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# COGNITIVE VERSUS MOTOR DUAL TASK BALANCE PERFORMANCE AND FALLS IN MIDDLE-AGED AND ELDERLY ADULTS

# ORTA YAŞLI VE YAŞLI YETİŞKİNLERDE BİLİŞSEL VE MOTOR ÇİFT GÖREV DENGE PERFORMANSI VE DÜŞMELER

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**ABSTRACT**

**Objective:** This study investigated the cognitive and motor dual-task performance and falls in middle-aged and elderly adults.

**Materials and Method:** This cross-sectional study included 84 adults, separated into two age groups of middle-aged adults (50-64 years) and elderly adults (65 years and older). The descriptive characteristics of the participants and the fall rate in the last year were recorded. The timed up-and-go test, four square step test and one leg step test performances were evaluated under single task, cognitive dual task (verbal fluency) and motor dual task (tray-carrying) conditions.

**Results:** The fall rate was 16.7% in middle-aged adults and 33.3% in elderly adults. The performance of elderly adults in the timed up-and-go test, four square step test and one leg stance test was lower than those of middle-aged adults under single task, cognitive dual task and motor dual task conditions ($p<0.05$). Performance was lower under cognitive dual task conditions for all tests in middle-aged and elderly adults ($p<0.05$). The timed up and go test and four square step test performances of non-faller elderly adults were better than those who fell ($p<0.05$).

**Conclusion:** The results of this study showed that single-task and dual-task balance performance in older adults is lower than in middle-aged adults, and lower in elderly adults who have a history of falls than in non-fallers. Efforts such as dual-task balance training to improve dual-task performance from middle age may be beneficial in reducing the risk of falls.

**Keywords:** Aging, dual task, balance, fall

**ÖZ**

**Amaç:** Bu çalışmanın amacı, orta yaşlı ve yaşlı yetişkinlerde bilişsel ve motor ikili görev performansını ve düşmeyi araştırmaktır.

**Gereç ve Yöntem:** Bu kesitsel çalışmaya seksen dört yetişkin dâhil edildi. Katılımcılar yaşa göre orta yaşlı yetişkinler (50-64 yaş) ve yaşlı yetişkinler (65 yaş ve üstü) olarak iki gruba ayrıldı. Katılımcıların tanımlayıcı özellikleri ve son bir yıldaki düşme oranları kaydedildi. Tekli görev, bilişsel ikili görev (sözel akıcılık) ve motor ikili görev (tepsi taşıma) koşullarında süreli kalk ve yürü testi, dört kare adım testi ve tek ayak üzerinde durma testi performansları değerlendirildi.

**Bulgular:** Düşme oranı orta yaşlı erişkinlerde %16,7 ve yaşlı erişkinlerde %33,3 idi. Tek görev, bilişsel ikili görev ve motor ikili görev koşullarında yaşlı yetişkinlerin süreli kalk ve yürü testi, dört kare adım testi ve tek ayak üzerinde durma testi performansları orta yaşlı yetişkinlere göre daha düşüktü ($p<0,05$). Performans, orta yaşlı ve yaşlı erişkinlerde tüm testler için bilişsel ikili görev koşullarında daha düşüktü ($p<0,05$). Düşen ve düşmeyen yaşlı yetişkinler arasında zamanlı kalk ve yürü testi ile dört kare adım testi performanslarında anlamlı fark bulundu ($p<0,05$).

**Sonuç:** Bu çalışmanın sonuçları, yaşlı yetişkinlerde tek görev ve ikili görev denge performansının orta yaşlı erişkinlere göre daha düşük olduğunu ve düşen yaşlı yetişkinlerde düşmeyenlere göre daha düşük olduğunu göstermektedir. Orta yaştan itibaren ikili görev performansını geliştirmeye yönelik ikili görev denge eğitimi gibi çalışmalar düşme riskini azaltmak açısından faydalı olabilir.

**Anahtar Kelimeler:** Yaşlanma, ikili görev, denge, düşme

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## INTRODUCTION

Balance deteriorates due to functional losses caused by natural physiological processes such as loss of strength and flexibility and cognitive disorders seen with aging. Maintaining balance in the elderly population is an important factor for maintaining functional independence (1). Balance disorders have been identified as one of the strongest predictors of falls (2). Impaired balance and gait, and a history of falls are major risk factors for falls in elderly individuals (3). Considering the role of balance in maintaining postural balance, improving balance capability in the elderly is often a goal of fall prevention interventions (4).

Activities of daily living are complex tasks, as they require individuals to perform multiple tasks at the same time and falls often occur during activities that require multitasking. Therefore, dual task (DT) ability indicates the individual's real daily life activity performance (5). Successful dual-task performance is necessary for elderly individuals to remain independent and can be difficult due to the decrease in cognitive and physical functions during the aging process (6).

Deterioration in both motor and cognitive performances may occur in individuals because of the decreased ability to divide attention resources and the degeneration of neural pathways in the aging process (7). Due to task complexity and decreased sensory feedback, balance disorders can be detected in the pre-elderly period (8). There is emerging evidence that midlife may represent an important period for balance related interventions. It has been reported that the prevalence of falls is significant in middle-aged adults, at a rate of 8.7%-31.1% (9).

Static and dynamic balance are important indicators of physical function and mobility in the elderly (10). It is important to evaluate balance and mobility in different dual-task conditions, as dual-task ability is critical to the safe performance of many activities of daily living (7). With current increases in the elderly population, it is of great importance to evaluate balance and mobility performance in different age groups so that preventive interventions related to physical function can be developed to reduce adverse events. The hypothesis of this study was that motor and cognitive dual-task performance would be worse in elderly adults and fallers. Therefore, the aim of this study was to evaluate cognitive and motor dual-task performance in middle-aged and elderly adults and to compare them according to age and fall history.

## MATERIAL and METHODS

### Study design and participants

This cross-sectional study was conducted at the University of Health Sciences Turkey, Faculty of Physiotherapy and Rehabilitation. Community-dwelling middle-aged and elderly individuals aged 50-82 years were included in the study. The inclusion criteria were; 1) age between 50-82 years, 2) ability to walk at least ten meters without using a walking aid, 3) Standardized Mini Mental Test score of ≥24 points. The exclusion criteria were; 1) diagnosis of any orthopedic, cognitive or neurological illness, 2) polypharmacy (>5 medication)

### Ethical approval

The study was approved by the University of Health Sciences Turkey, Gülhane Scientific Research Ethics Committee in accordance with the declaration of Helsinki (Date/No:2022,147). Written consent was obtained from the participants who volunteered for the study.

### Procedure

All the participants were questioned about age, height, weight, education level, marital status, living environment, number of falls in the last year, physical exercise habits, and number of medications. A fall was defined as an event that resulted in inadvertently landing on the ground (3). For those who reported falling, the place of fall and the reason for falling were questioned. Those who had one or more fall history in the last year were classified as "fallers", and those without a fall history were classified as "non-fallers". The Standardized Mini Mental State (MMS) examination was used to assess cognitive level. The timed up-and-go test, four square step test and one leg stance test were used to evaluate mobility and balance. The order of the tests was decided randomly. Balance and mobility performance were evaluated in single task (ST), motor dual task (DT) and cognitive DT conditions. As a cognitive concurrent task, individuals counted words beginning with a specific letter (K, E or A letters) while performing balance or mobility tasks. As a motor concurrent task, individuals carried a tray with a glass of water on it. The order of single task, motor DT and cognitive DT tests was chosen randomly. Verbal fluency and tray carrying are frequently used tasks to evaluate dual-task performance in the elderly (11, 12). The following formula was used to calculate the dual task cost (DTC):"DTC=((single task performance-dual task performance)/single task performance)×100". According to this formula, negative values indicate that the DT performance value is greater (13).

### Outcome measures

The Standardized Mini Mental State test is a standardized method used to evaluate cognitive status. This test consists of 11 items. The highest possible score is 30 points. As a result of the evaluation, 23/24 points and above are considered as normal cognitive function. The Turkish version of the Standardized Mini Mental Test is proven to be valid and reliable (14, 15).

The timed up-and-go (TUG) test is a test often used to evaluate functional mobility. The test measures speed during many functional maneuvers such as standing up, walking, turning, and sitting. It is a test frequently used in elderly individuals to determine the risk of falling (16, 17).

The Four Square Step (FSS) test was used to evaluate dynamic balance. In this test, individuals are asked to step into four squares as quickly as possible. The ability to step to the right, left, front and back is evaluated. It is a valid and reliable test in elderly individuals (18,19).

The one-leg stance (OLS) test is a commonly used balance test in the evaluation of static balance (20). The duration of standing on the preferred leg with the eyes open was recorded. The test is terminated when the position of the arms and the raised foot deteriorates or the foot in contact with the ground moves to maintain balance, or at the completion of 45 seconds. A longer test time indicates better balance ability (21,22).

**Statistical analysis**

Data were analyzed using the SPSS version 25.0 statistical software (SPSS Inc., Chicago, IL, USA). The conformity of the data to normal distribution was examined using visual and analytical methods. Continuous variables were presented as mean and standard deviation or median and interquartile range values, and categorical variables as frequency and percentage. The Mann-Whitney U test was used to compare the single task and DT functional performance of middle-aged and elderly individuals. The Mann-Whitney U test was used to compare the single task and DT functional performance of fallers and non-fallers in elderly individuals. Effect size (ES) was calculated with the formula "ES = z / √N" using the z score of the Mann-Whitney U test. An ES value of 0.1-0.3 indicates a small effect size, 0.3-0.5 indicates medium, and >0.5 indicates a large effect size. Wilcoxon Paired Samples tests were used to compare single task performance-cognitive DT performance and single task performance-motor DT performance. The level of statistical significance was accepted as $p<0.05$.

GPower 3.1.9.4 software (Heinrich-Heine-Universität Düsseldorf) was used to determine the required sample size. When

**Table 1:** Descriptive characteristics of the participants

| | | Middle-aged adults (n=42) | | Elderly adults (n=42) | |
|---|---|---|---|---|---|
| | | **Mean** | **Standard deviation** | **Mean** | **Standard deviation** |
| **Age (years)** | | 56.19 | 4.46 | 71.59 | 4.62 |
| **Height (cm)** | | 160.23 | 7.35 | 158.33 | 9.11 |
| **Weight (kg)** | | 73.04 | 10.77 | 70.94 | 11.14 |
| **Body mass index (kg/m$^2$)** | | 28.47 | 4.01 | 28.35 | 4.22 |
| **Mini mental status examination score** | | 27.54 | 2.19 | 26.52 | 2.56 |
| | | **n** | **%** | **n** | **%** |
| **Gender** | Female | 33 | 78.6 | 31 | 73.8 |
| | Male | 9 | 11.9 | 11 | 26.2 |
| **Marital status** | Single | 3 | 7.1 | 3 | 7.1 |
| | Married | 33 | 78.6 | 25 | 59.5 |
| | Widow | 6 | 14.3 | 14 | 33.4 |
| **Educational status** | ≤ 5 years | 33 | 78.6 | 31 | 73.8 |
| | >5 years | 9 | 11.9 | 11 | 26.2 |
| **Living environment** | Alone at home | 2 | 4.8 | 11 | 26.2 |
| | With a spouse at home | 13 | 31 | 22 | 52.4 |
| | With spouse and children at home | 20 | 47.6 | 2 | 4.8 |
| | With children/relatives at home | 7 | 16.6 | 7 | 16.6 |
| **Physical exercise habit** | No exercise | 36 | 85.7 | 35 | 83.3 |
| | Less than 2 hours per week | 3 | 7.1 | 4 | 9.5 |
| | More than 2 hours per week | 3 | 7.1 | 3 | 7.1 |
| **Fall history** | No | 35 | 83.3 | 28 | 66.7 |
| | 1-2 in the last year | 6 | 14.3 | 9 | 21.5 |
| | 3-4 in the last year | 0 | 0 | 2 | 4.8 |
| | More than 5 in the last year | 1 | 2.4 | 3 | 7.1 |
| **Number of medications** | 0 | 29 | 69 | 6 | 14.3 |
| | 1 | 8 | 19 | 18 | 42.8 |
| | 2 | 4 | 9.5 | 7 | 16.7 |
| | More than 3 | 1 | 2.4 | 11 | 26.2 |

the timed up-and-go test was accepted as the primary outcome measure, it was calculated that there should be 40 people in each group for 0.843 ES, 0.05 alpha and 0.98 power (1). The study was completed with 84 participants.

## RESULTS

Evaluation was made of 84 middle-aged and elderly individuals. Most of the participants were female (76.5%), married (68.2%), and had a sedentary lifestyle (84.7%). The descriptive characteristics of all the participants are presented in Table 1.

Tripping was seen to be the most common cause of falls in elderly fallers (50%). Other causes of falls include slipping, dizziness, ankle sprains, and lifting heavy objects. In middle-aged individuals, the causes of falls were reported as slipping, tripping and loss of balance. It was noted that most falls (85.7%) in middle-aged adults occurred outdoors, while in older adults most (57.1%) falls occurred at home.

The TUG test, FSS test and OLS test performance under single task, motor DT and cognitive DT conditions were significantly different in middle-aged and elderly adults (p≤0.001), and effect sizes were medium or large (Table 2). In the middle-aged group, the TUG test duration under cognitive DT condition was greater than its single task value (p<0.001), the FSS test duration under cognitive DT condition was greater than its single task value (p<0.001), the OLS test duration under cognitive DT condition was lower than its single task value (p=0.037), and the OLS test duration under motor DT condition was lower than its single task value (p=0.013). In the elderly group, the TUG test duration under cognitive DT condition was greater than its single task value (p<0.001), the FSS test duration under cognitive DT condition was greater than its single task value (p<0.001),

**Table 2:** Functional performance results under single task, cognitive dual task and motor dual task conditions in middle aged and elderly adults

| | Middle-aged adults (N=42) | | Elderly adults (N=42) | | | |
|---|---|---|---|---|---|---|
| **Single task** | **Median** | **IQR** | **Median** | **IQR** | **P** | **ES** |
| Timed up and go test (s) | 8.64 | 2.63 | 11.28 | 2.87 | <0.001 | 0.48 |
| Four square step test (s) | 10.43 | 3.47 | 14.88 | 4.37 | <0.001 | 0.63 |
| One leg stance test (s) | 45 | 18.37 | 11.01 | 21.48 | <0.001 | 0.58 |
| **Cognitive dual task** | | | | | | |
| Timed up and go test (s) | 10.65* | 3.48 | 14.15* | 6.5 | <0.001 | 0.42 |
| Four square step test (s) | 15.19* | 5.75 | 18.14* | 10.4 | 0.001 | 0.36 |
| One leg stance test (s) | 40* | 24.43 | 9* | 3.25 | <0.001 | 0.55 |
| **Motor dual task** | | | | | | |
| Timed up and go test (s) | 8.58 | 2.32 | 11.27 | 3.89 | <0.001 | 0.50 |
| Four square step test (s) | 10.69 | 3.35 | 14.4 | 4.43 | <0.001 | 0.57 |
| One leg stance test (s) | 37.5* | 26.84 | 12.5 | 20.8 | <0.001 | 0.49 |

IQR: Interquartile range, ES: Effect size, *Wilcoxon Paired sample test, significantly different from its value in single task condition (p<0.05)

**Table 3:** Dual-Task Costs of functional performance tests under cognitive dual task and motor dual task conditions in middle-aged and elderly adults.

| | Middle-aged adults (N=42) | | Elderly adults (N=42) | | |
|---|---|---|---|---|---|
| | **Median** | **IQR** | **Median** | **IQR** | **P** |
| **Cognitive dual task cost** | | | | | |
| Timed up and go test (%) | -24.99 | 22.47 | -23.06 | 26.9 | 0.795 |
| Four square step test (%) | -37.49 | 31.78 | -29.4 | 31.13 | 0.074 |
| One leg stance test (%) | 0 | 25.18 | 16.44 | 57.94 | 0.148 |
| **Motor dual task cost** | | | | | |
| Timed up and go test (%) | 0.58 | 10.63 | 0.86 | 7.53 | 0.823 |
| Four square step test (%) | -2.03 | 11.48 | 1.33 | 9.35 | **0.019** |
| One leg stance test (%) | 0 | 29.82 | 0 | 46.54 | 0.124 |

IQR: Interquartile range

**Table 4:** Comparison of single task and dual task performances of faller and non-faller elderly

| | Fallers (N=14) | | Non-fallers (N=28) | | | |
|---|---|---|---|---|---|---|
| **Single task** | **Median** | **IQR** | **Median** | **IQR** | **P** | **ES** |
| Timed up and go test (s) | 13.82 | 4.93 | 10.59 | 3.06 | **0.016** | 0.37 |
| Four square step test (s) | 16.15 | 5.74 | 13.64 | 3.36 | **0.035** | 0.32 |
| One leg stance test (s) | 9.45 | 19.83 | 13.79 | 22.85 | 0.321 | 0.15 |
| **Cognitive dual task** | | | | | | |
| Timed up and go test (s) | 19.65* | 9.63 | 12.8* | 4.53 | **0.043** | 0.31 |
| Four square step test (s) | 21.66* | 16.85 | 17.23* | 8.86 | 0.107 | 0.25 |
| One leg stance test (s) | 8.31 | 14.5 | 9.67 | 21.86 | 0.321 | 0.15 |
| **Motor dual task** | | | | | | |
| Timed up and go test (s) | 14.78 | 4.94 | 10.65 | 2.47 | **0.01** | 0.39 |
| Four square step test (s) | 16.15 | 5.59 | 13.46 | 3.25 | **0.043** | 0.31 |
| One leg stance test (s) | 12.25 | 17.3 | 12.66 | 29.3 | 0.376 | 0.13 |

IQR: Interquartile range, ES: Effect size, *Wilcoxon Paired sample test, significantly different from its value in single task condition (p<0.05)

**Table 5:** Dual-Task Costs of functional performance tests under cognitive dual task and motor dual task conditions in faller and non-faller elderly.

| | Fallers (N=14) | | Non-fallers (N=28) | | |
|---|---|---|---|---|---|
| | **Median** | **IQR** | **Median** | **IQR** | **P** |
| **Cognitive dual task cost** | | | | | |
| Timed up and go test (%) | -32 | 48.2 | -21.03 | 21.88 | 0.947 |
| Four square step test (%) | -27.45 | 35.32 | -29.54 | 35.64 | 0.722 |
| One leg stance test (%) | 14.26 | 74.36 | 21.12 | 56.47 | 0.793 |
| **Motor dual task cost** | | | | | |
| Timed up and go test (%) | 1.21 | 7.47 | -0.78 | 7.25 | 0.420 |
| Four square step test (%) | 2.51 | 9.09 | 0.96 | 8.99 | 0.626 |
| One leg stance test (%) | 0 | 46.72 | -1.85 | 50.95 | 0.709 |

IQR: Interquartile range

and the OLS test duration under cognitive DT condition was lower than its single task value (p=0.043).

There was no significant difference between the cognitive or motor DTCs of the TUG test (p=0.795, p=0.823 respectively) and OLS test (p=0.148, p=0.124 respectively) in middle-aged and elderly individuals. The motor DTC of the four square step test was significantly different in middle-aged and elderly adults (p=0.019) (Table 3).

As the rate of middle-aged participants with a history of falls was low, no analysis could be performed. The TUG test times of the faller elderly under single task, cognitive DT and motor DT conditions were higher than those of the non-faller elderly (p=0.016, p=0.043, p=0.01 respectively). The FSS test times under single task and motor DT conditions of faller elderly individuals were longer than those of elderly individuals who did not fall (p=0.035, p=0.043 respectively), (Table 4). The TUG test duration under cognitive DT condition was greater than its single task value (p=0.001), the FSS test duration under cognitive DT condition was greater than its single task value (p=0.002) in the faller elderly group. The TUG test duration under cognitive DT condition was greater than its single task value and the FSS test duration under cognitive DT condition was greater than its single task value (p<0.001) in the non-faller elderly group.

There was no significant difference between the faller and non-faller elderly individuals in respect of the cognitive or motor DTCs of the functional performance tests (p>0.05) (Table 5).

## DISCUSSION

This study was planned to evaluate dual-task balance and mobility performance in middle-aged and elderly individuals, and the results showed that single task, DT balance and mobility performance were worse in elderly individuals, but no significant difference was found between the age groups in terms of DTC. Performance was worse under cognitive DT conditions in both age groups. Although it was observed that balance and mobility

were worse under single task and cognitive DT conditions in faller elderly individuals than in non-faller elderly individuals, no difference was found in terms of DTC.

Cognitive DT performance is adversely affected in older individuals due to the decline in executive function over time and age-related neurodegenerative conditions (7). Considering the studies that evaluated balance performance under dual task conditions, it is thought that this is the reason why the cognitive task is used more frequently as a secondary task. However, performing a simultaneous motor task while walking increases demands for dynamic balance, and the effort not to spill water from the glass also increases attention demands (23). Mobility performance is multidimensional and requires high levels of motor control and cognitive load to pay attention to various external stimuli (6). Therefore, in the current study, balance performance was evaluated under both motor DT and cognitive DT conditions.

In the pre-elderly period, when balance ability and physical functions begin to decline, it is a critical period for early interventions to prevent falls (9). Single task and DT mobility and balance performance are reported to worsen with aging (1, 6, 13). In the current study, balance and mobility performance was found to be better in middle-aged individuals under single task, motor DT and cognitive DT conditions. Efforts to protect these performances of middle-aged adults would be beneficial in order to prevent adverse events that could occur in the future.

It is reported that DTCs related to gait parameters do not change with age or are higher in young individuals than in older individuals (24, 25). Research found that the postural DTCs of younger adults and older adults are similar in stable standing conditions (26). No age-related change was detected in the cost of the TUG test under motor DT conditions, and the cost of cognitive DT is reported to be higher in elderly individuals (13). The current study results demonstrated no difference between middle-aged and elderly adults with respect to DTCs. One reason for this could be that the middle-aged group was in the immediate pre-elderly age range. The fact that DTCs in functional performance tests are similar between age groups suggested that DT assessments should be considered in individuals aged 50-64 years, also called the pre-elderly period, as well as in elderly individuals (27).

Li et al. reported that the rate of outdoor falls is higher in middle-aged individuals than in elderly individuals, tripping is the most common cause of falls and poor health is an important risk factor, especially for indoor falls (28). In the current study, the rates of falling at home were higher in the elderly, partly because the elderly spent less time outside and partly because the elderly were in poorer health. In the current study, individuals who fell had worse performance in both single task and cognitive DT conditions, although the DTCs were similar. Muhaidat et al. found that the test performances were different and DTCs were similar in faller and non-faller adults (29). Asai et al. reported that DTCs were lower in faller elderly adults (30). This could be due to the inclusion of community-dwelling elderly individuals with good cognitive status. The results of the current study suggested that in community-dwelling elderly people with good cognitive status, fallers could manage dual-task conditions similarly to non-fallers and that assessments of falls should focus on single task and cognitive DT performance rather than DTC.

This is the first study that examined the effects of motor and cognitive simultaneous tasks on functional mobility, static and dynamic balance in middle-aged and older adults in Turkey. The results of this study provide important information about the change and decline in cognitive DT and motor DT performance during the aging process. However, the fact that most of the participants were female and sedentary individuals limits the generalizability of the results. In addition, the use of only one type of cognitive and motor task could be considered a limitation. It is suggested that in future studies, cognitive and motor simultaneous task performance of varying degrees of difficulty be evaluated in middle-aged and elderly individuals.

## CONCLUSION

The results of this study suggested that balance and mobility performance deteriorates with aging in single task, motor DT and cognitive DT conditions and a simultaneous cognitive task significantly reduced balance and mobility performance. It also showed that balance and mobility performance in single task and cognitive DT conditions were worse in elderly individuals with a history of falls than in non-fallers. In order to prevent future adverse events, the evaluation of single task and DT performances in middle-aged and elderly individuals should be considered.

**Ethics Committee Approval:** This study was approved by University of Health Sciences Gulhane Scientific Research Ethics Committee (Date: 26.05.2022, No: 2022-147).

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## REFERENCES

1. Aslan UB, Cavlak U, Yagci N, Akdag B. Balance performance, aging and falling: a comparative study based on a Turkish sample. Arch Gerontol Geriatr 2008;46(3):283-92.

2. Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? JAMA 2007;297(1):77-86.
3. Ambrose AF, Paul G, Hausdorff JM. Risk factors for falls among older adults: a review of the literature. Maturitas 2013;75(1):51-61.
4. Sherrington C, Fairhall NJ, Wallbank GK, Tiedemann A, Michaleff ZA, Howard K, et al. Exercise for preventing falls in older people living in the community: an abridged Cochrane Sysytematic Review. Br J Sports Med 2020;54(15):885-91.
5. Brustio PR, Magistro D, Zecca M, Liubicich ME, Rabaglietti E. Fear of falling and activities of daily living function: mediation effect of dual-task ability. Aging Ment Health 2018;22(6):856-61.
6. Brustio PR, Magistro D, Zecca M, Rabaglietti E, Liubicich ME. Age-related decrements in dual-task performance: Comparison of different mobility and cognitive tasks. A cross sectional study. PloS one 2017;12(7):e0181698.
7. Kahya M, Moon S, Ranchet M, Vukas RR, Lyons KE, Pahwa R, et al. Brain activity during dual task gait and balance in aging and age-related neurodegenerative conditions: a systematic review. Exp Gerontol 2019;128:110756.
8. Osoba MY, Rao AK, Agrawal SK, Lalwani AK. Balance and gait in the elderly: A contemporary review. Laryngoscope Investig Otolaryngol 2019;4(1):143-53.
9. Peeters G, van Schoor NM, Cooper R, Tooth L, Kenny RA. Should prevention of falls start earlier? Co-ordinated analyses of harmonised data on falls in middle-aged adults across four population-based cohort studies. PLoS one 2018;13(8):e0201989.
10. Shubert TE, Schrodt LA, Mercer VS, Busby-Whitehead J, Giuliani CA. Are scores on balance screening tests associated with mobility in older adults? J Geriatr Phys Ther 2006;29(1):33-9.
11. Bayot M, Dujardin K, Dissaux L, Tard C, Defebvre L, Bonnet CT, et al. Can dual-task paradigms predict falls better than single task?–a systematic literature review. Neurophysiol Clin 2020;50(6):401-40.
12. Muir-Hunter S, Wittwer J. Dual-task testing to predict falls in community-dwelling older adults: a systematic review. Physiotherapy 2016;102(1):29-40.
13. Brustio PR, Magistro D, Rabaglietti E, Liubicich ME. Age-related differences in dual task performance: A cross-sectional study on women. Geriatr Gerontol Int 2017;17(2):315-21.
14. McCollum L, Karlawish J. Cognitive impairment evaluation and management. Med Clin 2020;104(5):807-25.
15. Gungen C. Standardize Mini Mental Test'in Turk toplumunda hafif demans tanisinda gecerlik ve guvenilirligi. Turk Psikiyatri Derg 2002;13(4):273-81.
16. Alexandre TS, Meira DM, Rico NC, Mizuta SK. Accuracy of Timed Up and Go Test for screening risk of falls among community-dwelling elderly. Braz J Phys Ther 2012;16(5):381-8.
17. Beauchet O, Fantino B, Allali G, Muir S, Montero-Odasso M, Annweiler C. Timed Up and Go test and risk of falls in older adults: a systematic review. J Nutr Health Aging 2011;15(10):933-8.
18. Dite W, Temple VA. A clinical test of stepping and change of direction to identify multiple falling older adults. Arch Phys Med Rehabil 2002;83(11):1566-71.
19. Isık E, Altug F, Cavlak U. Relıabılıty And Valıdıty Of Four Step Square Test In Older Adults. Turk Geriatri Derg 2015;18(2):151-5.
20. Michikawa T, Nishiwaki Y, Takebayashi T, Toyama Y. One-leg standing test for elderly populations. J Orthop Sci 2009;14(5):675-85.
21. Springer BA, Marin R, Cyhan T, Roberts H, Gill NW. Normative values for the unipedal stance test with eyes open and closed. J Geriatr Phys Ther 2007;30(1):8-15.
22. Lin MR, Hwang HF, Hu MH, Wu HDI, Wang YW, Huang FC. Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. J Am Geriatr Soc 2004;52(8):1343-8.
23. Lundin-Olsson L, Nyberg L, Gustafson Y. Attention, frailty, and falls: the effect of a manual task on basic mobility. J Am Geriatr Soc 1998;46(6):758-61.
24. Holtzer R, Mahoney JR, Izzetoglu M, Izzetoglu K, Onaral B, Verghese J. fNIRS study of walking and walking while talking in young and old individuals. J Gerontol- Biomed Sci Med Sci 2011;66(8):879-87.
25. Malcolm BR, Foxe JJ, Butler JS, De Sanctis P. The aging brain shows less flexible reallocation of cognitive resources during dual-task walking: a mobile brain/body imaging (MoBI) study. Neuroimage 2015;117:230-42.
26. Boisgontier MP, Beets IA, Duysens J, Nieuwboer A, Krampe RT, Swinnen SP. Age-related differences in attentional cost associated with postural dual tasks: increased recruitment of generic cognitive resources in older adults. Neurosci Biobehav Rev 2013;37(8):1824-37.
27. Carmona-Torres JM, Cobo-Cuenca AI, Pozuelo-Carrascosa DP, Latorre-Román PÁ, Párraga-Montilla JA, Laredo-Aguilera JA. Physical activity, mental health and consumption of medications in pre-elderly people: the National Health Survey 2017. Int J environmental research and public health 2021;18(3):1100.
28. Li W, Keegan TH, Sternfeld B, Sidney S, Quesenberry Jr CP, Kelsey JL. Outdoor falls among middle-aged and older adults: a neglected public health problem. Am J Public Health 2006;96(7):1192-200.
29. Muhaidat J, Kerr A, Evans JJ, Skelton DA. Exploring gait-related dual task tests in community-dwelling fallers and non-faller: a pilot study. Physiother Theory Pract 2013;29(5):351-70.
30. Asai T, Oshima K, Fukumoto Y, Yonezawa Y, Matsuo A, Misu S. Association of fall history with the Timed Up and Go test score and the dual task cost: A cross-sectional study among independent community-dwelling older adults. Geriatr Gerontol Int 2018;18(8):1189-93.