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The Relationship Between Physical Performance with Dual-task Performance in Geriatric Individuals

Geriatrik Bireylerde Fiziksel Performans ile İkili Görev Performansı Arasındaki İlişki

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Abstract

Objective: Maintaining functional independence in older adults requires an intricate balance between physical and cognitive abilities. While physical performance is known to support overall health, its relationship with dual-task performance -an essential component of daily life activities- remains a critical area of investigation. This study aimed to investigate the association between physical performance and dual-task performance and to compare the effects of different levels of physical performance on dual-task execution in geriatric individuals.
Materials and Methods: A total of 79 geriatric individuals (mean age=68.68±4.42) were included in the study. Their physical performances were evaluated through the Alusti test, Timed Up and Go test (TUGT), 30-Second Sit-to-Stand test (30s STST) and 10-meter Walk test. Dual-task performance measurements were assessed using the TUGT, 30s STST and 10-meter Walk test (using motor and cognitive task) and the dual-task questionnaire.
Results: There was a low correlation between the Alusti test and Dual-task scale (r=-0.222; p=0.048), while a moderate-level correlation between TUGT (r=0.339; p=0.001), 30s STST (r=-0.336; p=0.002), and the 10-meter Walk test (r=0.365; p=0.001). When individuals were divided into two groups based on Alusti test scores (good mobility and very good mobility), the mean of 30s STST motor and -cognitive tasks were statistically significantly higher in the very good mobility group compared to good mobility (p=0.026, p=0.005; respectively).
Conclusion: The findings suggest that dual-task performance is closely linked to physical function in older adults, with higher physical performance associated with improved dual-task execution. Given the increasing importance of maintaining cognitive-motor abilities for aging populations, targeted physical activity interventions may help mitigate declines in dual-task performance, ultimately promoting safer mobility and greater independence in daily life. Future research should further explore the mechanisms underlying these interactions to develop effective strategies for cognitive-motor preservation in geriatric care.
Keywords: Physical performance, geriatrics, task performance, cognition, motor skills, balance

Öz

Amaç: Geriatrik bireylerde fonksiyonel bağımsızlığın korunması, fiziksel ve bilişsel yetilerin dengeli bir şekilde sürdürülmesini gerektirir. Fiziksel performansın genel sağlık üzerindeki olumlu etkileri bilinse de, ikili görev performansı ile olan ilişkisi -günlük yaşam aktivitelerinin önemli bir bileşeni- hala araştırılması gereken kritik bir konudur. Bu çalışma, fiziksel performans ile ikili görev performansı arasındaki ilişkiyi incelemeyi ve farklı fiziksel performans seviyelerinin ikili görev yürütme üzerindeki etkilerini karşılaştırmayı amaçlamaktadır.
Gereç ve Yöntem: Çalışmaya toplam 79 geriatrik birey (ortalama yaş=68,68±4,42) dahil edilmiştir. Fiziksel performansları Alusti testi, Zamanlı Kalk ve Yürü testi (ZKYT), 30 Saniye Otur-Kalk testi (30s OKT) ve 10 Metre Yürüme testi ile değerlendirilmiştir. İkili görev performansı ölçümleri ZKYT, 30s OKT ve 10 metre Yürüme testi (motor ve bilişsel görev kullanılarak) ile ikili görev ölçeği kullanılarak değerlendirilmiştir.
Bulgular: Alusti testi ile İkili Görev ölçeği arasında düşük düzeyde bir korelasyon (r=-0,222; p=0,048) bulunurken, ZKYT (r=0,339; p=0,001), 30s OKT (r=-0,336; p=0,002) ve 10 metre Yürüme testi (r=0,365; p=0,001) ile orta düzeyde korelasyon görülmüştür. Alusti test skorlarına göre bireyler iki gruba ayrıldığında (iyi mobilite ve çok iyi mobilite), çok iyi mobilite grubunda 30s OKT motor ve bilişsel görev ortalamalarının iyi mobilite grubuna kıyasla istatistiksel olarak anlamlı derecede yüksek olduğu bulunmuştur (sırasıyla p=0,026, p=0,005).

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Öz

Sonuç: Bulgular, ikili görev performansının yaşlı bireylerde fiziksel fonksiyon ile yakından ilişkili olduğunu ve daha yüksek fiziksel performansın daha iyi ikili görev yürütme ile bağlantılı olduğunu göstermektedir. Yaşlanan nüfus için bilişsel-motor yetilerin korunmasının artan önemi göz önüne alındığında, hedefe yönelik fiziksel aktivite müdahaleleri, ikili görev performansındaki düşüşleri azaltmaya yardımcı olabilir ve böylece daha güvenli hareketlilik ile günlük yaşamda daha büyük bir bağımsızlık sağlayabilir. Gelecekteki araştırmalar, bu etkileşimlerin altında yatan mekanizmaları daha ayrıntılı inceleyerek geriatrik bakımda bilişsel-motor korunmaya yönelik etkili stratejiler geliştirmelidir.
Anahtar kelimeler: Fiziksel performans, geriatri, görev performansı, biliş, motor beceriler, denge

Introduction

With ageing, structural and functional changes occur in many organ systems, leading to reductions in reserves. In the case of physical inactivity, the physiological changes associated with the ageing process accelerate, the frequency of chronic diseases increases, and life expectancy shortens (1). Therefore, the decrease in physical performance with advancing age can impact health and well-being, predicting disability and mortality in older adults (2,3). The importance of physical performance is emphasized in the relationship between physical disability and cognitive impairment (4). In addition to physical performance, cognitive impairment in the older people also diminish the quality of life and daily life activities (5).

The identification of age-related important conditions involves recognizing the loss of muscle strength and deterioration in physical performance as crucial elements. In the literature, the evaluation of these elements often includes grip strength, speed of walking, Timed Up and Go test (TUG), and batteries (6). Besides, the Alusti test, created by Alustiza Navarro (8) and rooted in existing assessments, offers a quick evaluation of physical performances in older adults with diverse functional and cognitive level capacities without causing exhaustion to the patient (7,8).

Dual-tasking refers to the capability of executing two or more tasks at the same time. It is known that different age groups exhibit varying performance outcomes for tasks that need to be accomplished simultaneously. It has been observed that dual-task conditions enhance both cognitive and motor performance, improving standing and walking performance (9). Previous studies employed various primary mobility tasks, such as balance or walking, alongside a secondary task, which could be cognitive (e.g., an arithmetic task) or motor-related (e.g., carrying an object) (10). These results highlight a possible cognitive-motor interaction that leads to a decrease in mobility performance and/or dual-task performance in older adults compared to younger individuals. Additionally, reduced performance in secondary tasks (both cognitive and motor) was observed in geriatric adults (11-13).

The literature consistently demonstrates that higher levels of physical activity correlate with better functional status and lower risks of cognitive decline and dementia (14). Assessing only a single performance parameter, typically mobility tasks, may result in misleading conclusions about the impact of dual-task performance, particularly in the geriatric population, where both cognitive and motor components may be affected. For this reason, this study aims to contribute to the growing body of evidence supporting physical activity as a cornerstone of aging, emphasizing the necessity for tailored assessments that address both physical and cognitive performance in the geriatric population. Specifically, the present study investigates the relationship between physical performance and dual-task performance, while also comparing the varying levels of physical performance among older adults in relation to their ability to manage dual tasks.

Materials and Methods

Study Design

The research was designed as a cross-sectional research.

Participants

The study's sample size was determined using the G*Power software. Using the dual task performance values obtained from a similar study, it was determined that the study should include at least 55 participants, ensuring a 95% confidence interval and an 80.3% statistical power level.

The research was carried out at a University Training and Research Hospital, involving a total of 79 geriatric individuals.

Inclusion criteria were (1) being between the ages of 65-85, (2) voluntary participation in the study, (3) ability to read and write, (4) Scoring 21 points or above on the Montreal Cognitive Assessment scale.

Exclusion criteria were (1) the presence of cardiovascular, pulmonary, orthopedic, or neurological disorders that significantly affect their physical condition.

The ethical approval for the study was obtained from the Local Ethical Committee for Research in Natural, Social, and Non-Invasive Health Sciences (decision no: 144 date: 10.11.2021). All patients were informed about the research before they started the study and obtained signed written and verbal consent for participation. All protocols followed were in compliance with the ethical standards set by the committee responsible for human experimentation and the principles of the Helsinki Declaration.

Assessment

All evaluations were completed by the same researcher. Demographic characteristics of geriatric individuals were recorded. Their physical performances were assessed using the Alusti test, timed up and go, the 30-second sit-to-stand tests and

10-meter walk test; and dual-task performance measurements were assessed by adding both motor and cognitive tasks to the tests used to evaluate physical performance, and using the dual Task scale.

Physical Performance Assessment

Alusti Test: This test is commonly used to assess physical performance in geriatric individuals. Comprising 10 items, the total score of the test was evaluated on a scale of 0 to 100. The assessment began with the individual lying supine in bed, evaluating the range of joint motion in four extremities (item 1), muscle strength of extremities (item 2), ability to transition from lying down to sitting position (item 3), and sitting balance in the sitting position (item 4). Additionally, the ability to stand up from a sitting position (item 5), standing (item 6), walking (item 7), walking distance (item 8), eyes closed tandem stance (item 9), and eyes closed single-leg stance (item 10) were assessed. The total score provides information about the individual's level of mobility. Based on the total score, the evaluation is as follows: 0-30: Completely dependent mobility, 31-40: Severely dependent mobility, 41-50: Moderately dependent mobility, 51-60: Mildly dependent mobility, 61-75: Good level of mobility, 76-90: Very good level of mobility, 91-100: Excellent level of mobility (8).

The Timed Up and Go Test (TUGT): It is used to assess an individual's dynamic balance, walking speed, and mobility. In the test, the individual is instructed to stand up from a standard chair with back support upon the starting command, walk a distance of 3 meters at their normal pace, return, and then sit back down in the chair. The time is measured with a stopwatch and recorded in seconds. During the test, the use of walking aids is allowed if the individual normally uses them. Completing the TUGT in 14 seconds or more is identified as a risk of falling (15).

The 30-Second Chair Stand Test: This test is utilized to assess individuals' physical performance levels. This test evaluates lower extremity muscle function, muscle endurance, sit-to-stand activity, lower extremity strength, and dynamic balance. During the test, the person's ability to stand up from and sit back down on a chair within 30 seconds is recorded. If the individual records a score of 10 or fewer sit-to-stand repetitions within the 30-second timeframe, it indicates lower extremity weakness (16).

The 10-Meter Walk Test: It evaluates an individual's normal walking speed. In this test, the person is asked to walk in a predefined 10-meter area at their usual walking pace in daily life. If the individual use a walking aid, it is allowed. The timing is initiated when the person's foot crossed the starting line and stopped when they crossed the finish line, with the total time recorded. Two measurements are taken, and the best result is recorded in seconds (17).

Dual-Task Assessment

Dual Task Questionnaire: It assesses the difficulties individuals face when performing dual-task activities encountered in their daily lives. It consists of 10 questions, each scored on a scale of very often (4), often (3), occasionally (2), rarely (1), and never (0). Responses to all questions are summed up to calculate a total score, which is then divided by 10. An increase score indicates greater difficulty in behaviors that require dual-task performance (18).

Motor-Motor Tasks: To evaluate the dual-task motor-motor performance of the participants, during the TUGT, 30-second sit-to-stand test, and 10-meter walk test, they were given the task of carrying a 0.5-liter bottle full of water in their hands. For motor-motor assessments something was carried in previous studies (19).

Motor-Cognitive Tasks: To assess cognitive performance, tasks involving the sequential recitation of months (from January to December) were assigned during the TUGT, 30-second sit-to-stand test, and 10-meter walking test. Studies showed that tasks requiring verbal processing, such as counting or reciting sequences, can impose varying levels of cognitive load that affect gait parameters, including speed and stability (20).

Mean time was recorded in seconds in TUGT and 10-meter walk test and number of repetitions in The 30-Second Chair Stand test. In order to minimize the effects of fatigue, rest intervals were given. Patients' failed attempts were repeated (inaccuracy in the order of months).

The dual-task performances were calculated separately for motor and cognitive-added tasks.

The dual-task effect (DTE) was calculated according to the following formula (20):

DTE = [(dual-task performance- single task performance)/single task performance]x100.

A higher DTE indicates a greater decline in performance under dual-task conditions.

Statistical Analysis

The data analysis was conducted using IBM SPSS Statistics 25 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for both categorical and continuous variables in the study. The homogeneity of variances, required for parametric tests, was assessed using the Levene test. The normality assumption was evaluated with the Shapiro-Wilk test. For comparing two groups, the Student's t-test was used when parametric test assumptions were met; otherwise, the Mann-Whitney U test was applied. The relationship between continuous variables was examined using the Pearson Correlation Coefficient when parametric assumptions were satisfied, and the Spearman correlation coefficient when they were not. A p-value of <0.05 was considered statistically significant.

Results

At the beginning, a total of 84 geriatric individuals who voluntarily participated in the study for treatment at the clinic were assessed. Five individuals were excluded from the study as they did not meet the inclusion criteria. The study was completed with a total of 79 individuals (40 male, 39 female), with an average age of 68.68±4.42. Demographic data and the mean scores of individuals on the scales and tests are presented in Table 1.

When comparing dual-task questionnaire and physical performance, The dual-task questionnaire showed a low correlation with the Alusti test (r=-0.290, p=0.009) and 30-second sit-to-stand test (r=-0.267, p=0.017), while it showed a moderate correlation with the 10-meter walk test (r=0.359, p=0.001) and TUGT (r=0.454, p<0.001) (Table 2).

When comparing physical performance and dual-task performances (both motor and cognitive tasks for each test), a moderate correlation was found between the Alusti test and the 30-second sit-to-stand test (r=-0.381, p=0.001; r=-0.407, p<0.001, respectively). Additionally, TUGT-motor/cognitive tasks had a low to moderate correlations with both 10-meter walk test (motor/cognitive) (r=-0.340, p=0.002; r=-0.232, p=0.039, respectively) and 30-second sit-to-stand test (motor /cognitive) (r=0.411, p<0.001; r=0.232, p=0.040, respectively) (Table 3).

When individuals were grouped into Alusti test categories as good mobility and very good mobility, the mean of 30-second the sit-to-stand test- motor and -cognitive tasks were statistically significantly higher in the very good mobility group compared to good mobility (p=0.026, p=0.005; respectively). No differences were observed among the groups for other dual-task performance parameters (p>0.05) (Table 4).

Table 1. Demographic data and the mean scores of measurements of individuals (n=79)

Variables	**Mean ± SD**
Age (years)	68.68±4.42
MOCA	23.91±2.27
Alusti test	79.39±6.09
TUG	11.67±1.86
30s STST	11.29±2.72
10-meter Walk test	20.77±2.88
	n (%)
Gender	
Male	40 (51)
Female	39 (49)
Dominant side	
Right	64 (81)
Left	15 (19)
History of fall	
None	23 (29)
1-2 times	41 (52)
More than 2	15 (19)
Smoking	
Yes	16 (20)
No	63 (80)
Assistive device usage	
Yes	0
No	70 (100)

TUG: Timed up and go test, 30s STST: 30-second sit-to-stand test, SD: Standard deviation, MOCA: Montreal cognitive assessment

Discussion

This cross-sectional study showed that the physical performances in geriatric individuals are associated with their dual-task performance. Additionally, individuals with very good mobility observed to exhibit better performance in sit-to-stand tasks with added motor and cognitive tasks.

With ageing, loss of muscle strength and decreased balance cause older adults to be less able to automatically adapt their balance and movement abilities to environmental stimuli. They need to be more cautious to maintain their balance. Consequently, walking speed decreases, and the risk of falls increases (21). The decline in physical performance adversely affects individuals' daily life activities. Decreased balance, inactivity, and increased fear of falling are associated with this decline. Diminished physical performance in older individuals has led to serious issues, particularly deterioration in physical and cognitive functions, progressing with age and contributing to falls (5). Therefore, when assessing physical performance in older individuals, their cognitive capacities should also be evaluated. The physical performance of the participants in our study was evaluated with the Alusti test, which has been previously used in this population. When the participants were divided into two groups based on their scores on this test, it was observed that the participants had good or very good levels of mobility. This may explain the low-moderate correlations we obtained.

In a study examining the dual-task performance in older adults, it was noted that the performance of the TUG test, slowing down particularly during the returning to the chair and sitting, was affected when performed concurrently with an additional cognitive task. The study was recorded that the performance of the TUG test with an added cognitive task was worse compared to performing the TUG test alone (22). Sertel et al. (23), in their study investigating the impact of additional cognitive and motor tasks on balance in older adults, reported increased performance times in the one-leg standing test, TUG, and sit-to-stand test when performed with additional tasks. Therefore, they concluded that task addition impairs balance performance in older adults. Similarly, our study revealed a

Table 2. Correlation between physical performance tests and dual-task questionnaire

	Dual-task questionnaire	
	r	**p***
Alusti test	-0.290	**0.009**
TUG	0.454	**<0.001**
30s STST	-0.267	**0.017**
10-meter Walk test	0.359	**0.001**

TUG: Timed up and go test, 30s STST: 30-second sit-to-stand test
*: Pearson correlation

Table 3. Correlation between physical performance and dual task performances in motor and cognitive tasks

		Alusti test		TUG		10-meter Walk test		30s STST	
		r	p	r	p	r	p	r	p
TUG	Cognitive	-0.033	0.770	**0.228**	**0.043**	**-0.340**	**0.002**	**0.411**	**<0.001**
	Motor	-0.033	0.770	**0.333**	**0.003**	**-0.232**	**0.039**	**0.232**	**0.040**
10-meter Walk test	Cognitive	-0.037	0.747	-0.108	0.343	0.189	0.096	0.077	0.500
	Motor	-0.125	0.272	-0.133	0.243	0.119	0.295	-0.051	0.658
30s STST	Cognitive	**-0.381**	**0.001**	-0.125	0.271	-0.099	0.384	0.217	0.055
	Motor	**-0.407**	**<0.001**	-0.024	0.833	-0.072	0.526	0.105	0.358

TUG: Timed up and go test, 30s STST: 30-second sit-to-stand test
*: Pearson correlation

Table 4. Comparison of cognitive and motor measurements of physical performance tests according to Alusti test categories

	Alusti test		P*
	Mean ± SD Median (min-max)		
	Good mobility	Very good mobility	
TUG Cognitive	-10.07±24.11 -7.1 (-100-22.2)	-7.99±17.21 -7.1 (-87.5-10)	0.659
TUG Motor	-7.42±20.88 0 (-87.5-7.7)	-5.31±16.89 0 (-87.5-18.2)	0.670
10-meter Walk test Cognitive	-2.14±6.77 0 (-14.3-12.5)	-3.04±5.15 -4.2 (-25-5.6)	0.476
10-meter Walk test Motor	-0.28±4.75 0 (-9.5-10)	-1.52±3.7 0 (-9.5-6.3)	0.243
30s STST Cognitive	0.40±6.99 0 (-22.2-10.5)	-2.88±8.01 0 (-27.3-18.8)	**0.026 ***
30s STST Motor	5.51±12.66 10 (-33.3-30)	-0.92±9.64 0 (-27.3-18.8)	**0.005 ***

TUG: Timed up and go test, 30s STST: 30-second sit-to-stand test, SD: Standard deviation, min-max: Minimum-maximum
*: Mann-Whitney U test

correlation between dual-task performances assessed through both questionnaire and performance tests with the TUG test. As dual-task performance deteriorates, physical performance may be affected or performing the second task to prevent performance impairment may become more challenging.

The 30-second sit-to-stand test explained as a suitable method to assess physical function and screen the risk of falls in older individuals due to the recurrent falls being a risk factor for lower extremity weakness (24). Our study also demonstrated a correlation between the dual-task questionnaire and the 30-second sit-to-stand test. The decrease in muscle strength may be associated with dual-task performance deficits. Additionally, in this test where motor and cognitive dual tasks are added, individuals with good mobility performed better.

In the study conducted by Soumaré et al. (25), it was stated that there is a relationship between cognitive function and walking speed in geriatric individuals. The assessed cognitive function was specifically associated with psychomotor speed and verbal fluency, correlating with a decrease in walking speed over time. Another study found that individuals with faster walking speeds exhibited better cognitive performance across various domains, including executive function, memory, and processing speed (26). A systematic review and meta-analysis revealed that adding a dual task significantly reduces walking speed in community-dwelling older adults. Furthermore, it highlighted that the assessment of walking with a dual task is essential as part of the standard clinical evaluation for older individuals (27). In our study, a positive correlation was observed between single-task 10-meter walking test and dual-task questionnaire scores; however, no relationship was observed in dual-task performances. This may be attributed to the participants included in the study having good physical performance.

There are also studies in the literature where dual-task experiments were conducted using laboratory and clinical measurements. Coelho et al. (28) investigated the standing balance of older adults living in the community under both single and dual-task conditions through sway analysis [center of pressure (COP) sway parameters]. Generally, it was found that older adults have poorer standing balance compared to younger individuals. Performing a secondary task had increased swaying and had an impact on the standing balance of older adults. Older adults required more attention to maintain postural stability compared to young individuals. Similarly, in another study, it was reported that dual-tasking may increase the amount of sway activity assessed by the COP and impede balance control (29).

Various cognitive tasks, such as serial subtraction, word production, and responding to stimuli, have been used in dual-task gait research (20). Beauchet et al. (30) found that older adults exhibited a significant increase in gait variability during dual-task walking with an arithmetic task, but not with a verbal fluency task. Different attentional resources may have varying levels of sensitivity to brain damage or aging, which can lead to task-specific dual-task interference in different populations (31). The motor and cognitive tasks included in our study were limited. Future research should explore the effects of a broader range of tasks, including attention, inhibitory control, working memory, and cognitive flexibility.

The strength of this research lies in its integration of both mobility and cognitive aspects, providing a more comprehensive evaluation of dual-task performance, unlike many studies that focus solely on mobility or cognitive function. By including both motor-motor and motor-cognitive dual-task conditions, the study offers a nuanced understanding of how different types of secondary tasks impact mobility in geriatric individuals. Furthermore, the use of the Alusti test, a novel and efficient assessment tool designed for older adults, enhances the practicality of the study in clinical settings. These findings contribute to the growing body of evidence supporting the inclusion of dual-task assessments in standard geriatric evaluations, encouraging a more holistic approach to fall prevention and the promotion of functional independence.

Study Limitations

There are several limitations to this study. One limitation is the inability to assess physical performance measures, such as balance and muscle strength, using computerized systems, which could have provided more precise data. Additionally, since the study included only one group, cutoff values could not be established. Another limitation is that the participants generally had good physical performance, which may have resulted in weaker correlations in some tests. Furthermore, the variety of cognitive and motor tasks used in dual-task performance assessments was limited, potentially restricting the scope of the findings. Future studies should utilize computerized systems for more precise physical performance assessments and include a more diverse sample to establish cutoff values. Additionally, expanding dual-task conditions, conducting longitudinal research, and considering gender differences, real-world environments, and multiple assessors would enhance the reliability and applicability of findings.

Conclusion

The dual-task capabilities of older people individuals correlate with their physical performance. Enhancements in the physical performance of geriatric individuals could potentially result in improved dual-task performances, attributed to variations in cognitive skills observed as part of the natural ageing process.

Ethics

Ethics Committee Approval: The ethical approval for the study was obtained from the Local Ethical Committee for Research in Natural, Social, and Non-Invasive Health Sciences (decision no: 144 date: 10.11.2021).

Informed Consent: All patients were informed about the research before they started the study and obtained signed written and verbal consent for participation.

Footnotes

Authorship Contributions

Concept: E.A., Design: E.A., Data Collection or Processing: M.A., Analysis or Interpretation: M.A., Literature Search: B.Ç.B., Writing: B.Ç.B.

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