Turkish Journal of Clinical Research

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

RESEARCH ARTICLE

An investigation into the effects of dual-task conditions on gait and balance in older adults with knee osteoarthritis

Diz osteoartritli yaşlı bireylerde ikili görevlerin yürüme ve denge üzerine etkilerinin incelenmesi

Mustafa Ozkan FIRAT[1], Ertugrul DEMIRDEL[2]

[1]Ağrı İbrahim Çeçen University, Vocational School of Health Services, Department of Health Care Services, Ağrı, Türkiye
[2]Ankara Yıldırım Beyazıt University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Türkiye

Abstract

Aim: To investigate the effects of motor and cognitive dual-task conditions on walking and dynamic balance in older adults with knee osteoarthritis.

Methods: This cross-sectional analytical study included 28 adults aged ≥65 years diagnosed with knee osteoarthritis according to American College of Rheumatology criteria. Performance was assessed using the Timed Up and Go Test, 10-Meter Walk Test, and Four-Square Step Test under single-task, motor dual-task, and cognitive dual-task conditions. Dual-task costs were calculated as percentages. Data were analyzed using the Wilcoxon test and Spearman correlation analysis ($p<0.05$).

Results: Completion times significantly increased under both motor and cognitive dual-task conditions across all functional tests, indicating poorer performance (all $p<0.001$). In the Four Square Step Test, the motor dual-task condition resulted in a greater increase in completion time than the cognitive dual-task condition ($p=0.023$). No significant differences were observed between dual-task conditions in walking-based tests, and dual-task cost values were not correlated ($p>0.05$).

Conclusion: Motor tasks impair dynamic balance more than cognitive tasks in older adults with knee osteoarthritis.

Keywords: Knee osteoarthritis, dual-task performance, gait and balance, older adults, functional mobility.

Özet

Amaç: Diz osteoartriti olan yaşlı yetişkinlerde motor ve bilişsel çift görev koşullarının yürüme ve dinamik denge üzerindeki etkilerini araştırmak

Yöntemler: Bu kesitsel analitik çalışmaya, Amerikan Romatoloji Derneği kriterlerine göre diz osteoartriti tanısı almış ≥65 yaş aralığındaki 28 yetişkin dahil edildi. Performans, tek görev, motorik ikili görev ve bilişsel ikili görev koşulları altında Zamanlı Kalk ve Yürü Testi, 10 Metre Yürüme Testi ve Dört Kare Adım Testi kullanılarak değerlendirildi. İkili görev maliyetleri yüzdelik olarak hesaplandı. Veriler Wilcoxon testi ve Spearman korelasyon analizi kullanılarak analiz edildi ($p<0,05$).

Bulgular: Motor ve bilişsel ikili görev koşullarında tüm fonksiyonel testlerin tamamlanma süreleri anlamlı düzeyde arttı ($p<0,001$). Dört Kare Adım Testinde, motor becerileri gerektiren çift görev, bilişsel beceriler gerektiren çift göreve göre daha fazla bozulmaya neden oldu ($p=0,023$). Yürüyüş temelli testlerde çift görev koşulları arasında anlamlı bir fark gözlenmedi ve çift görev maliyeti değerleri arasında korelasyon bulunamadı ($p>0,05$).

Sonuç: Diz osteoartriti olan yaşlı yetişkinlerde, motor görevler dinamik dengeyi bilişsel görevlerden daha fazla olumsuz etkilemektedir.

Anahtar Kelimeler: Diz osteoartriti, çift görev performansı, yürüyüş ve denge, yaşlı yetişkinler, fonksiyonel hareketlilik.

INTRODUCTION

Knee osteoarthritis is one of the most common degenerative joint diseases in the elderly population. Its symptoms include pain, loss of joint cartilage, and physical and functional impairment (1,2). Knee osteoarthritis accounts for approximately four-fifths of all osteoarthritis cases worldwide (3). Knee OA is the leading cause of OA globally, and aging is cited as one of the primary contributing factors(4). Epidemiological data indicate that the prevalence of knee osteoarthritis increases significantly with age, reaching approximately 30–40% in individuals over 60 years of age, and rising to as high as 50% in those aged 65 and older(5). The increasing prevalence of knee osteoarthritis imposes a substantial burden on individual health, healthcare systems, and society (6). Knee osteoarthritis does not merely involve changes in joint structure but also

Corresponding Author: Mustafa Ozkan FIRAT mozkan@agri.edu.tr
Cite as: Firat MO, Demirdel E. An investigation into the effects of dual tasks on gait and balance in older adults with knee osteoarthritis. Turk J Clin Res. 2026;2(2):102-110

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial-NonDerivatives 4.0 International License

Received: 20 May 2026 | **Accepted:** 25 July 2026 | **Published:** 30 September 2026

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

causes significant effects on functional mobility and postural control (7). Knee osteoarthritis reduces an individual's ability to independently perform activities of daily living (8). When evaluating individuals with knee osteoarthritis, a functional assessment alone is insufficient; it is also important to assess them neuromotorically and cognitively(9). Activities of daily living typically require the simultaneous execution of multiple tasks rather than the performance of a single task(10). This phenomenon is defined in the literature as "dual-tasking" and involves the simultaneous use of motor and cognitive processes(11). Cognitive-motor dual-tasking is defined as the parallel processing of a motor task and a cognitive task (12). Studies conducted on older adults have shown that dual-task conditions have a significant negative impact on walking speed, balance, and functional mobility (13,14). Movement adaptations resulting from pain, reduced joint stability, and muscle weakness in individuals with knee osteoarthritis exacerbate performance deficits during dual-task conditions (15). In particular, increased cognitive load leads to disruptions in gait patterns and deficiencies in postural control mechanisms, thereby increasing the risk of falls(16). Daily activities, such as carrying an object while walking, require the simultaneous performance of motor and cognitive tasks. Age-related declines in executive function and attentional control may therefore contribute to poorer dual-task performance in older adults (17). Certain cognitive and motor dual-task training programs have been reported to improve dual-task performance (18-20). Although dual-task gait and balance performance has been investigated in individuals with knee OA, existing studies have predominantly focused on cognitive dual-task paradigms, and direct comparisons between motor and cognitive dual-task conditions remain limited (21–23). This evidence gap highlights the need to evaluate gait, functional mobility, and dynamic balance under different task conditions in older adults with knee osteoarthritis. Assessing performance solely under single-task conditions may not adequately reflect the dual-task demands encountered in daily life. Therefore, examining motor and cognitive dual-task conditions separately may provide a clearer understanding of their task-specific effects on gait and postural control. Such an approach may also clarify the interaction between sensorimotor and cognitive processes in knee osteoarthritis and contribute to the development of more targeted clinical assessment and rehabilitation strategies. Accordingly, this study aimed to compare the effects of motor and cognitive dual-task conditions on gait, functional mobility, and dynamic balance in older adults with knee osteoarthritis.

METHODS

Study Design

This study was designed to examine the effects of motor and cognitive dual-task conditions on gait and balance performance in older adults with knee osteoarthritis. This is a cross-sectional study conducted at a single center. Within the scope of the study, functional mobility and dynamic balance performance were evaluated comparatively under motor and cognitive tasks. No intervention was applied in the study, and all analyses are based on the participants' baseline performance measurements. The study was designed to elucidate the effects of motor and cognitive load on functional performance within a dual-task framework.

Research and Ethical Approval

Research data were collected at Ağrı Training and Research Hospital. The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Ankara Yıldırım Beyazıt University Institute of Health Sciences Ethics Committee (research code: 2024-1009; meeting date: 26 December 2024; decision no.: 10/1009). Participants who voluntarily joined the study were provided with detailed information regarding the study's purpose, the tests to be administered, potential risks, and their rights. It was clearly stated that participation in the study was entirely voluntary and that participants could withdraw from the study at any time without providing a reason. Written informed consent was obtained from all participants prior to the data collection process. Participant data was kept confidential, and all data was anonymized for analysis.

Participants

The study included individuals aged 65 years or older who met the American College of Rheumatology clinical classification criteria for knee osteoarthritis and whose diagnosis was confirmed by a specialist physician (24).

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

Prior to the study, the sample size was calculated using the G*Power software, and it was determined that at least 28 individuals were required for a moderate effect size, 80% power, and a 5% significance level. In the sample size calculation at , the effect size was set at 0.50 (moderate), power at 0.80, and the alpha value at 0.05. Inclusion criteria: being 65 years of age or older, having a clinical and/or radiological diagnosis of knee osteoarthritis, being able to walk independently, possessing sufficient cognitive ability to understand and follow instructions, scoring 24 or higher on the Standardized Mini-Mental State Examination (SMMT), and scoring 91 or higher on the Barthel Index of Activities of Daily Living.

Exclusion criteria were defined as neurological diseases such as Parkinson's disease, stroke, and dementia; severe vision or hearing loss; musculoskeletal disorders significantly affecting mobility; having undergone lower extremity surgery within the past six months; use of assistive devices; and participation in a regular exercise program.

Data Collection Tools

Participants' sociodemographic characteristics were recorded by the researcher in accordance with the literature. In this context, questions regarding age, gender, and body mass index were asked and documented.

The Timed Up and Go Test (TUG), the 10-Meter Walk Test, and the Four Square Step Test (FSST) were used to assess functional mobility and dynamic balance performance.

Functional Performance Tests

Timed Up and Go Test (TUG)

The Timed Up and Go Test was used to assess participants' functional mobility. This test evaluates physical performance and functional mobility. It is used to measure fall risk, balance, and walking speed in older adults (25). This test was also administered alongside cognitive and motor secondary tasks. The cognitive secondary task involved counting backward in threes from a spoken number; the motor secondary task involved carrying a cup on a tray. Participants began the test in a seated position on a standard chair approximately 45 cm high; upon the "go" command, they stood up, walked a distance of 3 meters, turned at the designated point, and sat back down on the chair. The test was administered twice, and the average time was used in the analyses.

10-Meter Walk Test

The 10-Meter Walk Test was used to assess participants' walking speed. Participants are asked to walk 14 meters; the first 2 meters are designated as the acceleration phase, and the last 2 meters as the deceleration phase. In the middle 10-meter section, a stopwatch is started and stopped when the participant crosses the starting and finishing lines. This minimizes the effects of acceleration and deceleration, allowing for an accurate measurement of walking speed (26). This test was also administered while assessing walking speed in conjunction with cognitive and motor secondary tasks. As a cognitive secondary task, the participant was asked to name animals whose names begin with the letter "K" while walking. As a motor secondary task, the participant was instructed to rhythmically snap their fingers while walking. The test was repeated twice, and the average value was included in the analyses.

Four Square Step Test (FSST)

The Four-Square Step Test was used to assess participants' dynamic balance. This test is frequently used in clinical settings to evaluate dynamic balance, postural sway, and the ability to change direction (27). The test was administered by marking four squares on a stable surface, which were numbered. The patient was instructed to step onto the numbered squares in sequence (1-2-3-4 and then 4-3-2-1). During this process, the patient must not step on the lines or boundaries. The patient was first shown how to perform the test and given a practice trial. The best time was recorded after three trials to obtain the result; if the patient stepped on the lines, the test was repeated (28). This test was also administered while evaluating dynamic balance alongside cognitive and motor secondary tasks. As a cognitive secondary task, the participant was asked to recite the winter months (November, December, January, February) in order while moving between squares. As a motor secondary task, the participant was

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

given the task of passing an object (a plastic ball) from one hand to the other while moving between squares. The test was repeated three times, and the shortest time was used for evaluation.

All tests were administered by the same researcher using standardized procedures, and familiarization trials were conducted before testing to reduce potential learning effects.

Task Conditions and Implementation Protocol

All performance tests were conducted under three different task conditions, and each condition was carried out in a standardized manner.

Single Task

Participants performed only the relevant performance test.

Motor Dual Task

While performing the performance task, participants simultaneously performed a second motor task:

- TUG: carrying a cup on a tray
- 10-meter walk: rhythmic finger movement
- FSST: transferring an object from one hand to the other

Cognitive Dual Task

Participants performed a cognitive task simultaneously while carrying out the performance task:

- TUG: Counting backward in threes from a given number
- 10-meter walk: Generating animal names starting with a specific letter (K)
- FSST: Ranking the winter months (November, December, January, February)

Participants were instructed to perform the cognitive tasks continuously throughout the dual-task assessments to ensure engagement with the assigned task. The test order was randomized using a computer-based random number generator, and a 2–3-minute rest period was provided between measurements to minimize the effect of fatigue.

Dual-Task Cost (DTC)

Dual-task cost (DTC) was calculated using the following formula:

(Dual-task duration – single-task duration) / single-task duration × 100.

Data Collection Process

All measurements were conducted under standard environmental conditions (20–22°C) and in a single session. First, participants' demographic and clinical data were recorded, followed by the administration of performance tests.

Statistical Analysis

Data analysis was performed using the SPSS (Statistical Package for the Social Sciences) programme. Descriptive statistics were presented as mean, standard deviation, minimum–maximum values, and frequency and percentage distributions. The suitability of the data for a normal distribution was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. As the assumption of normal distribution was not met, non-parametric methods were preferred for the analyses. The Wilcoxon Signed-Rank Test was used to compare paired measurements, whilst Spearman's correlation analysis was employed to examine relationships between variables. When the participants' demographic characteristics were examined, the mean age was 69.04±3.63 years, the mean height was 164.21±7.58 cm, the mean body weight was 81.82±9.81 kg, and the mean BMI was 30.40±4.81 kg/m^2.

Compared with the single-task condition, completion times significantly increased under both motor and cognitive dual-task conditions across all functional tests, indicating poorer performance. In the FSST measurement, significant differences were observed in both the motor dual-task ($Z=-4.623$, $p<0.001$) and cognitive dual-task ($Z= 4.623$, $p<0.001$) conditions. Similarly, significant differences were found in the 10-metre walk test under both motor and cognitive dual-task conditions ($Z=-4.623$, $p<0.001$). In the TUG test, significant differences were detected in both the motor dual-task ($Z=-4.623$, $p<0.001$) and cognitive dual-

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

task (Z=-4.509, p<0.001) conditions. Completion times increased across all functional tests under dual-task conditions, indicating poorer performance. Effect sizes were found to be high (r≈0.85–0.87).

When motor and cognitive DTCs were compared, a statistically significant difference was observed only for the FSST (Z=–2.277, p=0.023). When median values were examined, it was observed that the change in performance was higher under the motor dual-task condition. In contrast, no significant difference was found between motor and cognitive dual-task performance changes in the 10-metre walk test (Z=-0.888, p = 0.374) and the TUG (Z=-1.435, p=0.151) measurements.

No statistically significant correlations were observed among DTC values across the functional tests under either motor or cognitive dual-task conditions. A moderate correlation was found between the FSST and the 10-metre walk test (r=0.604, p=0.001). Similarly, significant correlations were found between the FSST and the TUG (r=0.471, p=0.011) and between the 10-metre walk test and the TUG (r=0.460, p=0.014). Under motor dual-task conditions, significant correlations were found between the FSST and the 10-metre walk test (r=0.502, p=0.007) and between the FSST and the TUG (r=0.570, p=0.002). In contrast, the relationship between the 10-metre walk test and the TUG was found to be statistically insignificant (r=0.370, p=0.053). In cognitive dual-task conditions, however, significant and positive correlations were found between all test pairs.

When examining the relationships between dual-task performance change values, no statistically significant relationship was found between the tests in either the motor or cognitive conditions. In motor dual-task performance changes, FSST and the 10-metre walk test (r=0.215, p=0.273), the FSST and the TUG (r=0.295, p=0.127), and between the 10-metre walk test and the TUG (r=0.144, p=0.465). Similarly, no statistically significant correlations were found in changes in cognitive dual-task performance. The correlation between the 10-metre walk test and the TUG was borderline (r=0.368, p=0.054), but did not reach the level of significance.

RESULTS

Compared with the single-task condition, completion times significantly increased under both motor and cognitive dual-task conditions across all functional tests, indicating poorer performance (p < 0.001; Table 2). Large effect sizes were observed for all comparisons, indicating a substantial impact of dual-tasking on functional performance.

Table 1. Descriptive statistics for participants

Variable	n	Min–Max	Mean ± SD
Age	28	65–77	69.04±3.63
Height (cm)	28	152.00–183.00	164.21±7.58
Body Weight (kg)	28	58–105	81.82±9.81
BMI (kg/m²)	28	22.94–43.70	30.40±4.81

Table 2. Comparison of single-task and dual-task performance

Measurement	Single-Task Median (Q1–Q3)	Motor Dual-Task Median (Q1–Q3)	Cognitive Dual-Task Median (Q1–Q3)	Z^1	p^1	Z^2	p^2
FSST (sec)	11.07 (10.14–11.82)	13.01 (11.92–13.93)	12.69 (11.75–13.64)	-4.623	<0.001	-4.623	<0.001
10-meter walk (sec)	9.55 (8.95–10.45)	11.10 (10.48–11.87)	11.22 (10.59–11.84)	-4.623	<0.001	-4.623	<0.001
TUG (sec)	13.74 (12.93–14.32)	16.00 (15.05–16.99)	15.77 (14.70–16.40)	-4.623	<0.001	-4.509	<0.001

Note: The Wilcoxon signed-rank test was used. p1: Comparison of single-task and motor dual-task performance; p2: Comparison of single-task and cognitive dual-task performance; FSST: Four Square Step Test; TUG: Timed Up and Go Test.

Comparison of motor and cognitive DTCs revealed a significant difference only for the FSST, with a greater DTC under the motor dual-task condition. No significant differences between motor and cognitive DTCs were observed for the 10-Meter Walk Test or the TUG (Table 3).

Significant positive correlations were observed among most functional tests under single-, motor dual-, and cognitive dual-task conditions, although the strength of these relationships varied across task conditions (Table 4).

The relationships among DTC values were evaluated using Spearman's correlation analysis. No statistically

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

Table 3.	Comparison of motor and cognitive dual-task costs (DTCs)			
Measurement	Motor DTC Median (Q1–Q3)	Cognitive DTC Median (Q1–Q3)	Z	p
FSST (%)	16.70 (9.63–21.82)	14.00 (7.61–21.73)	-2.277	0.023
10-meter walk (%)	16.32 (10.66–22.66)	16.16 (9.89–21.93)	-0.888	0.374
TUG (%)	17.23 (13.74–25.71)	14.51 (10.12–25.90)	-1.435	0.151

Note: The Wilcoxon signed-rank test was used. DTC: dual-task cost; FSST: Four Square Step Test; TUG: Timed Up and Go Test.

Table 4.	Inter-test correlation under single- and dual-task conditions		
Measurement	Single-Task (r, p)	Motor Dual-Task (r, p)	Cognitive Dual-Task (r, p)
FSST – 10 m	0.604 (0.001)	0.502 (0.007)	0.440 (0.019)
FSST – TUG	0.471 (0.011)	0.570 (0.002)	0.441 (0.019)
10 m – TUG	0.460 (0.014)	0.370 (0.053)	0.476 (0.010)

Note: Spearman correlation analysis was used.
FSST: Four-Square Step Test; TUG: Timed Up and Go Test;
r: Spearman correlation coefficient.

Table 5.	Correlations among motor and cognitive dual-task costs	
Measurement	Motor DTC (r, p)	Cognitive DTC (r, p)
FSST – 10 m	0.215 (0.273)	0.261 (0.180)
FSST – TUG	0.295 (0.127)	0.311 (0.107)
10 m – TUG	0.144 (0.465)	0.368 (0.054)

Note: Spearman correlation analysis was used.
DTC: dual-task cost; FSST: Four Square Step Test;
TUG: Timed Up and Go Test; r: Spearman correlation coefficient.

significant correlations were observed among motor or cognitive DTC values across the functional tests, suggesting that dual-task cost was task-specific rather than generalized (Table 5).

DISCUSSION

This study examined the effects of dual-task conditions on walking and balance in older adults with knee osteoarthritis; the findings indicate that dual-task load significantly and negatively affects motor performance (29-31). Dual-task conditions increased completion times across all functional tests, indicating a consistent and pronounced deterioration in performance (Table 2). These results cannot be adequately explained by age-related increases in cognitive load alone. Knee osteoarthritis leads to multilayered impairments in the sensorimotor system. Pain-related inhibitory mechanisms, quadriceps weakness, reduced joint stability, and, in particular, weakened proprioceptive feedback render motor control fragile. Therefore, the increased completion times observed under dual-task conditions, indicating poorer functional performance, may reflect the additional demands placed on an already compromised sensorimotor system (7,32-34). It also demonstrates that the dual-task effect does not manifest in the same way across all tests. The greater increase in FSST completion time under the motor dual-task condition than under the cognitive dual-task condition may be related to the complex structure of the test (Table 3), is thought to be related to the test's complex structure. The FSST requires rapid direction changes, multi-planar movement control, and instantaneous postural shifts. In knee osteoarthritis, such tasks are already challenging. This may be explained by impaired synchronization of periarticular muscles and the adoption of more protective postural control strategies(35) . It can be argued that adding a motor secondary task causes the system to reach its limits more quickly. Additionally, studies showing impaired dynamic balance and stability control in individuals with osteoarthritis support this finding (14,35,36).

The absence of significant differences between motor and cognitive tasks in walking tests (10-meter walk and TUG) suggests a distinct mechanism. In healthy individuals, walking is largely an automatic process; in knee osteoarthritis, however, this automaticity is significantly impaired. Adaptive gait patterns developed to avoid pain-such as shorter step length, increased double-support phase, and reduced speed transform walking into an activity requiring greater attention (35,37,38). Therefore, it is expected that both types of dual tasks would affect walking performance to a similar degree. This finding suggests that walking has already become a cognitively demanding process in individuals with osteoarthritis. Indeed, the literature emphasizes that dual-task walking performance is associated not only with motor capacity but also with executive functions and attention control (29,30,31,32).

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

The fact that relationships between tests are largely preserved (Table 4) indicates that functional mobility and balance performance are interrelated. However, the weakening of these relationships under dual-task conditions suggests that performance becomes more variable and individual-specific. In this process, not only physical capacity but also pain perception, avoidance behavior, and individual compensation strategies play a decisive role (2,32,42). Consequently, performance under dual-task conditions reflects the interplay of multiple factors rather than the output of a single system.

One of the notable findings of this study was the absence of significant correlations among DTC values across the functional tests (Table 5). This finding suggests that DTC is task-specific rather than a generalizable characteristic. An individual with a high DTC in one functional test may not necessarily exhibit a similarly high DTC in another test. This finding supports the contextual and task-dependent nature of motor control in osteoarthritis. The borderline correlation between cognitive DTC values for the 10-Meter Walk Test and the TUG may indicate a shared influence of cognitive load on walking-related performance; however, this association did not reach statistical significance. This can be explained by an increased reliance of walking on frontal cortical networks (29,39,40). When all findings are evaluated together, it becomes evident that dual-task performance in individuals with knee osteoarthritis is not one-dimensional. Performance varies depending on the type of task, task complexity, and the individual's neuromuscular capacity. The fact that motor load places a greater strain on balance, while cognitive load exerts a more systematic effect on walking, presents a clinically significant distinction (11,31). From a clinical perspective, single-task tests are still widely used in the assessment of individuals with knee osteoarthritis. This approach may not fully reflect daily living performance. Daily living activities typically involve multitasking, and true performance emerges under these conditions. Therefore, the use of dual-task protocols in fall risk assessments and rehabilitation planning may yield more realistic results. Additionally, exercise approaches targeting cognitive-motor integration have been reported to be effective in improving functional performance (19,20,42).

This study has several limitations. First, the cross-sectional design precludes causal inferences. Second, the relatively small sample size and the single-center setting may limit the generalizability of the findings to broader populations of older adults with knee osteoarthritis. Although participants were diagnosed according to the American College of Rheumatology (ACR) clinical criteria, radiographic disease severity (e.g., Kellgren–Lawrence grade), pain intensity, and disease duration were not assessed as potential factors influencing dual-task performance. Future studies should include larger, multicenter samples and incorporate these clinical characteristics to provide a more comprehensive understanding of dual-task performance in older adults with knee osteoarthritis.

Future studies using comprehensive models that simultaneously address pain, muscle strength, proprioception, and central nervous system interactions may provide a better understanding of dual-task performance in older adults with knee osteoarthritis.

CONCLUSION

Dual-task performance in older adults with knee osteoarthritis varies depending on the type of motor and cognitive dual-task. While motor tasks more significantly affect dynamic balance, cognitive tasks have a greater impact on walking performance. These results indicate that dual-task-based approaches should be considered in assessment and rehabilitation processes.

Acknowledgement: The authors would like to thank all participants for their voluntary participation in the study. This manuscript was prepared using preliminary data obtained from the first author's doctoral dissertation.

Ethical Approval: The study was approved by the Health Sciences Ethics Committee of Ankara Yıldırım Beyazıt University (decision no: 10/1009, date: 26 December 2024; study code: 2024-1009).

Author Contributions: Idea/Concept: M.O.F., E.D.; Design: M.O.F., E.D.; Supervision: E.D.; Resources: M.O.F.; Materials: M.O.F.; Data Collection and/or Processing: M.O.F.; Analysis and/or Interpretation: M.O.F., E.D.; Literature Review: M.O.F.; Written by: M.O.F.; Critical Review: E.D.

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

Conflict of Interest: The authors declare that there is no conflict of interest.

Financial Disclosure: The authors declare that they received no financial support for this study.

REFERENCES

1. Abramoff B, Caldera FE. Osteoarthritis: pathology, diagnosis, and treatment options. Med Clin North Am. 2020;104(2):293-311.
2. Katz JN, Arant KR, Loeser RF. Diagnosis and treatment of hip and knee osteoarthritis: a review. JAMA. 2021;325(6):568-79.
3. Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine. 2020;29:100587.
4. Daniel RA, Kalaivani M, Aggarwal P, Gupta SK. Prevalence of knee osteoarthritis among elderly persons in India: a systematic review and meta-analysis. J Family Med Prim Care. 2025;14(5):1675-84.
5. Cross M, Smith E, Hoy D, Nolte S, Ackerman I, Fransen M, et al. The global burden of hip and knee osteoarthritis: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis. 2014;73(7):1323-30.
6. Salmon JH, Rat AC, Sellam J, Michel M, Eschard JP, Guillemin F, et al. Economic impact of lower-limb osteoarthritis worldwide: a systematic review of cost-of-illness studies. Osteoarthritis Cartilage. 2016;24(9):1500-8.
7. Sharma L. Osteoarthritis of the knee. N Engl J Med. 2021;384(1):51-9.
8. Wojcieszek A, Kurowska A, Majda A, Liszka H, Gądek A. The impact of chronic pain, stiffness and difficulties in performing daily activities on the quality of life of older patients with knee osteoarthritis. Int J Environ Res Public Health. 2022;19(24):16815.
9. Zhu S, Qu W, He C. Evaluation and management of knee osteoarthritis. J Evid Based Med. 2024;17(3):675-87.
10. Beauchet O, Annweiler C, Dubost V, Allali G, Kressig R, Bridenbaugh S, et al. Stops walking when talking: a predictor of falls in older adults? Eur J Neurol. 2009;16(7):786-95.
11. Al-Yahya E, Dawes H, Smith L, Dennis A, Howells K, Cockburn J. Cognitive motor interference while walking: a systematic review and meta-analysis. Neurosci Biobehav Rev. 2011;35(3):715-28.
12. Tuena C, Borghesi F, Bruni F, Cavedoni S, Maestri S, Riva G, et al. Technology-assisted cognitive motor dual-task rehabilitation in chronic age-related conditions: a systematic review. J Med Internet Res. 2023;25.
13. Ali N, Tian H, Thabane L, Ma J, Wu H, Zhong Q, et al. The effects of dual-task training on cognitive and physical functions in older adults with cognitive impairment: a systematic review and meta-analysis. J Prev Alzheimers Dis. 2022;9(2):359-70.
14. Piche E, Chorin F, Gerus P, Jaafar A, Guerin O, Zory R. Effects of age, sex, frailty and falls on cognitive and motor performance during dual-task walking in older adults. Exp Gerontol. 2023;171:112022.
15. Gramani-Say K, Godoi-Jacomassi D, Polastri PF. Postural control and physical function in older adults with chronic musculoskeletal pain: effects of physical exercises and implications for activities of daily living. In: Locomotion and posture in older adults: the role of aging and movement disorders. Cham: Springer; 2025. p. 355-67.
16. Van Hove O, Pichon R, Pallanca P, Cebolla AM, Noel S, Feipel V, et al. Influence of speech and cognitive load on balance and Timed Up and Go. Brain Sci. 2022;12(8):1018.
17. Yildiz SE, Fidan O, Gulsen C, Colak E, Genc GA. Effect of dual-task training on balance in older adults: a systematic review and meta-analysis. Arch Gerontol Geriatr. 2024;121:105368.
18. Agmon M, Belza B, Nguyen HQ, Logsdon RG, Kelly VE. A systematic review of interventions conducted in clinical or community settings to improve dual-task postural control in older adults. Clin Interv Aging. 2014;9:477-92.
19. Gregory MA, Gill DP, Zou G, Liu-Ambrose T, Shigematsu R, Fitzgerald C, et al. Group-based exercise combined with dual-task training improves gait but not vascular health in active older adults without dementia. Arch Gerontol Geriatr. 2016;63:18-27.
20. Silsupadol P, Siu KC, Shumway-Cook A, Woollacott MH. Training of balance under single- and dual-task conditions in older adults with balance impairment. Phys Ther. 2006;86(2):269-81.
21. Abdallat R, Sharouf F, Button K, Al-Amri M. Dual-task effects on performance of gait and balance in people with knee pain: a systematic scoping review. J Clin Med. 2020;9(5):1554.
22. Levinger P, Nagano H, Downie C, Hayes A, Sanders KM, Cicuttini F, et al. Biomechanical balance response during induced falls under dual-task conditions in people with knee osteoarthritis. Gait Posture. 2016;48:106-12.
23. Lee S, Kim E, Duolikun D, Cha B, Ferre CL, Yücel M, et al. Prefrontal cortex function and gait alterations during single- and dual-task walking in knee osteoarthritis. PLoS One. 2025;20(9).
24. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. Arthritis Rheum. 1986;29(8):1039-49.
25. Podsiadlo D, Richardson S. The Timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8.

Turk J Clin Res. 2026;2(2):102-110
https://doi.org/10.63909/1453050

26. Liikavainio T, Bragge T, Hakkarainen M, Karjalainen PA, Arokoski JP. Gait and muscle activation changes in men with knee osteoarthritis. Knee. 2010;17(1):69-76.
27. 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.
28. Işık EI, Altuğ F, Cavlak U. Reliability and validity of Four Step Square Test in older adults. Turk J Geriatr. 2015;18(2):151-5.
29. Montero-Odasso MM, Sarquis-Adamson Y, Speechley M, Borrie MJ, Hachinski VC, Wells J, et al. Association of dual-task gait with incident dementia in mild cognitive impairment: results from the Gait and Brain Study. JAMA Neurol. 2017;74(7):857-65.
30. Montero-Odasso M, Verghese J, Beauchet O, Hausdorff JM. Gait and cognition: a complementary approach to understanding brain function and the risk of falling. J Am Geriatr Soc. 2012;60(11):2127-36.
31. Plummer P, Eskes G, Wallace S, Giuffrida C, Fraas M, Campbell G, et al. Cognitive-motor interference during functional mobility after stroke: state of the science and implications for future research. Arch Phys Med Rehabil. 2013;94(12):2565-74.e6.
32. Hinman R, Bennell K, Metcalf B, Crossley K. Balance impairments in individuals with symptomatic knee osteoarthritis: a comparison with matched controls using clinical tests. Rheumatology (Oxford). 2002;41(12):1388-94.
33. Øiestad BE, Juhl C, Eitzen I, Thorlund J. Knee extensor muscle weakness is a risk factor for development of knee osteoarthritis: a systematic review and meta-analysis. Osteoarthritis Cartilage. 2015;23(2):171-7.
34. Rice D, Nijs J, Kosek E, Wideman T, Hasenbring MI, Koltyn K, et al. Exercise-induced hypoalgesia in pain-free and chronic pain populations: state of the art and future directions. J Pain. 2019;20(11):1249-66.
35. Zeni JA Jr, Higginson JS. Differences in gait parameters between healthy subjects and persons with moderate and severe knee osteoarthritis: a result of altered walking speed? Clin Biomech (Bristol, Avon). 2009;24(4):372-8.
36. Levinger P, Menz HB, Morrow AD, Wee E, Feller JA, Bartlett JR, et al. Lower limb proprioception deficits persist following knee replacement surgery despite improvements in knee extension strength. Knee Surg Sports Traumatol Arthrosc. 2012;20(6):1097-103.
37. Favre J, Jolles BM. Gait analysis of patients with knee osteoarthritis highlights a pathological mechanical pathway and provides a basis for therapeutic interventions. EFORT Open Rev. 2016;1(10):368-74.
38. Mills K, Hunt MA, Ferber R. Biomechanical deviations during level walking associated with knee osteoarthritis: a systematic review and meta-analysis. Arthritis Care Res (Hoboken). 2013;65(10):1643-65.
39. Holtzer R, Wang C, Verghese J. Performance variance on walking while talking tasks: theory, findings, and clinical implications. Age (Dordr). 2014;36(1):373-81.
40. Mirelman A, Maidan I, Bernad-Elazari H, Nieuwhof F, Reelick M, Giladi N, et al. Increased frontal brain activation during walking while dual tasking: an fNIRS study in healthy young adults. J Neuroeng Rehabil. 2014;11:85.
41. Wallis J, Webster K, Levinger P, Taylor N. What proportion of people with hip and knee osteoarthritis meet physical activity guidelines? A systematic review and meta-analysis. Osteoarthritis Cartilage. 2013;21(11):1648-59.
42. Wollesen B, Voelcker-Rehage C. Training effects on motor-cognitive dual-task performance in older adults: a systematic review. Eur Rev Aging Phys Act. 2014;11(1):5-24.