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IMPACT OF DUAL-TASK TRAINING ON COGNITIVE FUNCTION, BALANCE, GAIT AND QUALITY OF LIFE IN PATIENTS WITH PARKINSON'S DISEASE: A NARRATIVE REVIEW

Physiotherapy

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ABSTRACT

Background: Parkinson's disease affects the central nervous system which is progressive in nature, characterized by cardinal motor symptoms rigidity, bradykinesia, tremor, postural instability, and non-motor symptoms. Parkinson's disease occurs due to the degeneration of dopaminergic neurons that produce dopamine in the basal ganglia. Patients with Parkinson's disease can be identified by their bent posture, expressionless, mask-like face, drooling lips, pills rolling in their fingers, and stiff, shuffling gait. **Study Selection:** This narrative review is conducted on databases from PubMed, Google Scholar, and ResearchGate. **Conclusion:** Dual-task interventions hold promise as a therapeutic approach to address gait impairments and potentially enhance cognitive function in individuals with Parkinson's disease. Task-specific training targeting gait prioritization, balance with cognitive tasks, and integrated dual-task training have demonstrated promising results in improving dual-task abilities, gait performance, and balance control in individuals with PD.

KEYWORDS

Dual-task training, Parkinson's disease, Gait, cognitive functions, balance, Quality of life.

INTRODUCTION

Parkinson's disease is a degenerative neurological condition with numerous motor and non-motor symptoms that can influence on function by varying degrees.[1] About 1-2 people out of every 1000 people suffer from Parkinson's disease (PD). Around 60 years of age, 1% of people have Parkinson's disease (PD), which is more common as people age.[2] In unselected populations, monogenetic variants of Parkinson's disease are most likely uncommon, but they might be common in specific ethnic groups. Typically, 5–10% of cases are assumed to have hereditary components; however, this number may be higher. The first signs and symptoms are frequently slowness in carrying out daily tasks as well as sluggish movement and reaction times. Unilateral tremors usually occur at a frequency of 4 to 6 Hz and are most noticeable in the distal portion of an extremity. Supination-pronation, or "pill-rolling," tremors. In people with Parkinson's disease (PD), rest tremor can also affect the lips, chin, jaw, and legs. Rigidity occur commonly in flexor muscles of neck, trunk, limbs leads to flexed posture.[1] Parkinson's diseases causes gait abnormality of individual with slow speed of walking, short strides length, reduced arm swing, shuffling of gait and freezing of gait leads to increase risk of fall in patients.[4] It is diagnosed on the basis of clinical criteria having cardinal symptoms and response to levodopa. Pathological confirmation by presence of lewy bodies. However, Parkinson's patients also have an increase in gait and incorrect posture in addition to these treatments, which increases the patient's disability.[5] Patients with Parkinson's disease get better symptoms after rehabilitation. Resistance training is one way to strengthen and enhance gait performance.[5] Dual task training is one method of treating Parkinson's disease's motor and cognitive symptoms. It involves performance of two individual task at the same time like solving arithmetic questions while walking.[3] Primary balance tasks like walking and standing on one foot are included in dual task training. Secondary motor tasks include holding a cup or moving one's head, while memory tasks include addition, subtraction, and word recall.[6] Dual task training helps Parkinson's patients manage their balance, gait, and cognitive issues by combining their motor and cognitive systems.[3] Communicating and moving objects while walking both benefit from dual task performance. It also reduces chances of fall due to balance impairment while performing dual task at the same time.[7] When two jobs are completed at once, the performance of the first task is generally reduced this is called dual task cost. On the other hand, dual tasking can be trained in physical therapy to improve general function while lowering dual task costs.[8] Neuroplasticity is the ability of our brains to reorganize and change. Specificity is one of the principles of neuroplasticity: we must train and practice in the exact manner in which we intend to carry out an activity.[9]The possible mechanism involved in the dual task effect on motor learning could be related to the neural activation facilitated by the secondary task.[10] Neural activation is correlated with the difficulty of the dual task, so the more difficult the dual task is during practice the more active the neuronal areas required to perform the task.[11]

METHOD: Studies are searched from the following search engine Pubmed, Google scholar, Research Gate. Studies include that investigate effect of dual task training in patients with Parkinson's disease.

DISCUSSION

Brauer et al. (2009) investigated whether individuals with PD could improve dual-tasking while walking through a 20-minute training session. Their results suggest that training led to improvements in gait performance, particularly in step length and gait speed, under various dual-task conditions. This emphasizes how task-specific training may improve PD patients' ability to multitask. Fok et al. (2010) focused on prioritizing gait in dual-task conditions among individuals with PD. Their study revealed immediate improvements in stride length and gait speed following instructions to prioritize attention to taking bigger steps. Moreover, these improvements were sustained even 30 minutes after training, indicating the potential for lasting effects of focused gait training in PD. Fernandes et al. (2014) in this pilot study examined the effects of dual-task training on balance and executive functions in PD. They found superior outcomes for dual-task training compared to single-task training in improving static postural control. This suggests that incorporating cognitive tasks into balance training may offer additional benefits for individuals with PD. Salazar et al. (2017) investigated the cognitive consequences of dual-tasking while walking in PD. Their results indicate significant effects on cognition and walking for both PD and control groups. This highlights the interconnectedness of cognitive and motor functions in PD and the need for interventions targeting both domains. Geroin et al. (2018) the DUALITY trial compared the effects of consecutive versus integrated dual-task training on spatiotemporal gait parameters in PD. Both groups showed significant improvements in stride length and cadence under both single and dual-task conditions, with these improvements sustained at follow-up. This suggests that both training approaches can be effective in enhancing gait performance in PD.

CONCLUSION:

Overall, the reviewed studies provide valuable insights into the effects of dual-task interventions on gait and cognition in PD. Task-specific training targeting gait prioritization, balance with cognitive tasks, and integrated dual-task training have demonstrated promising results in improving dual-task abilities, gait performance, and balance control in individuals with PD.

Authors, Journal, Year	Objectives	Design	Material and Methods	Outcomes Measures	Results

Sandra G. Brauer et al 200912	Can people with Parkinson's disease improve dual tasking when walking?	Experimental study design	Participants performed a series of 10 m walking trials under seven conditions: gait only, and with six different added tasks (e.g. motor, cognitive), domain gait performance under single and six dual task conditions was tested at baseline and immediately after one 20-min training session.	GAITRite-1 electronic walkway measure- step length (m), step length co-efficient of variation(CV), gait speed (m/s), cadence (steps/min) and double support time (s) Added task measurement (time taken/no. of correct responses	step length increased when performing five of the six added tasks, indicating transfer of dual task training when walking occurred across task types and domains. Improvements in gait speed occurred in three of the six added tasks, step length variability, few improvements were found.
Pamela Fok., et al (2010)13	Prioritizing gait in dual-task conditions in people with Parkinson's.	non-randomized mixed design	They divided patients in training group (n=6) and control group (n=6). Participants in the training group received 30-min therapy to prioritize their attention to take big steps while performing serial three subtractions. Participants in the control group received no therapy.	Stride length (m) and gait speed (m/s) measured with GAITRite System Accurate enumeration rate for cognitive task measured by GAITRite mat (f/s)	No difference in the accurate enumeration rate
Angela Fernandes et al.201414	Effects of dual-task training on balance and executive functions in Parkinson's disease: A pilot study	A pilot study	The training done twice a week for 6 weeks. The single-task group (balance training) dual-task group (cognitive tasks simultaneously with the balance training) All measurement done at baseline and after the intervention for all participants by a clinician who was blinded to the participant's group.	Time Up and Go (TUG) test, Unified Parkinson's Disease Rating Scale-part III (UPDRS-III), Pressure platform	The results suggest superior outcomes for the dual-task training compared to the single-task training for static postural control, except in anteroposterior sway with eyes closed.
Robert D. Salazar., et al (2017)15	Dual tasking in Parkinson's Disease: cognitive consequences while walking	Experimental study design	Executive function (set-shifting) and walking were assessed singly and during dual tasking	The measure of cognition (executive function, TMT-B) The measures of gait were for walking speed, stride length, and stride frequency, Walking speed (meters per second)	Result shows significant effect on cognition (decreases set-shifting) and on walking (speed, stride length) for both Parkinson's and normal control group people and stride frequency only on Parkinson's patients
Christian Geroin et al 201816	Does dual-task training improve spatiotemporal gait parameters in Parkinson's disease?	the DUALITY trial is a single-blind, randomized, controlled trial (RCT)	Randomly assigned to Consecutive group (n = 65) (cognitive and gait tasks were trained separately) Integrated group (n = 56) (cognitive and gait tasks were trained simultaneously) Both groups received 24 in-home physiotherapy sessions for six consecutive weeks	Two baseline measurements were performed during a six-week control period prior to the interventions. Gait was evaluated under three different (and untrained) dual-task conditions immediately after the treatment period and at 12-week follow-up	A significant post-training increase in stride length ($P < .001$) and cadence ($P < .001$) was found under both the single and the dual-task conditions.
Niklas Löfgren 2018 et al17	The Effects of Integrated Single- and Dual-Task Training on Automaticity and Attention Allocation in Parkinson's Disease	A Secondary Analysis From a Randomizd Trial	Randomizd to 10 weeks of challenging gait and balance training (including single and dual-task conditions) or to a control group (care as usual).Three 60-min training sessions per week for 10 weeks The training period was divided into three blocks (A, B, and C). In Block A (Weeks 1–2), single-task exercises, Block B (Weeks 3– 6), dual-task exercises, In Block C (Weeks 7–10), the difficulty level and the variation was increased by combining training components	Gait performance - The GAITRite system include five domains: pace, rhythm, variability, asymmetry, postural control The cognitive parameters used were cognitive performance, cognitive variability	The results indicate that challenging training can improve automaticity of cognitive processing during walking. This may have a beneficiary effect on the ability to ambulate safely in the community, thereby improving independence and the quality of life in this population

Yea-Ru Yang et al.20191 8	Cognitive and motor dual task gait training exerted specific training effects on dual task gait performance in individuals with Parkinson's disease	A randomized controlled pilot study	Randomization in three groups 1.Control group n=6 (general gait training) 2.CDTT group n=6 (cognitive dual task gait training) 3. MDTT group n=6 (motor dual task gait training) The training was 30 min each session, 3 sessions per week for 4 weeks	Gait parameters were recorded by a GAITRite system, including speed, cadence, stride length, double support time, and stride time variability, The secondary outcomes included timed up and go test (TUG), freezing of gait (FOG), and fall efficacy scale-international (FES-I)	Result showed that 12- session of CDTT decreased double support time during cognitive dual task walking, and MDTT reduced gait variability during motor dual task walking. Different training strategy can be adopted for possibly different training effects in people with PD

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