

DUAL-TASK TRAINING IN GERIATRIC PHYSIOTHERAPY: IMPROVING BALANCE, MOBILITY, AND COGNITIVE- MOTOR FUNCTION

Manmeet Kaur Bhalla^{1*}

^{1*}Dean, School of Allied and Healthcare Professions, GRD Uttarakhand University, Dehradun,
Uttarakhand, India (*Corresponding Author)

Abstract

Ageing is accompanied by progressive changes in postural control, gait, muscle strength, sensory integration, attention, executive function, and the ability to manage simultaneous motor and cognitive demands. These changes become particularly important during everyday mobility because older adults frequently walk while talking, carrying objects, navigating obstacles, responding to environmental cues, or making decisions. Dual-task training (DTT), which combines a motor activity with a concurrent cognitive or secondary motor task, has therefore emerged as an important approach within geriatric physiotherapy. Unlike conventional single-task exercise, DTT attempts to reproduce the cognitive-motor demands encountered during real-world activities while progressively challenging balance, gait adaptability, attention, and executive control. Evidence from recent systematic reviews and meta-analyses indicates that DTT can improve dynamic balance, functional mobility, gait performance, and selected cognitive outcomes in older adults, although the magnitude of benefit varies according to intervention design, participant characteristics, task complexity, training dose, and outcome measures. DTT may be particularly relevant for individuals with increased fall risk, mild cognitive impairment, Parkinson's disease, frailty, and mobility limitations. However, DTT should complement rather than replace conventional strength, balance, gait, and aerobic exercise. This review examines the physiological and neurocognitive basis of DTT and discusses assessment, intervention design, progression, safety, fall prevention, technology-assisted rehabilitation, home-based applications, and future research directions in geriatric physiotherapy.

Keywords: Dual-Task Training, Geriatric Physiotherapy, Older Adults, Balance, Gait, Mobility, Cognitive-Motor Function, Falls, Postural Control, Executive Function, Rehabilitation

Introduction

Population ageing has increased the importance of rehabilitation strategies that address not only physical impairment but also the complex interaction between cognition and movement. Older adults frequently experience reductions in muscle strength, reaction speed, sensory integration, postural stability, gait adaptability, processing speed, attention, and executive function. These changes do not occur independently. Instead, they interact to influence the ability to perform safe and efficient mobility in complex environments. Walking is often considered an automatic motor behaviour, but real-world walking requires continuous attention. An older person walking through a busy hospital corridor may need to maintain balance, recognize obstacles, listen to instructions, communicate with another person, remember a destination, and adjust walking speed simultaneously. Similarly, shopping, crossing a road, carrying groceries, climbing stairs, or walking while using a mobile phone can require simultaneous cognitive and motor processing. Therefore, evaluating mobility only under simple single-task conditions may underestimate the challenges experienced during everyday life. Dual-task training has emerged from this concept. In its simplest form, DTT requires an individual to perform a primary motor task while simultaneously completing a secondary cognitive or motor task. Examples include walking while counting backward, standing while naming objects, stepping while responding to auditory cues, walking while carrying a cup, or negotiating obstacles while performing a memory task. The purpose is not simply to make exercise more difficult, but to train the nervous system to distribute attention and maintain movement quality when multiple demands occur simultaneously. Recent evidence supports this approach. A 2024 systematic review and meta-analysis found that DTT improved balance in healthy older adults compared with no intervention and also demonstrated benefits compared with other interventions (Yildiz et al., 2024). A larger 2025 systematic review and meta-regression involving 44 studies and 2,782 older adults reported improvements in dynamic balance and functional mobility and a reduction in fall frequency, although the certainty of evidence ranged from very low to moderate (Khan et al., 2025). Figure 1 illustrating the interaction between motor performance, cognitive processing, attentional resources, progressive task challenge, and functional mobility. The relevance of DTT extends beyond balance testing.

Cognitive-motor interference can influence gait speed, stride variability, turning, obstacle negotiation, and the ability to respond to unexpected environmental changes. Consequently, DTT may provide an important bridge between impairment-based physiotherapy and functional community rehabilitation. This review discusses the current role of DTT in geriatric physiotherapy, with emphasis on balance, mobility, cognitive-motor integration, falls, neurological conditions, frailty, technology, assessment, progression, and clinical implementation.



Figure 1. Conceptual framework of dual-task training in geriatric physiotherapy

Ageing and Cognitive-Motor Interaction

Successful mobility requires coordinated activity across the musculoskeletal, sensory, and central nervous systems. Visual information provides environmental information, vestibular inputs contribute to orientation, proprioceptive signals provide information regarding limb and joint position, while cortical and subcortical networks coordinate movement planning and execution. Ageing can reduce the efficiency of each of these systems. Muscle mass and strength may decline, sensory information may become less precise, reaction time may increase, and executive functions may become less efficient. Consequently, tasks that were previously automatic may require greater conscious attention. The addition of a second task can reveal these limitations. During single-task

walking, an older person may demonstrate a relatively normal gait speed. However, when asked to count backward or respond to questions simultaneously, gait speed may decline, stride variability may increase, or cognitive accuracy may deteriorate. This phenomenon is generally referred to as cognitive-motor interference. The magnitude of deterioration can be quantified as dual-task cost. A high dual-task cost indicates that performance changes substantially when a second task is introduced. Importantly, dual-task cost may affect either motor or cognitive performance. Some individuals prioritize walking and allow cognitive performance to deteriorate, whereas others maintain the cognitive task and demonstrate greater deterioration in gait. This variability is clinically important because it reflects individual strategies for managing limited attentional resources. DTT therefore attempts to improve the capacity to divide, shift, and prioritize attention during movement. Figure 2 showing how limited attentional reserve can influence gait speed, balance, cognitive accuracy, task prioritization, and environmental adaptability during simultaneous activities.

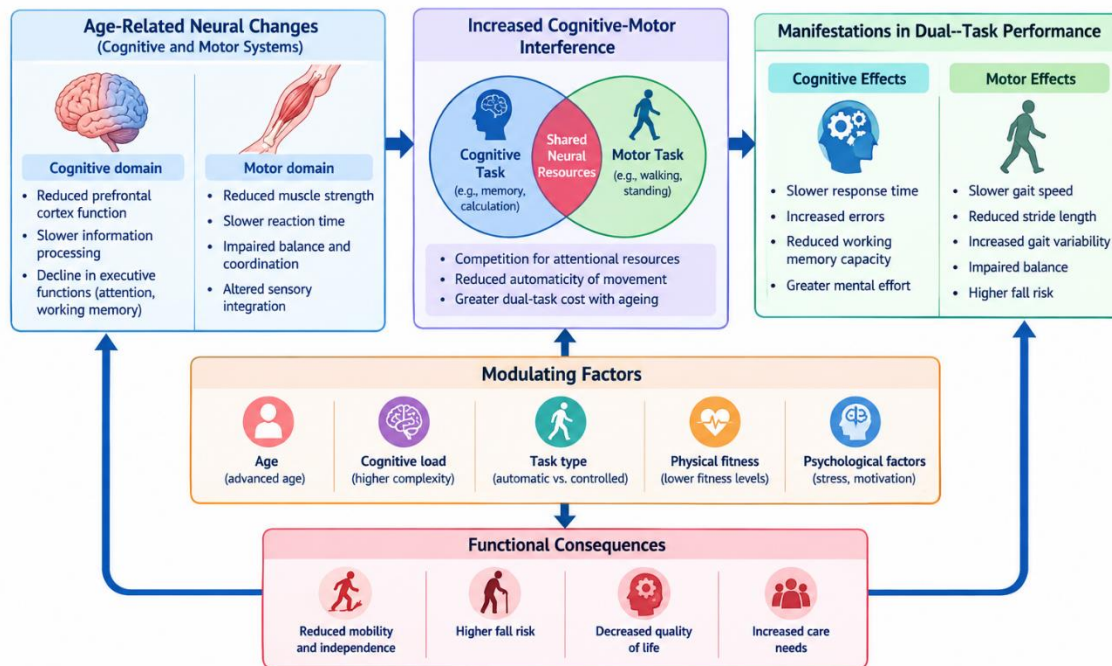


Figure 2. Proposed cognitive-motor interference model in ageing

Theoretical Basis of Dual-Task Training

Several theoretical concepts explain the rationale for DTT. The capacity-sharing model proposes that individuals have limited cognitive resources that must be distributed between simultaneous tasks. When the combined demands exceed available capacity, performance in one or both tasks declines. Another important concept is task prioritization. During challenging mobility, a person may consciously prioritize walking safety over the secondary task. This may be an appropriate strategy in situations where a fall would have serious consequences. However, excessive prioritization of gait may limit the ability to communicate or process environmental information. DTT can therefore be designed to train flexible attention. Initially, the therapist may instruct the patient to prioritize walking. Once stability improves, the therapist may ask the patient to shift attention between the motor and cognitive tasks. Automaticity is another important concept. Repeated practice can reduce the attentional requirements of familiar motor tasks. If walking becomes more automatic, cognitive resources can potentially be allocated to environmental monitoring and communication. Conversely, DTT may also improve the ability to consciously regulate gait when environmental conditions change. Neuroplasticity may contribute to these adaptations. Cognitive-motor training repeatedly activates networks associated with attention, executive function, motor planning, sensory integration, and postural control. Although the precise neural mechanisms remain incompletely established, systematic reviews have reported improvements in executive function following cognitive-motor interventions in older adults (Wollesen et al., 2020). Research examining brain activity during dual-task gait suggests that ageing and neurological disorders may alter the neural demands associated with simultaneous walking and cognitive processing (Kahya et al., 2019). DTT may therefore provide repeated practice of the neural integration required for real-world mobility.

Components of Dual-Task Training

DTT can be broadly divided into cognitive-motor and motor-motor approaches. Cognitive-motor DTT combines movement with a cognitive activity, whereas motor-motor DTT combines two physical activities. Common motor tasks include standing, weight shifting, stepping, walking, turning, sit-to-stand transfers, stair negotiation, and obstacle crossing. Cognitive tasks may involve arithmetic, verbal fluency, memory, categorization, response inhibition, reaction to auditory signals, or visuospatial processing. Simple cognitive tasks may include counting forward, naming animals, or answering basic questions. More complex activities can involve counting backward,

switching between categories, remembering sequences, or responding to unpredictable instructions. Motor-motor tasks may include walking while carrying an object, walking while manipulating a ball, stepping while transferring objects, or negotiating obstacles while carrying an item. These tasks can closely reproduce common daily activities.

Table 1. Examples of dual-task training activities and their principal therapeutic targets

Motor activity	Secondary task	Principal target
Standing	Counting	Attention and postural control
Weight shifting	Naming categories	Cognitive flexibility
Sit-to-stand	Object recall	Functional transfer and memory
Straight walking	Counting backward	Gait and divided attention
Walking with turns	Verbal response	Dynamic balance
Obstacle negotiation	Auditory response	Environmental adaptability
Walking while carrying an object	Conversation	Functional mobility
Stepping to targets	Rule switching	Motor planning and executive control

Task selection should be individualized. A person who has difficulty while carrying groceries may benefit from a motor-motor task, whereas an individual who becomes unstable while talking during walking may require cognitive-motor practice.

Effects of Dual-Task Training on Balance

Balance is one of the most frequently studied outcomes of DTT. Conventional balance training can improve postural control, but DTT adds a cognitive challenge that requires simultaneous processing. A 2024 systematic review and meta-analysis of healthy older adults concluded that DTT improved balance compared with no intervention and provided additional benefits in some comparisons with other exercise interventions (Yildiz et al., 2024). The findings are further supported by the 2025 systematic review by Khan et al., which included 44 studies and 2,782

participants. Significant improvements were observed in dynamic balance measured using instruments such as the Berg Balance Scale, although heterogeneity between studies was high and evidence quality varied (Khan et al., 2025). Balance improvement may result from multiple adaptations. Repeated simultaneous-task exposure may increase the efficiency of attentional allocation, improve anticipatory postural adjustments, and strengthen the ability to maintain stability when attention is divided. Figure 3 shows progression from stable standing and weight shifting to stepping, walking, turning, obstacle negotiation, and complex community mobility. DTT should nevertheless complement conventional balance exercise. The WHO recommends regular physical activity for older adults, including aerobic activity, muscle strengthening, and multicomponent activity emphasizing functional balance and strength (World Health Organization, 2020).



Figure 3. Progressive dual-task balance pathway

Effects on Gait and Functional Mobility

Gait is a complex behaviour involving temporal, spatial, cognitive, and sensory control. Ageing can result in slower gait speed, shorter stride length, increased variability, and reduced adaptability. When a cognitive task is added, these changes may become more pronounced. A systematic review

by Smith et al. (2017) demonstrated that cognitive dual-tasking can influence gait parameters in healthy older adults. The type and difficulty of the cognitive task influence the magnitude of gait change. Dual-task gait is particularly relevant because community mobility rarely occurs under laboratory-like conditions. Older adults must frequently walk while talking, carrying objects, monitoring the environment, or planning their next action. Intervention studies suggest that DTT can improve functional mobility. The 2025 meta-analysis by Khan et al. reported significant improvements in Timed Up and go performance following DTT, although the average improvement did not necessarily reach the commonly accepted minimal clinically important difference in every comparison (Khan et al., 2025). This distinction is important. Statistical improvement does not always equal clinically meaningful improvement. Physiotherapists should therefore combine standardized mobility measures with patient-reported functional goals.

Cognitive Function and Executive Control

Cognitive function plays a central role in mobility. Executive functions such as inhibition, working memory, planning, cognitive flexibility, and divided attention contribute to safe movement through complex environments. Cognitive-motor interventions may provide simultaneous stimulation of physical and cognitive systems. A systematic review and meta-analysis by Wollesen et al. (2020) reported beneficial effects of cognitive-motor training on selected executive functions in older adults. DTT may be particularly useful because the cognitive task is embedded within movement rather than being performed separately. This allows the therapist to observe how cognitive performance changes when physical demands increase. For example, a patient may successfully perform a verbal fluency task while sitting but make numerous errors while walking. The difference provides clinically useful information about cognitive-motor interference. However, DTT should not be regarded as a treatment that universally prevents dementia. Evidence supports improvements in selected cognitive domains and dual-task performance, but long-term prevention of cognitive disease requires much stronger evidence.

Dual-Task Cost as a Clinical Measure

Dual-task cost provides a useful method for quantifying cognitive-motor interference. It can be calculated using changes in gait speed, walking time, cognitive accuracy, or other performance measures.

A commonly used formula is:

$$\text{Dual-task cost (\%)} = [(\text{single-task performance} - \text{dual-task performance}) / \text{single-task performance}] \times 100$$

The formula should be adapted according to whether higher or lower scores indicate better performance. For example, if walking speed decreases substantially during a cognitive task, the resulting dual-task cost indicates that the cognitive activity has a measurable effect on locomotor performance. However, dual-task cost should not be interpreted in isolation. Task difficulty, hearing, vision, anxiety, fatigue, familiarity, medication, neurological disease, and learning effects may influence the result. Dual-task gait has been investigated as a potential indicator of cognitive impairment, although current evidence supports its use as an adjunctive assessment rather than as an independent diagnostic test (Ramírez et al., 2021).

Table 2. Recommended clinical outcomes for evaluating dual-task performance in geriatric physiotherapy

Domain	Single-task measure	Dual-task measure	Clinical significance
Gait	10-Meter Walk Test	Walking + counting	Divided-attention gait
Mobility	Timed Up and Go	Cognitive TUG	Functional mobility
Balance	Berg Balance Scale	Balance + cognitive task	Postural control
Stepping	Repetitive stepping	Stepping + response task	Adaptive balance
Cognition	Verbal fluency	Verbal task during walking	Cognitive-motor integration
Falls	Fall history	Dual-task mobility	Functional risk
Fear of falling	FES-I	Dual-task observation	Psychological influence

Dual-Task Training and Fall Prevention

Falls represent one of the major causes of loss of independence in older adults. Because many falls occur during complex activities rather than simple straight-line walking, DTT has considerable theoretical relevance to fall prevention. Older adults may fall while turning, carrying an object, responding to someone, walking over an obstacle, or negotiating a crowded environment. These situations require simultaneous motor and cognitive processing. Evidence from exercise research strongly supports balance and functional training for reducing falls. Sherrington et al. (2019) reported that exercise programmes reduce falls among community-dwelling older adults, particularly when they include balance and functional exercises. DTT adds cognitive complexity to this established approach. The 2022 review by Khan et al. proposed that improved attention shifting and task prioritization may contribute to the beneficial effects of DTT on balance and falls. More recent evidence is encouraging. Khan et al. (2025) found that DTT significantly improved dynamic balance and functional mobility and reduced fall frequency across the included studies, although the certainty of evidence was low to moderate and substantial heterogeneity remained. Figure 4 showing dual-task training alongside strength training, balance training, gait training, sensory management, medication review, environmental modification, and patient education. DTT should therefore be incorporated into a multifactorial fall-prevention programme rather than used as an isolated intervention.

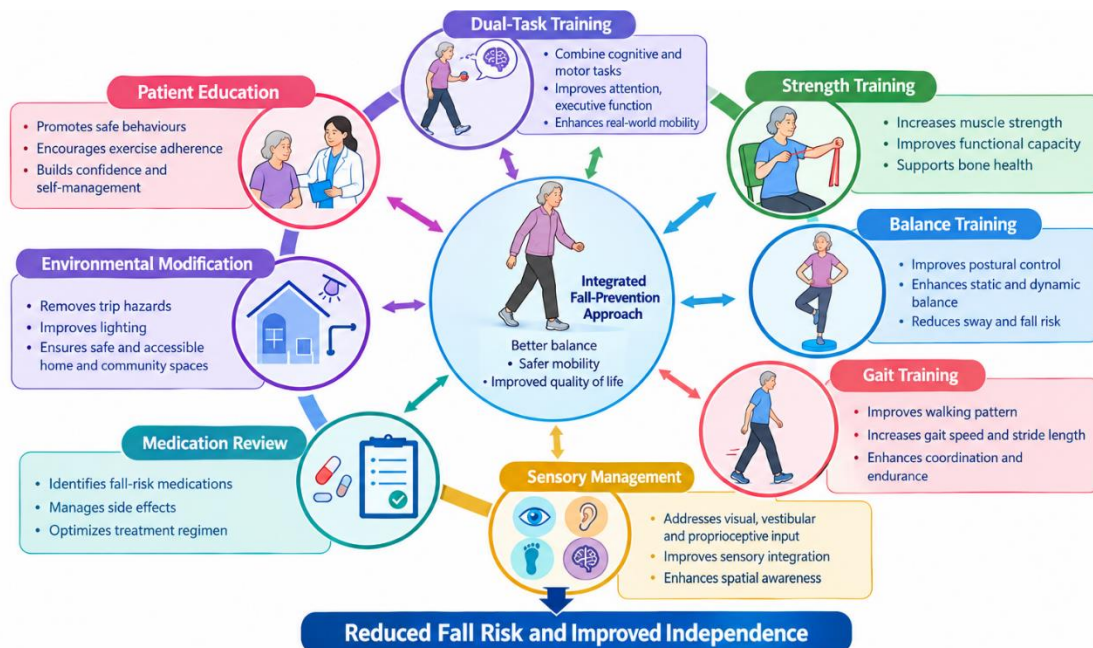


Figure 4. Integrated fall-prevention model showing

Dual-Task Training in Mild Cognitive Impairment and Dementia

Cognitive impairment increases the complexity of geriatric rehabilitation. Individuals with mild cognitive impairment or dementia may have difficulties with attention, memory, executive function, visuospatial processing, and motor planning. A systematic review and meta-analysis by Ali et al. (2022) reported that DTT can improve global cognition, memory, executive function, gait speed, dual-task cost, and balance in older adults with cognitive impairment. Similarly, Ye et al. (2024) reported beneficial effects of DTT on global cognition, executive function, working memory, and gait in older adults with cognitive impairment, although the authors emphasized the need for additional high-quality evidence. DTT for these individuals should be adapted to cognitive capacity. Instructions should be short and clear, tasks should be familiar, and progression should occur gradually. For a person with mild cognitive impairment, the therapist may use category switching or working-memory tasks during walking. For a person with more advanced dementia, simple object recognition, familiar songs, rhythmic movement, or basic response tasks may be more appropriate. Caregiver involvement can improve continuity and safety. Meaningful tasks may also enhance engagement. For example, walking while naming familiar family members or household objects may be more motivating than abstract arithmetic.

Dual-Task Training in Parkinson's Disease

Parkinson's disease is characterized by bradykinesia, gait dysfunction, postural instability, impaired automaticity, and, in some individuals, freezing of gait. Cognitive-motor interference can further compromise mobility. A systematic review and meta-analysis by Li et al. (2020) included 11 randomized controlled trials involving 322 individuals with Parkinson's disease and found evidence that DTT can influence gait, motor symptoms, and balance. DTT may include walking while counting, responding to external cues, changing direction, carrying an object, or navigating obstacles. Auditory or visual cues may be incorporated when clinically appropriate. However, safety is particularly important. A cognitively demanding activity may increase gait instability or freezing in some individuals. Therefore, DTT should initially be performed under close supervision, with appropriate environmental support. The progression should follow the patient's

clinical status. A person with frequent freezing may first require cueing strategies and gait-specific training before more complex dual-task activities are introduced.

Dual-Task Training in Frailty

Frailty is characterized by reduced physiological reserve and increased vulnerability to stressors. Frail older adults may have muscle weakness, slow gait, fatigue, reduced activity, cognitive impairment, and high fall risk. DTT may be beneficial, but frail individuals require careful progression. A highly challenging dual task introduced too early may increase instability and fear.

An appropriate progression may begin with seated cognitive-motor activities, followed by supported standing, independent standing, stepping, slow walking, and finally community-oriented tasks. The therapist should monitor fatigue and ensure adequate recovery between tasks. DTT should complement strength training because low muscle capacity can limit the ability to perform more advanced mobility activities.

Intervention Dose and Progression

There is no single universally accepted DTT protocol. Intervention studies differ in session duration, frequency, task complexity, intensity, supervision, and programme length. The 2025 meta-regression by Khan et al. provides useful preliminary information. Dynamic balance benefits were associated with approximately 30-minute sessions performed three times per week with moderate intensity and challenge, while functional mobility improvements were associated with longer sessions and longer intervention periods. However, these findings represent study-level associations rather than a universal prescription for every older adult. Progression can occur through several dimensions:

1. Increasing cognitive complexity.
2. Increasing motor complexity.
3. Increasing walking speed.
4. Reducing external support.
5. Introducing turns.
6. Adding obstacles.

7. Increasing environmental variability.
8. Introducing unpredictable cues.
9. Changing task priority.
10. Increasing community relevance.

Table 3. Practical progression framework for dual-task training in geriatric physiotherapy

Level	Motor challenge	Cognitive challenge	Example
1	Supported standing	Simple naming	Name three fruits
2	Independent standing	Counting	Count forward/backward
3	Weight shifting	Verbal fluency	Name animals while shifting
4	Stepping	Auditory response	Step according to commands
5	Straight walking	Counting	Walk while counting
6	Walking with turns	Category switching	Change categories during walking
7	Obstacle walking	Memory task	Remember and repeat sequence
8	Community simulation	Multiple cues	Walk, converse, and avoid obstacles

Task Prioritization and Attention Shifting

Task prioritization is a fundamental element of DTT. Older adults may use different strategies when confronted with simultaneous demands. A therapist may initially instruct the patient to prioritize walking safety. As stability improves, the patient may be asked to divide attention more equally between the two tasks. Variable-priority training may be particularly relevant to real-world situations because the priority changes according to environmental conditions. For example, when crossing a road, traffic information must receive priority. In a conversation while walking in a familiar hallway, walking may require less conscious attention. Trombini-Souza et al. (2023) examined different DTT protocols in community-dwelling older adults and demonstrated that different approaches can influence gait, balance, cognitive function, and health-related outcomes. The clinical aim should therefore be flexible attention rather than simply improving performance on one repeated task.

Technology-Assisted Dual-Task Training

Technological developments have expanded the possibilities for DTT. Virtual reality, interactive screens, wearable sensors, instrumented treadmills, motion capture systems, and gaming platforms can provide adjustable cognitive and motor challenges. Virtual reality can simulate environments such as streets, supermarkets, parks, or crowded corridors. A therapist can manipulate obstacles, visual information, auditory signals, and task complexity. Technology can also provide objective feedback. Wearable sensors may measure step variability, gait speed, turning, acceleration, and changes in performance under dual-task conditions. Figure 5 showing baseline assessment, individualized task selection, real-time feedback, progressive cognitive-motor challenge, performance monitoring, and transfer to home and community mobility. Technology should nevertheless complement rather than replace therapist judgement. Older adults may experience difficulties with unfamiliar interfaces, visual complexity, cybersickness, or digital literacy. The intervention should therefore remain clinically meaningful and patient-centred.

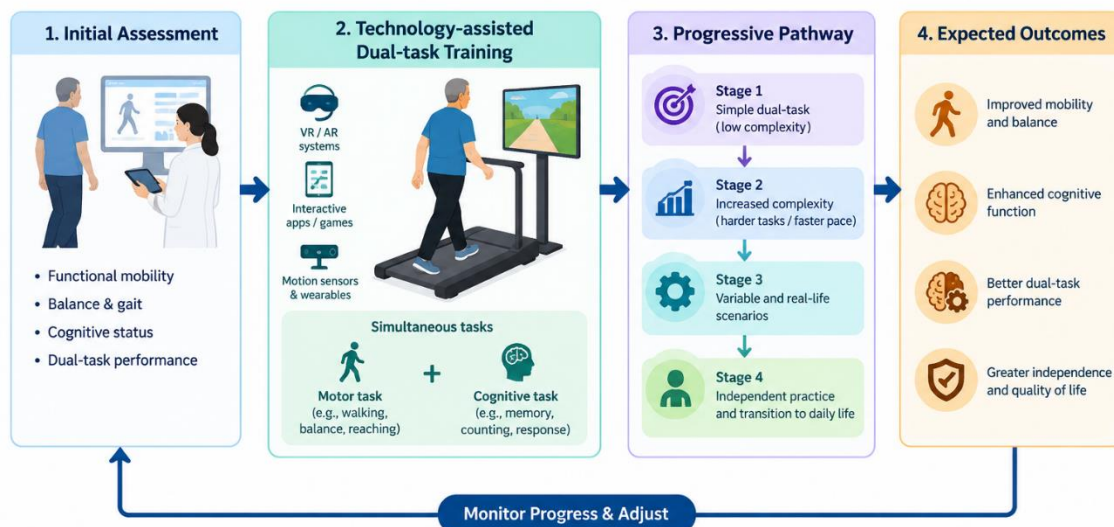


Figure 5. Technology-assisted dual-task rehabilitation pathway

Neurophysiological Mechanisms

DTT probably produces benefits through multiple interacting mechanisms. First, repeated movement practice can improve neuromuscular coordination and postural control. Second, cognitive tasks challenge attention and executive control. Third, simultaneous practice may improve the ability to allocate resources between motor and cognitive activities. Sensory

integration is another important mechanism. Walking requires continuous integration of visual, vestibular, and proprioceptive information. When attention is simultaneously directed toward a cognitive task, conscious monitoring of movement may decrease. Repeated DTT may therefore encourage more efficient integration and greater motor automaticity. Anticipatory postural control may also improve. Carrying an object while walking or changing direction requires prediction of changes in the center of mass. Repeated practice may improve anticipatory adjustments. Neural adaptation is another possibility. Kahya et al. (2019) reviewed brain activity during dual-task gait and balance and highlighted differences in neural recruitment associated with ageing and neurological disease. These findings support the concept that cognitive-motor training may influence the neural networks responsible for attention and movement.

Relationship Between DTT and Conventional Physiotherapy

DTT should not replace conventional physiotherapy. Instead, it should be incorporated into a comprehensive programme. A geriatric physiotherapy programme may include:

- Progressive resistance training.
- Lower-limb strengthening.
- Static and dynamic balance.
- Gait retraining.
- Aerobic exercise.
- Flexibility training.
- Transfer practice.
- Stair training.
- Sensory integration.
- Functional activity training.
- Dual-task practice.

The WHO recommends that older adults undertake regular physical activity, including 150–300 minutes of moderate-intensity aerobic activity per week or an equivalent combination, along with muscle-strengthening and multicomponent balance-focused activities (World Health Organization, 2020). DTT should therefore be integrated into a broader exercise programme rather

than viewed as a standalone substitute. For example, a patient with severe quadriceps weakness may first require resistance training before advanced walking-based DTT can be performed safely.

Clinical Assessment Before DTT

Comprehensive assessment should precede DTT. Important components include:

- Medical history.
- Fall history.
- Medication review.
- Gait assessment.
- Balance testing.
- Lower-limb strength.
- Functional mobility.
- Cognitive screening where appropriate.
- Vision and hearing.
- Fear of falling.
- Cardiovascular tolerance.
- Assistive-device requirements.

Baseline single-task and dual-task performance should be recorded. Common assessments include the 10-Meter Walk Test, Timed Up and Go, Berg Balance Scale, Functional Reach, Five Times Sit-to-Stand, and selected cognitive measures. A cognitive task can be added to the Timed Up and Go to examine dual-task mobility. However, the therapist should document both motor and cognitive outcomes. A patient who walks faster but makes substantial cognitive errors may not demonstrate meaningful cognitive-motor improvement. Conversely, a patient whose gait speed remains stable while cognitive accuracy improves may demonstrate better divided-attention capacity.

Safety Considerations

Safety is fundamental because cognitive loading can temporarily reduce motor performance. Important precautions include:

- Beginning with simple tasks.
- Providing appropriate supervision.
- Using stable support when required.
- Maintaining a safe environment.
- Monitoring fatigue.
- Avoiding excessive cognitive complexity initially.
- Using assistive devices appropriately.
- Progressing one major challenge at a time.
- Monitoring gait deterioration.
- Considering cardiovascular and neurological limitations.

The therapist should avoid deliberately destabilizing the patient. The purpose of DTT is controlled exposure to cognitive-motor challenge, not uncontrolled risk. The World Guidelines for Falls Prevention emphasize individualized exercise and appropriate progression according to functional capacity and clinical status. DTT should be implemented within this broader safety framework.

Home-Based and Community-Based DTT

Home-based DTT may increase accessibility and facilitate transfer into everyday activities. Simple exercises can include walking while naming objects, stepping while responding to instructions, walking while carrying a light object, or performing a simple memory task during movement. However, the home environment must be assessed carefully. Tasks involving turning, obstacles, or carrying objects should be introduced only when the patient can perform them safely. A major challenge is transfer. Improvement on a repeatedly practiced task does not necessarily mean that the patient will automatically perform better in a novel environment. Therefore, home programmes should vary task conditions. Community-based training may include simulated shopping, hallway navigation, carrying groceries, walking while talking, negotiating obstacles, and changing direction. The ultimate goal is functional transfer rather than performance on a single standardized exercise.

DTT and Fear of Falling

Fear of falling can create a cycle of activity restriction, deconditioning, weakness, reduced confidence, and further mobility limitation. DTT may help break this cycle by exposing individuals gradually to challenging but controlled situations. Successful completion of progressively difficult tasks may improve confidence. However, cognitive challenge should not be introduced at the expense of psychological safety. Individuals with severe fear of falling may initially require conventional balance training before progressing to complex dual-task activities. The therapist should monitor perceived confidence as well as objective performance. Measures such as the Falls Efficacy Scale International can complement physical assessments.

DTT and Functional Independence

The ultimate purpose of geriatric physiotherapy is to preserve independence and participation. A patient may improve on a balance test but remain unable to perform meaningful activities independently. DTT should therefore be linked to personal goals. For one individual, the goal may be walking to a nearby shop while carrying a bag. For another, it may be walking while speaking with a spouse. For another, it may be safely navigating a crowded hospital corridor. This patient-centred approach increases ecological validity and makes rehabilitation more meaningful. Functional activities can also be used to determine whether improvements transfer outside the treatment environment.

DTT in Community-Dwelling Older Adults

Community-dwelling older adults represent an important target population because they encounter variable environments and unpredictable demands. A person living independently may need to walk over uneven ground, cross streets, enter shops, carry groceries, use stairs, talk to other people, and respond to unexpected obstacles. These demands are difficult to reproduce through single-task exercise alone. DTT provides a structured method for introducing progressively complex conditions. The 2025 evidence synthesis suggests that DTT can improve dynamic balance and functional mobility in older adults, although the authors emphasize heterogeneity and varying evidence quality (Khan et al., 2025). Consequently, therapists should individualize the programme and monitor whether changes translate into meaningful daily activities.

Limitations of Current Evidence

Despite increasing research interest, several limitations remain in the current evidence on dual-task training. First, DTT interventions are heterogeneous, with substantial differences in task type, duration, frequency, intensity, progression, supervision, and outcome measures. Second, participant characteristics vary considerably, and healthy older adults, frail individuals, people with mild cognitive impairment or dementia, and individuals with Parkinson's disease cannot be considered a homogeneous population. Third, many studies have relatively small sample sizes; although Yildiz et al. (2024) included 14 studies and Khan et al. (2025) included 44 studies, substantial statistical heterogeneity was still observed. Fourth, the evidence regarding fall reduction remains less certain than the evidence for improvements in balance and mobility, and although some recent findings suggest reduced fall frequency, the overall quality of evidence is not consistently high. Fifth, the optimal training dose remains uncertain, and dosage estimates derived from meta-regression should therefore be considered preliminary guidance rather than rigid clinical prescriptions. Sixth, long-term retention and transfer of training effects remain important unanswered questions, as improvements may be greater for tasks that closely resemble the activities practiced during rehabilitation. Finally, cognitive outcomes are assessed using a wide range of measures and protocols, highlighting the need for standardized assessment methods to improve comparisons across studies and strengthen the evidence base for DTT in geriatric physiotherapy.

Future Research Directions

Future studies should establish more standardized descriptions of DTT. Researchers should report the motor task, cognitive task, task difficulty, progression strategy, intervention frequency, session duration, adherence, supervision, and safety outcomes. Long-term follow-up is also necessary. Future research should examine whether improvements remain after supervised treatment ends. Wearable sensors may provide objective information about real-world mobility. Smartphone-based systems may allow monitoring of gait and activity outside the clinic. Virtual reality may facilitate standardized community simulations, although ecological validity and accessibility require further investigation. Personalized DTT represents another promising direction. Sensor-based systems could potentially modify cognitive or motor difficulty according to real-time performance. Future research should also compare DTT with high-quality conventional multicomponent exercise rather than only inactive controls. The most clinically meaningful

question is whether adding DTT to established geriatric physiotherapy produces additional improvements in mobility, independence, and fall prevention.

Practical Clinical Model

A practical DTT programme can be divided into five stages.

Stage 1: Assessment. Determine baseline strength, balance, gait, cognition, dual-task cost, fall history, and fear of falling.

Stage 2: Preparation. Address basic strength, balance, gait, and transfer limitations.

Stage 3: Introduction. Add a simple cognitive or motor task to a stable movement.

Stage 4: Progression. Increase cognitive complexity, motor difficulty, environmental variability, and task switching.

Stage 5: Functional transfer. Practice meaningful home and community activities.

This progression prevents the common mistake of introducing complex dual-task activities before the patient has adequate single-task capacity. The choice of secondary task should also reflect the patient's real-world problems. A person who loses balance while carrying objects may require motor-motor DTT, whereas a person who becomes unstable while talking may require cognitive-motor training.

Conclusion

Dual-task training represents an important and increasingly relevant component of geriatric physiotherapy because everyday mobility rarely occurs under single-task conditions. Older adults must frequently walk while talking, carrying objects, navigating obstacles, remembering information, monitoring traffic, or responding to environmental cues. Age-related changes in balance, gait, sensory integration, attention, executive function, and muscle strength can make these simultaneous activities increasingly difficult. Current evidence indicates that DTT can improve selected measures of dynamic balance, functional mobility, gait, and cognitive-motor

performance. Recent systematic reviews and meta-analyses provide supportive evidence for balance and mobility benefits, although heterogeneity and limitations in evidence quality remain important considerations. DTT may also have applications in individuals with mild cognitive impairment, dementia, Parkinson's disease, frailty, and increased fall risk. Nevertheless, it should not replace conventional strength, balance, gait, aerobic, and functional training. The most appropriate approach is individualized progression. Physiotherapists should first establish adequate single-task ability, introduce manageable cognitive or motor challenges, progressively increase complexity, and ultimately transfer the skills into meaningful home and community activities. The future of DTT is likely to involve personalized exercise prescription, wearable sensors, virtual reality, real-world gait monitoring, and increasingly sophisticated methods of measuring cognitive-motor interference. High-quality longitudinal research is required to determine whether improvements in clinic-based dual-task performance translate into sustained reductions in falls and greater independence. Overall, DTT provides geriatric physiotherapists with a clinically relevant framework for training the interaction between cognition and movement. By incorporating attention, executive control, balance, gait, and environmental adaptability into a progressive rehabilitation programme, DTT can help address the complex demands of mobility in later life.

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