Rydwik, Bergland, Forsén & Frändin, 2011).

In instrumental-ADL, functional independence was evaluated using the Lawton Instrumental Activities of Daily Living (L-IADL) Scale. Eight items make up the questionnaire, which asks about using the telephone, shopping, doing laundry, doing daily household chores, preparing food, managing money, using drugs, and using transport. The overall score ranges from 0 (dependent) to 8 (independent), with each item receiving a value of "0-not independent" or "1-independent." (Graf, 2009; Pashmdarfard, & Azad, 2020).

Older adults' depression levels were measured using the Geriatric Depression Scale-Short Form (GDS-SF). There are fifteen items on the GDS-SF that ask about the patient's mood. Responses are based on how you felt during the previous week; they are in the form of "yes" or "no," just like in the long form, and depending on the question, one point is awarded for each response. In scoring the questions, scores of 0-4 are interpreted as the absence of depressive symptoms, 5-8 as mild depression, 9-11 as moderate depression and 12 and above as severe depression. The Turkish validity and reliability study was conducted by Durmaz et al. (Durmaz, Soysal, Ellidokuz, & Isik, 2018).

Statistical analysis

To determine the necessary sample size for the investigation, authors utilized the G*Power software program (Faul, Erdfelder, Buchner, & Lang, 2009). As a result of the calculation made using research data which the total number of samples is 69, for the correlation analysis, the research's correlation value was determined to be 0.573 (coefficient of correlation between the CFS and TUG), and its power (1-β) was assessed to be 0.99 with a 5% margin of error (a= 0,05).

The data was statistically analyzed using the Statistical Package for Social Sciences (SPSS) Version 22 statistical software program. Utilizing the Kolmogorov-Smirnov test, data normality was examined. The median (IQR25–75) represents data that is non-normally distributed, whereas the mean and standard deviation reflect data that is normally distributed. The gender variable is shown as percentages (%) and frequencies. Since the data were not normally distributed, the relationship between variables in older adults was determined using Spearman correlation analysis. Alpha was set at <0.05 for statistical significance.

Ethical approval

The Scientific Research Ethics Committee of Giresun Training and Research Hospital gave its approval to the study (Date: 19.02.2025, Approval no: 09).

RESULTS

A total of 69 older adults, 34 female and 35 male, were included in the study. The age of the older adults was 86 ± 4 years, their body mass index was 25.73 ± 3.01 kg/m2 and Standardized Mini-Mental State Examination score was 28 ± 2. Table 1 lists the clinical and demographic traits of older persons.

When frailty, lower extremity muscle strength, functional mobility, ADL and depression levels were examined, it was found that CFS was positively correlated with 5-Repetition STS Test and TUG Test at moderate level, negatively correlated L-IADL Scale at good level and positively correlated with GDS-SF at fair level in older adults (p<0.05, Table 2).

Table 1. Demographic and clinical characteristics.

Characteristics	Older adults (n = 69)
Age (y) X±S	86 ± 4
Gender, n (%) Female Male	 34 (% 49.3) 35 (% 50.7)
Body Mass Index (kg/m^2) X±S	25.73 ± 3.01
Standardized Mini-Mental State Examination, score X±S	28 ± 2

Table 1. (Continue) Demographic and clinical characteristics.

Clinical Frailty Scale, n (%)	
1	9 (13)
2	10 (14.5)
3	14 (20.3)
4	11 (15.9)
5	19 (29.5)
6	6 (8.7)
Median (IQR25-75)	4 (2-5)
Timed Up and Go Test, s Median (IQR25-75)	14 (12-17)
5-Repetition Sit-to-Stand Test, s Median (IQR25-75)	15 (13-19)
Lawton Instrumental Activities of Daily Living Scale, score Median (IQR25-75)	6 (4-8)
Geriatric Depression Scale-Short Form, score Median (IQR25-75)	1 (0-3)

s: second; y: year, kg: kilogram; m: meter, SD: Standard deviation; X: Mean; IQR: Interquartile range

Table 2. Correlation analysis.

		Clinical Frailty Scale
Timed Up and Go Test	**rho**	0.573
	p	**<0.001***
5-Repetition Sit-to-Stand Test	**rho**	0.418
	p	**<0.001***
Lawton Instrumental Activities of Daily Living Scale	**rho**	-0.637
	p	**<0.001***
Geriatric Depression Scale-Short Form	**rho**	0.281
	p	**0.019***

rho: Spearman's rank correlation coefficient, *p<0.05.

DISCUSSION

In this study, which was planned to investigate the relationship between frailty and lower extremity muscle strength, functional mobility, ADL, and depression in older adults AD, we found that frailty was associated with lower extremity muscle strength, functional mobility, ADL, and depression in older adults.

In their study in which they evaluated lower extremity muscle strength with 5-Repetition STS Test, Batista et al. showed that older individuals with 1 or 2 frailty criteria exhibited higher lower extremity strength outcomes than older individuals with 3 or more frailty criteria, and that individuals with higher lower extremity muscle strength exhibited better functional independence (Batista et al., 2014). Another study by Batista et al. found that older age and the presence of more frailty symptoms were related to reduced lower limb muscle strength levels (Batista et al., 2012). Purser et al. evaluated 309 elderly individuals and concluded that the 5-Repetition STS Test alone can detect frailty (Purser et al., 2006). Lower extremity muscle strength, as determined by manual dynamometry, is a powerful indicator of frailty according to the findings of a study by Ottenbacher et al. (Ottenbacher et al., 2005). These findings demonstrate the importance and feasibility of identifying groups at risk of frailty with an easy-to-administer lower extremity muscle strength test. According to Papiol et al., the two most common frailty factors among older persons living in the community are a lack of physical exercise and poor muscle strength (Papiol et al., 2016). Theo and colleagues demonstrated that the best performance measures for predicting frailty in older women were ambulatory mobility and muscle endurance (Theou, Jones, Jakobi, Mitnitski, & Vandervoort, 2011). In a systematic review and meta-analysis by Navarrete Villanueva et al. lower body muscle strength may be a more accurate indicator of frailty than hand grip strength (Navarrete-Villanueva et al., 2021). Buckinx et al. examined the relationship between frailty and various muscle groups, particularly the hip abductors, hip extensors, ankle extensors, ankle flexors, knee flexors, elbow extensors, and elbow flexors. In comparison to pre-frail and frail people, these authors reported that robust older adults had much higher scores on all of these assessments (Buckinx et al., 2016). In a study conducted by Aslan and colleagues on 115 elderly patients who were able to walk without assistance and had no neurological diseases or visual and/or auditory impairments, the average time to complete the 5-

repetition STS test was found to be 14.4 ± 6.88 seconds (Aslan, Cavlak, Yagci, & Akdag, 2008). This value is compatible with the median score of the 15-second sit and stand test found in our study. The results of all these studies are important in terms of showing relationship between frailty and lower extremity muscle strength in health older adults and supporting our results. Our study's findings indicate that muscle strength may have significant effects on the development of frailty even in early frailty periods. These findings can aid in the development of practical plans to lessen or avoid frailty in older adults.

It is widely acknowledged that aged individuals who are frail frequently have impaired mobility and balance, which is, of course, essential to the phenotypic definition of frailty. Similar to the phenotypic definition, which qualifies a person as frail if three of the five characteristics - including slowing - are present. Our study's findings in healthy older persons are consistent with other research that links functional mobility, walking, and balance impairments to frailty. Hartley et al. observed a strong association between lower discharge usual walking speed and higher admission Clinical Frailty Scale (Hartley et al., 2017). In their study comparing clinical evaluations and performance measures of impaired balance and mobility with frailty, they found that patients with higher scores on the Frailty Index - Comprehensive Geriatric Assessment performed worse on performance measures (the Functional Reach Test and TUG) and were more likely to have a history of falls or low mobility (Davis, Rockwood, Mitnitski, & Rockwood, 2011). People 75 years of age and older who walk less than 0.8 m/s are at significant risk of frailty, according to Castell et al. (Castell et al., 2013). Shimada and colleagues examined the individual contributions of frailty phenotype components to the development of disability over a 30-month period in community-dwelling individuals aged 65 and older. It was founded that slow walking speed was a powerful indicator of disability in both prefrail and frail people (Shimada, Makizako, Doi, Tsutsumimoto, & Suzuki, 2015). Kawai et al. showed that walking speed during daily life is associated with physical function and pre-frailty in older adults (Kawai et al., 2020). Daily walking features were found to be related to frailty, according to Kumar et al. (Pradeep Kumar et al., 2020). Walking speed can be regarded as a clinical sign of frailty because it is a powerful indicator of declining physical and cognitive reserve. Our results suggest that gait may be affected from the early stages of frailty, which may play a role in the increase in frailty. Therefore, we suggest that gait and functional mobility should be evaluated at regular intervals and treatment approaches to improve these parameters should be included in geriatric rehabilitation practices in order to prevent the occurrence of frailty even in the absence of frailty symptoms in older adults.

Activities of daily living are broad in scope and fall into different categories, and instrumental-ADL is one of them. Instrumental-ADL are the more complex level of actions required to maintain independent living in society (e.g. cooking, grocery shopping and managing finances). Instrumental-ADL are more prone to early cognitive and functional decline than basic ADL. As a result, the first limitations in ADL are seen in instrumental-ADL. Our findings are consistent with studies on older individuals which indicated that the frailty and ADL are related. Baysal et al. investigated how depression, balance issues, and frailty affected older persons' ability to execute ADL. They found that depression, frailty, and balance were related to ADL performance, and that frail older persons were more dependent on ADL than normal or pre-frailty adults (Baysal & Saka, 2024). Tornero et al. have shown that frailty is a significant factor of independence in ADL (Tornero-Quiñones et al., 2020). According to Theou et al., the frail group had the most severe limitations in ADL. They also found that frailty was a significant determinant of independence in ADL and that the categories of medication management, cooking, financial affairs, driving, cleaning, and shopping had the greatest impairments in instrumental-ADL (Theou, Rockwood, Mitnitski, & Rockwood, 2012). All frailty components-aside from weight loss-were related to handicap in the physical aspects of instrumental-ADL (transportation, housekeeping, meal preparation, shopping, and food preparation) in a research by Provencher et al. (Provencher et al., 2017). Frailty and fall risk are important predictors of autonomy in basic ADL (15%), according to Tornero-Quiñones et al. (Tornero-Quiñones et al., 2020). According to Ji et al., among community-dwelling older persons, frailty was related to recent falls, positive cognitive impairment screening, and difficulties in both basic ADL and instrumental-ADL (D. Ji et al., 2024). Considering the multifactorial nature of frailty, our results showing an association between frailty and ADL are not surprising given the need for balance, lower extremity muscle strength and functional mobility to perform many instrumental-ADL. This evidence demonstrates the importance of better understanding the relationship between instrumental-ADL and frailty in order to provide early, targeted and individualized interventions.

In older adults, depression is a major health issue. Despite the fact that depression affects people of all ages, geriatric depression is related to severe outcomes like sleep disturbances, falls, cognitive impairments, a lack of self-care, malnourishment, a lower quality of life, and an increased risk of morbidity and death. According to Yin et al., geriatric depressive symptoms were substantially inversely connected with non-frailty and good

walking abilities (Yin, Gao, Quan, & Zhang, 2023). In a research of 1789 older adults, Ji et al. found a strong correlation between depression symptoms and frailty (L. Ji et al., 2020). Cristina et al. investigated whether depression contributes to the vulnerability syndrome or whether the two conditions occur independently and found a significant causal relationship between them (Buigues et al., 2015). In their systematic review and meta-analysis, Soysal et al. reported a consistent reciprocal relationship between depression and frailty in older adults (Soysal et al., 2017). According to a paper released as part of the Aging and Dementia Study, depression was significantly correlated with pre-frailty and frailty, and 23% of frail people exhibited clinically severe symptoms (Buigues et al., 2015). It is evident that the findings of our study are in line with those of all these investigations. In the longitudinal process, depression is related to frailty, and the likelihood of developing depression is four times higher for frail people. Similarly, depressed individuals were similarly likely to be frail, suggesting an interaction between frailty and depression. Additionally, burnout, poor energy expenditure, weight loss, and slow walking speed- possibly as a result of a lack of motivation - are important phenotypic components of frailty that overlap with the clinical symptoms of depression (Soysal et al., 2017). When combined, these findings imply that treating depressive symptoms may be a useful strategy for postponing or lowering the risk of frailty progression in older adults.

There are some limitations to our study. Our first limitation is that individuals with advanced frailty were not included in the study. Therefore, the results of our study cannot be generalized to patients with advanced frailty. Although the sample size was calculated, the relatively small sample size is the second limitation of our study. Correlation analyses with larger samples may yield more robust results.

CONCLUSION

Our study provides evidence that frailty was associated lower extremity muscle strength, functional mobility, ADL and depression in older adults. Therefore, even in the absence of frailty symptoms, lower extremity muscle strength, functional mobility, instrumental-ADL, and depression should be evaluated at regular intervals in order to prevent the emergence of frailty or stop its progression in older adults, and we think that treatment approaches to improve these parameters should be included in geriatric rehabilitation practices.

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Conflict of Interest

No conflicts of interest were reported by the authors for this study.

Author Contributions

Plan, design: TÖ, ÜKŞ, AA; **Material, methods and data collection:** TÖ, ÜKŞ, AA, AY; **Data analysis and comments:** TÖ; **Writing and corrections:** TÖ, ÜKŞ.

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Ethical Approval

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