

The Relationship Between Frailty, Dual-Task Performance, and Activities of Daily Living in Older Adults

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Abstract

Background

Frailty, dual-task performance, and independence in activities of daily living (ADL) are closely related to functional health in older adults. Aim of this study examine the relationships among frailty, dual-task performance, and ADL independence in older adults residing in nursing homes.

Methods

This descriptive, cross-sectional study included 75 older adults aged 65–90 years residing in two nursing homes in Konya, Türkiye. Frailty was assessed using the Edmonton Frail Scale, ADL independence using the Katz Index, and perceived dual-task difficulty using the Dual-Task Questionnaire. Motor-cognitive dual-task performance was assessed using the Timed Up and Go test with a serial counting task, while motor-motor performance was assessed using a 10-meter walking test while carrying a tray. Dual-task cost (DTC) was calculated as the percentage change from single- to dual-task performance.

Results

Dual-task conditions significantly prolonged both TUG and 10-meter walking times compared with single-task conditions (both $p < 0.001$), with greater cognitive DTC (30.7%) than motor DTC (11.2%). Frailty was moderately and negatively correlated with ADL independence ($r = -0.486$, $p < 0.001$) and positively correlated with perceived dual-task difficulty ($r = 0.387$, $p < 0.001$) and TUG dual-task time ($r = 0.373$, $p < 0.01$). ADL independence was negatively correlated with TUG and 10-meter dual-task times. DTC was not significantly associated with frailty or ADL independence.

Conclusion

Greater frailty was associated with reduced ADL independence, slower dual-task performance, and greater perceived dual-task difficulty. Absolute dual-task performance measures may be more informative than percentage-based DTC for identifying functional vulnerability in nursing home residents.

Trial registration:

A registration was filed with ClinicalTrials.gov prior to the start of the study (NCT07415382).

Background

The rapid growth of the elderly population worldwide has made frailty a central focus in geriatric health management [1]. Frailty is a clinically recognizable state of vulnerability resulting from the loss of reserves and function in multiple physiological systems associated with aging, leading to increased sensitivity to stressors [1, 2]. This syndrome is a strong predictor of adverse health outcomes such as falls, hospitalizations, disability, and mortality [2, 3].

The deterioration in dual-task performance is another critical factor that threatens the independence of older adults [4]. Maintaining daily life often relies on dual-task performance, which requires the simultaneous use of both motor and cognitive resources—such as following a conversation while walking or responding to environmental cues [5]. The dual-task paradigm is based on the hypothesis that walking and cognitive tasks share common cortical resources; as aging progresses, walking becomes more dependent on cognitive control, thereby increasing the cost of dual-task performance, particularly in frail individuals [2, 6]. It has been reported that individuals in the frail or pre-frail stages experience greater difficulty with dual-task performance compared to their healthy peers, and that this situation poses serious safety risks in complex activities of daily living (ADL) [2, 7]. The literature emphasizes a bidirectional and strong relationship between frailty and ADL dependence; while frailty triggers a decline in ADLs, limitations in ADLs also accelerate the progression of frailty [8]. Skills requiring high levels of cognitive organization—such as cooking, financial management, and using public transportation—are among the first areas affected in the early stages of frailty and cognitive decline [9, 10].

Research suggests that dual-task ability may be relevant to the relationship between frailty and ADL [11]. Dual-task performance reflects not only physical capacity but also the executive control required to manage the complex demands of daily life [2, 11]. It has been noted that in cases of cognitive frailty, where physical frailty is combined with cognitive decline, the risk of ADL limitations reaches its highest level [12]. Determining the interaction between frailty and dual-task performance and functional independence in older adults will provide a foundation for both the early identification of high-risk individuals and the development of evidence-based preventive intervention programs. The aim of this study is to examine the relationship among dual-task performance, frailty levels, and activities of daily living in older adults living in nursing homes.

Methods

Study Design

This study was conducted using a cross-sectional, correlational design and is reported in accordance with the STROBE statement.

Setting

The study was conducted at the Dr. İsmail Işık Nursing Home, Elderly Care, and Rehabilitation Center in Konya and the Meliha Ercan Nursing Home in Silile, Konya. Data for the study were collected between

May and July 2026. Prior to the study, a meeting was held with the facility director to ensure that participants' privacy would be protected during the data collection phase and to request that a suitable environment be provided for effective data collection. The researcher visited the facilities during the specified time periods to collect the data.

Sample

The study population consisted of a total of 136 older adults residing in the nursing home units of the Dr. İsmail Işık Nursing Home for Elderly Care and Rehabilitation Center in Konya and the Meliha Ercan Nursing Home in Sille, Konya. There was no sample calculation; the goal was to reach all individuals living in the nursing homes who were deemed eligible to participate in the study. Elderly individuals residing in the rehabilitation units were not included in the study population because they were dependent in their activities of daily living and unable to independently perform walking-based performance tests. The 136 elderly individuals residing in the nursing home units were evaluated according to inclusion and exclusion criteria. At the first facility, 1 person with a vision impairment, 3 with a hearing impairment, and 30 who used a walking aid were excluded; at the second facility, 10 who used a walking aid and 17 who were not present at the facility during working hours were excluded from the study. Thus, a total of 61 individuals were excluded, and the study sample consisted of 75 elderly individuals. The study did not employ a sampling method; instead, the goal was to reach all older adults who met the criteria.

Eligibility criteria

- Be 65 years of age or older,
- Be literate,
- Have a Mini-Mental State Examination (MMSE) score of 24 or higher (cognitively sound),
- Be able to walk at least 10 meters without the use of assistive devices,
- Not have a severe sensory impairment that would hinder vision or hearing.

Exclusion criteria

- Having a severe neurological (Parkinson's, stroke, etc.) or orthopedic condition,
- Having a psychiatric diagnosis that impedes communication.

Measurement

Personal Information Form

This is a form created by researchers that includes participants' sociodemographic and clinical information, such as age, gender, marital status, number of children, educational status, history of chronic diseases, medication use, and history of falls. An unauthorized version of the Turkish MMSE was

used by the study team without permission, however this has now been rectified with PAR. An unauthorized version of the Turkish MMSE was used by the study team without permission, however this has now been rectified with PAR. The MMSE is a copyrighted instrument and may not be used or reproduced in whole or in part, in any form or language, or by any means without written permission of PAR (www.parinc.com).

Edmonton Frail Scale (EFS)

The scale was developed by Rolfson et al. [13] to measure frailty in older adults and is designed for routine use even by healthcare professionals without specialized training in geriatrics or gerontology. The scale assesses a total of 17 items across 11 categories, including cognitive status, general health, dependence, social support, medication use, nutrition, mood, continence, and functional performance. The validity and reliability study of the scale in Turkish was conducted by Aygör et al. [14]. The Cronbach's alpha value for the scale's internal consistency is 0.75.

Katz index of independence in activities of daily living: The Katz index of independence in Activities of Daily Living (Katz ADL) is the best-known measure in clinical practice and the most widely used in clinical research. The Katz ADL was developed by Katz and colleagues [15]. This scale, used to assess participants' level of independence in basic ADLs, includes six basic activities: bathing, dressing, toileting, transfers, continence, and eating. Each activity is rated as independent (1 point) or dependent (0 points). The total score ranges from 0 to 6. A validity and reliability study in Turkish was conducted by Arık et al. [16]. The Cronbach's alpha value was found to be 0.838.

Dual Task Performance Assessment

Participants' performance on both motor-cognitive and motor-motor dual-task conditions was assessed.

Motor-Cognitive

The Timed Up and Go (TUG) test is a valid and reliable functional mobility assessment that can be used to track clinical changes over time in older adults. In the TUG test, the time (in seconds) it takes a person to stand up from a standard chair (approximately 46 cm in seat height and 65 cm in armrest height), walk a distance of 3 meters (approximately 10 feet), turn around, return to the chair, and sit down again is measured [17]. An additional cognitive task—counting by twos starting from 0—was included. When the test had to be repeated, the participant continued counting from the number they had left off. Counting errors were disregarded [18].

Motor-Motor

The motor dual-task test evaluates the simultaneous performance of motor tasks, such as walking and carrying a glass of water on a tray. Carrying a glass of water while walking is a motor task frequently performed in daily life. The participant walked a predetermined 10-meter distance while carrying a tray

with three paper cups filled with water, and the time taken to cover the 2- to 8-meter range was recorded [19]. The purpose of this test was to measure performance on a motor-motor dual-task.

Dual Task Questionnaire

The Dual-Task Questionnaire, conducted verbally, was used to gather information about the difficulties individuals experience while performing tasks in dual-task situations they encounter in daily life. The Dual-Task Questionnaire consists of 10 questions. The questions were read aloud to the participants in sequence, and no time limit was imposed for their responses. Where geriatric participants did not understand a question, necessary explanations were provided, and the question was repeated. Each question is scored as very often (4), often (3), sometimes (2), rarely (1), and never (0). The total score is calculated by summing the responses to all questions and dividing by 10 [20]. Lower scores indicate better dual-task performance.

Dual-Task Cost (DTC)

Dual-task cost (DTC) was calculated to assess the relative effect of dual-tasking on performance in motor-cognitive (TUG) and motor-motor (10-meter walk) tasks. DTC was calculated separately for each task using the formula $[(\text{dual-task time} - \text{single-task time}) / \text{single-task time}] \times 100$, expressed as a percentage. Higher DTC values indicate a greater decline in performance resulting from the addition of the second task.

Data Collection

The data for this study were collected using a structured questionnaire and scales. Data collection was conducted by the same researcher through face-to-face interviews with older adults. Prior to the study, the nursing home administration was informed, and appropriate time slots for data collection were determined. During these designated time slots, the researcher invited older adults to participate in the study. The researcher was present while the participants filled out the questionnaires and provided assistance with any questions they did not understand. The dual-task assessment was conducted by two researchers who are physical therapists. The entire data collection process took approximately 20–30 minutes.

Statistics

The Jamovi software (version 2.7) was used for the statistical analysis of the data, and a significance level of $p < 0.05$ was adopted for all tests. Categorical variables were summarized as counts and percentages (n, %), while continuous variables were summarized as mean $\pm$ standard deviation and median (minimum–maximum). No a priori sample size calculation was performed; a post hoc sensitivity analysis indicated that, for a two-tailed test at $\alpha = 0.05$, the sample of 75 participants provided approximately 80% power to detect correlations of $|r| \geq 0.32$, so smaller associations and subgroup differences may have been underpowered.

The internal consistency of the measurement instruments used in the study was assessed using Cronbach's alpha coefficient for this sample. Skewness and kurtosis coefficients were used to determine whether the variables followed a normal distribution; variables with these coefficients within the range $[-1, +1]$ were considered to follow a normal distribution.

The Wilcoxon signed-rank test was used for paired groups when comparing performance under single-task and dual-task conditions, as the distributions did not meet the assumption of normality.

Independent groups were compared based on the dependent variables as follows: for variables with a normal distribution in two independent groups, the independent groups t-test was used; for those without a normal distribution, the Mann-Whitney U test was used; for variables with a normal distribution in three or more independent groups, one-way analysis of variance (One-Way ANOVA) was used; and for those without a normal distribution, the Kruskal-Wallis test was used.

Relationships between quantitative variables were examined using Spearman's correlation analysis, as some of the variables were not normally distributed and were ordinal in nature. Correlation coefficients were interpreted as follows: 0.00–0.19 indicated no relationship or a negligible relationship; 0.20–0.39 indicated a weak (low) relationship; 0.40–0.69 indicated a moderate relationship; 0.70–0.89 indicated a strong (high) relationship; and 0.90–1.00 indicated a very strong relationship [21].

Ethics

Prior to the start of the study, ethical approval was obtained from the xxxx University Ethics Committee for Non-Pharmaceutical and Non-Medical Device Research under Decision No. 2026/075. After receiving ethical approval, permission was obtained from the institution where the study was to be conducted under Approval No. E-*****3-605-20611165. A registration was filed with ClinicalTrials.gov prior to the start of the study (NCT07415382). After the purpose of the study was clearly explained to the participants, their written consent was obtained via an informed consent form. All stages of the study were conducted in accordance with the Declaration of Helsinki.

Results

The study included a total of 75 older adults living in a nursing home, ranging in age from 65 to 90 (72.8 ± 6.7 years) (Fig. 1).

Figure 1. STROBE flowchart

The participants were 69.3% male, 68.0% had at least one chronic condition, and 85.3% were taking medication on a regular basis. The proportion of participants who reported a history of falls in the past year was 36.0%. The sociodemographic and clinical characteristics of the participants are presented in Table 1.

Table 1
Sociodemographic and clinical characteristics of the
participants (n = 75)

Characteristic	Value
Age (years), $\bar{X} \pm SD$	72.8 $\pm$ 6.7
Age, median (min–max)	71 (65–90)
Sex, n (%)	
Male	52 (69.3%)
Female	23 (30.7%)
Marital status, n (%)	
Separated/widowed	33 (44.0%)
Married	22 (29.3%)
Single	20 (26.7%)
Education level, n (%)	
Primary education	40 (53.3%)
Literate	21 (28.0%)
High school	13 (17.3%)
University and above	1 (1.3%)
Chronic disease, n (%)	
Yes	51 (68.0%)
No	24 (32.0%)
Regular medication use, n (%)	
Yes	64 (85.3%)
No	11 (14.7%)
Falls in the past year, n (%)	
No	48 (64.0%)
Yes	27 (36.0%)
Number of children, $\bar{X} \pm SD$	2.7 $\pm$ 2.1
Number of falls among fallers, $\bar{X} \pm SD$ (n = 26)	2.2 $\pm$ 2.5
<i>X: mean; SD: standard deviation; n: number; %: percentage.</i>	

Table 1. Sociodemographic and clinical characteristics of the participants (n = 75)

Internal consistency for the Edmonton Frail Scale ($\alpha = 0.634$) and the dual-task questionnaire ($\alpha = 0.572$) was found to be at an acceptable-to-moderate level. In the Katz index, however, the ceiling effect resulting from the vast majority of participants being fully independent (49 participants scored 6 points, indicating full independence) led to a low alpha value ($\alpha = 0.225$) (Table 2). Because the Edmonton Frail Scale and the Katz index are multidimensional index (formative) instruments rather than unidimensional scales, Cronbach's alpha is of limited relevance for them, and their internal-consistency values should be interpreted with caution.

Table 2
Descriptive statistics and reliability coefficients for scale and test scores

Variable	n	X $\pm$ SD	Median	Min–Max	α
Frailty – Edmonton (0–17)	74	6.61 $\pm$ 3.12	6.00	1.00–15.00	0.634
ADL independence – Katz (0–6)	75	5.60 $\pm$ 0.62	6.00	3.00–6.00	0.225
Dual-task questionnaire (0–4)	75	1.24 $\pm$ 0.57	1.10	0.50–2.60	0.572
TUG single task (s)	75	13.93 $\pm$ 4.41	13.69	7.41–33.10	—
TUG dual task (s)	75	18.21 $\pm$ 6.55	17.02	8.72–40.14	—
TUG-DT correct count (n)	75	5.81 $\pm$ 2.45	6.00	0.00–12.00	—
10 m walk single task (s)	75	8.56 $\pm$ 3.93	7.48	3.78–26.93	—
10 m walk dual task (s)	75	9.52 $\pm$ 5.21	8.57	3.74–33.99	—
DTC cognitive (%)	75	31.88 $\pm$ 29.61	25.82	–15.75–157.33	—
DTC motor (%)	75	11.60 $\pm$ 27.09	9.61	–50.07–99.05	—
<i>X: mean; SD: standard deviation; DTC: dual-task cost; TUG: Timed Up and Go Test; ADL: activities of daily living; α: Cronbach's alpha.</i>					

Table 2. Descriptive statistics and reliability coefficients for scale and test scores

In both the motor-cognitive (TUG) and motor-motor (10-meter walk) tasks, the dual-task condition significantly affected performance compared to the single-task condition. The dual-task cost was more pronounced in the cognitive task (30.7%) than in the motor task (11.2%) (Table 3).

Table 3
Comparison of Single-Task and Dual-Task Conditions

TUG – Timed Up-and-Go (motor-cognitive)	Single task	Dual task	Δ%	Test stat.	p
	13.69 (13.93 ± 4.41)	17.02 (18.21 ± 6.55)	30.7	Z = 68.0	< 0.001
10 m walk (motor-motor)	7.48 (8.56 ± 3.93)	8.57 (9.52 ± 5.21)	11.2	Z = 792.5	< 0.001
<i>Values are presented as the median (mean ± SD). Δ%: dual-task cost relative to the mean; s: seconds; p < 0.05.</i>					

Table 3. Comparison of Single-Task and Dual-Task Conditions

The level of frailty is negatively correlated with ADL independence ($r = -0.486$; $p < 0.001$) and moderately positively correlated with the dual-task questionnaire score ($r = 0.387$; $p < 0.001$) and the TUG dual-task time ($r = 0.373$; $p < 0.01$). Similarly, ADL independence is negatively correlated with the TUG dual-task time ($r = -0.384$; $p < 0.001$) and the 10-meter dual-task time ($r = -0.284$; $p < 0.05$). In contrast, the dual-task cost (DTC), calculated as a percentage, did not show a significant relationship with any variable ($p > 0.05$) (Table 4).

Table 4
Spearman correlation matrix between variables

Variable	1	2	3	4	5	6	7	8	9
1. Frailty (EFS)	1								
2. ADL independence	-0.49‡	1							
3. Dual-task questionnaire	0.39‡	-0.19	1						
4. TUG single	0.35†	-0.33†	0.03	1					
5. TUG dual	0.37†	-0.38‡	0.09	0.81‡	1				
6. 10 m single	0.41‡	-0.29*	0.11	0.63‡	0.63‡	1			
7. 10 m dual	0.36†	-0.28*	0.19	0.39‡	0.41‡	0.74‡	1		
8. DTC cognitive %	0.03	-0.16	0.07	-0.12	0.43‡	0.09	0.05	1	
9. DTC motor %	-0.02	-0.06	0.18	-0.14	-0.11	-0.04	0.58‡	-0.03	1
<i>*p < 0.05; †p < 0.01; ‡p < 0.001. DTC: dual-task cost; TUG: Timed Up and Go Test; ADL: activities of daily living.</i>									

Table 4. Spearman correlation matrix between variables

Participants were classified according to the Edmonton Frail Scale cutoff points; 27.0% were classified as not frail, 28.4% as at risk for frailty, 18.9% as mildly frail, 12.2% as moderately frail, and 13.5% as severely frail. The Edmonton Frail Scale total score was available for 74 participants (one item was missing for one participant); for the group comparisons, these five categories were collapsed into three groups—non-frail, vulnerable, and frail (n = 20, 21, and 33, respectively). The level of frailty was significantly associated with a decrease in ADL independence; dual-task questionnaire scores, as well as TUG and 10-meter walk times for both single and dual tasks, increased significantly. DTC values, expressed as percentages, were similar across groups (Table 5).

Table 5
Comparison of Dual-Task and ADL Variables by Vulnerability Groups

Variable	Non-frail (n = 20)	Vulnerable (n = 21)	Frail (n = 33)	Test stat.	p
ADL independence (Katz)	6.00	6.00	5.00	H = 13.80	0.001
Dual-task questionnaire	0.90 ± 0.36	1.30 ± 0.50	1.42 ± 0.65	F = 5.63	0.005
TUG single (s)	13.16	11.34	15.20	H = 9.39	0.009
TUG dual (s)	15.49	14.89	19.31	H = 8.03	0.018
10 m single (s)	7.29	6.74	8.76	H = 12.19	0.002
10 m dual (s)	7.66	7.92	9.63	H = 6.36	0.042
DTC cognitive (%)	21.42	33.86	23.20	H = 4.55	0.103
DTC motor (%)	10.75 ± 14.15	13.36 ± 22.82	10.99 ± 35.35	F = 0.06	0.941
<i>For normally distributed variables, one-way ANOVA (F) and mean ± SD are reported; for the others, the Kruskal-Wallis test (H) and median are reported. DTC: dual-task cost; TUG: Timed Up and Go Test; ADL: activities of daily living; p < 0.05.</i>					

Table 5. Comparison of Dual-Task and ADL Variables by Vulnerability Groups

Individuals with a history of falls in the past year had higher levels of frailty (p = 0.018), lower independence in activities of daily living (ADL) (p = 0.003), and longer 10-meter single-task walking times (p = 0.017) compared to those without such a history. In addition, female participants exhibited a significantly higher level of frailty than male participants (p = 0.047) (Table 6).

Table 6
Comparison of Frailty, ADL, and Dual-Task Variables According to Fall History

Variable	Falls (+) (n = 27)	Falls (-) (n = 48)	Test stat.	p
Frailty (EFS)	7.78 ± 3.26	5.94 ± 2.85	t = 2.44	0.018
ADL independence	5.00	6.00	U = 420.0	0.003
Dual-task questionnaire	1.25 ± 0.62	1.24 ± 0.55	t = 0.05	0.964
TUG dual (s)	18.50	16.29	U = 744.0	0.292
10 m single (s)	8.81	7.23	U = 865.0	0.017
10 m dual (s)	9.42	8.00	U = 787.5	0.125
<i>For normally distributed variables, the independent samples t-test (t) and mean ± SD are reported; for the others, the Mann-Whitney U test and median are reported. ADL: activities of daily living; TUG: Timed Up and Go Test; p < 0.05.</i>				

Table 6. Comparison of Frailty, ADL, and Dual-Task Variables According to Fall History

Discussion

This study examined the relationship between frailty levels, dual-task performance, and ADL independence among older adults living in nursing homes. The findings of this study showed that, in both motor-cognitive (TUG) and motor-motor (10-meter walk) tasks, the dual-task condition significantly altered performance compared to the single-task condition, and that the cognitive cost of the dual task was higher than that of the motor task. The level of frailty was associated with decreased ADL independence, longer dual-task completion times, and increased self-reported dual-task difficulty. In contrast, the dual-task cost (DTC), calculated as a percentage, was not found to be associated with frailty. Individuals with a history of falls in the past year were more frail and more dependent in ADLs; women exhibited higher levels of frailty compared to men.

The fact that the dual-task condition significantly affects both walking and functional mobility performance is consistent with the central capacity-sharing and bottleneck models underlying the dual-task paradigm. Both models propose that walking and a concurrent cognitive task share common cortical resources, and that performance is impaired in individuals with limited cognitive reserve [2]. In this study, the fact that the cognitive dual-task cost was significantly higher than that of the motor dual-task can be explained by tasks requiring executive function—such as counting—competing more intensely for resources with gait control. Kasiukiewicz et al. [22], using a similar approach, administered the Timed Up-and-Go Test to geriatric patients by combining it with both a backward counting (cognitive) task and a task involving carrying a cup in the hand, and reported that these dual-task measures were associated with cognitive status. Similarly, Abdollahi et al. [23] found that dual-task conditions prolonged the duration of the Timed Up-and-Go and 10-meter walk tests by approximately 14% and 17%, respectively; Casemiro et al. [7] demonstrated that frail older adults exhibited a marked decline in

performance on both simple and dual-task motor/cognitive walking tasks. The ability of dual-task-based measures to distinguish cognitive and functional status in older adults has also been highlighted in other studies [24]. The findings of this study are consistent with the literature and demonstrate that the dual task creates a measurable motor-cognitive challenge even in a nursing home population.

The results of this study revealed moderate and significant associations between the level of frailty and ADL independence, reported dual-task difficulty, and TUG dual-task time. Comparisons among frailty groups also showed differences in the same direction. This pattern supports the view that frailty is a multidimensional syndrome intertwined with functional independence and mobility. Yeo et al. [2] demonstrated that dual-task walking speed can distinguish between robust and frail older adults; Ji et al. [25], meanwhile, showed that frailty is strongly associated with limitations in basic and instrumental ADLs in a large sample of 20,724 older adults.

The findings of this study indicate that, although raw dual-task reaction times are associated with frailty, DTC values expressed as percentages are not significantly associated with either the level of frailty or other variables. This apparent contradiction may stem from the nature of proportional cost. Since vulnerable individuals are slow under both single- and dual-task conditions, the proportional difference between the two conditions may remain relatively constant. Abdollahi et al. [23] similarly reported that the effects of between-group interactions were minimal and that DTC values remained similar across groups. Similarly, studies on age have shown that while absolute dual-task reaction times increase with age, the proportional DTC does not differ significantly across age groups. On the other hand, Kasiukiewicz et al. [22] defined DTC values above 20% as a risk indicator for progression to dementia. This suggests that while DTC may have clinical significance at certain thresholds, its sensitivity to frailty as a continuous variable may be limited. When these findings are evaluated together, it can be concluded that, in terms of vulnerability in a nursing home population, absolute dual-task times may be more informative than DTC values normalized to a percentage, and that caution is warranted when interpreting DTC on its own.

The fact that individuals who reported a history of falls in the past year had higher levels of frailty, lower independence in activities of daily living (ADL), and longer single-task walking times reflects the frailty-fall-functional decline triangle. Ji et al. [25] demonstrated that frailty is strongly associated with frequent falls over the past year, while Piche et al. [26] showed that a history of falls is an independent factor affecting dual-task walking performance. This suggests that assessments based on frailty and dual-task performance in a nursing home setting may have clinical value for fall risk screening.

The finding that female participants exhibited higher levels of frailty than males is consistent with the literature. Mielke et al. [27] reported that the prevalence and incidence of frailty are higher in women; Arizaga-Iribarren et al. [28] reported that frailty rates are higher in women than in men, particularly among older adults living in nursing homes. It has been suggested that this difference may be related to biological factors such as osteoporosis, sarcopenia, and hormonal changes. However, in this study, no

significant effect of gender on the dual-task cost was detected, which may be related to the sample size and the imbalance in the gender distribution.

Considering the relationship between frailty and ADL independence, it is important to identify frail individuals early and refer them to multicomponent exercise programs; indeed, multicomponent exercise has been shown to improve physical function in older adults in institutional care [29]. Incorporating dual-task components into such programs may help reduce functional decline and the risk of falls.

This study has some limitations. First, due to its cross-sectional design, causal inferences cannot be drawn among the variables. Second, since the sample consisted of two nursing homes in a single region, the generalizability of the findings is limited. Third, because the inclusion criteria required that the vast majority of the sample be independent in ADL, this led to a ceiling effect in the Katz index and low internal consistency ($\alpha = 0.225$); this may have limited the discriminatory power of the ADL measurement. Finally, the relatively small sample size and the imbalance in gender distribution may have affected the statistical power of subgroup comparisons. It is recommended that future studies, using larger, multicenter, and longitudinal designs, evaluate objective dual-task measures alongside both the absolute and relative forms of the DTC.

Conclusion

The level of frailty among older adults living in nursing homes is associated with a decrease in independence in daily living, longer dual-task performance times, and increased reported difficulty with dual tasks. In contrast, the dual-task cost expressed as a percentage has not emerged as a frailty-sensitive indicator. The relationships between frailty, history of falls, and functional independence support the use of dual-task and frailty-based assessments as part of clinical follow-up in this setting.

Abbreviations

ADL
Activities of Daily Living
DTC
Dual-task Cost
EFS
Edmonton Frail Scale
MMSE
Mini-Mental State Examination
TUG
Timed Up and Go

Declarations

Ethics Approval and Consent to participate: The approval of KTO Karatay University Non-Pharmaceutical and Medical Device Studies ethics committee (project number 2026/075) was obtained for this study. All procedures were carried out in accordance with the Declaration of Helsinki. Written informed consent to participate was obtained from all participants prior to their inclusion in the study.

Consent for publication: All participants included in this study provided their written consent for publication.

Availability of data and Materials: Data can be provided by the corresponding author upon request.

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Figures

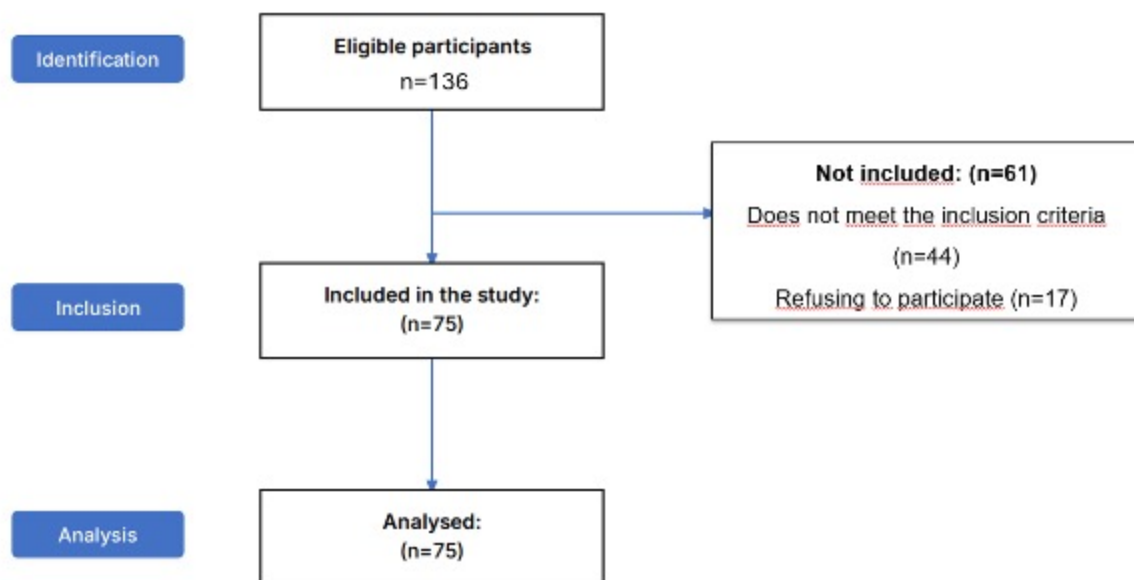


Figure 1

STROBE flowchart