

“EFFECTS OF SINGLE TASK TRAINING VERSUS DUAL TASK TRAINING ON BALANCE PERFORMANCE AND COGNITION AMONG OLDER ADULT”

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ABSTRACT

Objective: The objective of current study was to determine the effects of single task training versus dual task training on balance performance and cognition among older adult.

Methodology: The randomized control trail (IRCT20210909052419N1) included 63 participants. Participants were randomly divided into two groups: single task training group and dual task training group. Convenient sampling technique was used for enrollment of participants. The inclusion criteria were adults of age 50 years and above, able to ambulate independently walk without assistive devices, Mini-Mental State Examination (MMSE) score between 18 to 23 and score less than 50 on Berg balance scale. Participant who had recent history of fall within one year, unstable medical condition, significant visual and auditory impairments, Presence of other neurological or musculoskeletal conditions affecting balance, unwillingness for participation in the study were excluded. Demograph were recorded and assessment was done at baseline and after 8 weeks using Berg balance scale (BBS), Time up and Go test (TUG), MMSE and MoCA. Participants of both groups performed the training 3 days a week for up to 8 weeks; 5 minutes warm up followed by 30 to 35 minutes training session and 5 minutes cool down.

Results: The mean age of participants was 64.05±4.046. Inter group analysis showed significant improvement $p<0.05$ in BBS, TUG, MMSE and scores of MoCA. Within group analysis showed significant improvement in dual task training group whereas no significant improvements were in participants performing single task training activities.

Conclusion: The study suggested that dual task training program thrice weekly for eight weeks improve balance and cognition in older adults.

Key words: Older adults, Dual task, Cognition, Montreal Cognitive Assessment, Balance, Sustainable Development Goal 3

INTRODUCTION:

Aging is a complex and multifaceted process that involves age-dependent deterioration in survival and reproductive rates, leading to a decline in physiological function. In human beings, it manifests as a multidimensional process of physical, psychological, and social change (1). Globally, countries are facing an increase in the extent and number of elder populations. Among the huge social changes of the twenty-first century, increase number of elderly population is causing economic and social burden e.g., increase demand for goods and services, housing etc. (2). It is reported that older adults cover 9 % of global population, which is expected to rise up to 16 % in future. It is expected that the number of persons 65 years and older will rise up to 7% which is currently 18% in developed countries, in comparison to underdeveloped countries where the percentage of older persons 65 years and above is expected to increase up to 14 % (3). Pakistan is ranked as 6th most densely populated country with 7% of its population above the age of 60 years. It is predicted that by 2050, this number will increase up to 27 million (4). Fall is sudden change in body position of an individual which results in moving from a higher to lower level, usually ground or floor without an intention to change the position. A recent cross-sectional study in Pakistan reported 42.6% of fall in elderly persons aged 60 and above (5). Fall is reported to be a major cause of disability and illness. Approximately 1/3rd elderly people fall each year, furthermore its prevalence is high among cognitively impaired older adults with an incidence of 70% fall each year, double the estimate in older adults with normal cognition (6). Balance control is important for a person to move around and perform functional tasks independently. Balance is defined as center of gravity of center of body mass lying within base of support. Balance depends on somatosensory system, central nervous system and appropriate responses from the musculoskeletal system. With aging decline in these can lead to fall and balance

problems in elderly (7). Various research studies has reported that advancing age is widely associated with many mental and physical health challenges. A significant issue under consideration is related to deterioration of motor function in older individuals, indicating an elevated susceptibility to falls among them. The risk of fall intensifies with increased sedentary life style, which in turn results in regression of both balance and overall motor performance (8). The prevalence of non-communicable diseases like sensory impairment, osteoporosis, cardiovascular diseases, diabetes, fall and osteoarthritis are more common in elderly people with increasing age. Additionally, decline in cognitive function emerges as a prevalent concern, employing a substantial impact on the overall well-being of the elderly, leading to disability that significantly compromises their quality of life (9). As per recent systematic review on global prevalence of cognitive impairment in older adults living in the community, it was documented to be between 5.1% and 41% with 19% of median interval (10). A person must frequently multitask in everyday situations like walking and talking on phone at the same time, walking while carrying objects like glass of water, or strolling while eating something. Traditional assessment and training methods primarily focus on physical function testing and rehabilitation under single task conditions. These approaches aim solely to enhance or evaluate the real time movement capabilities of elderly persons while neglecting the possibility of movement or cognitive impairments manifesting in the presence of dual or multi tasks (11). The performance of dual tasks demands simultaneous execution of two tasks: a primary task involving static or dynamic motor functions and a secondary cognitive task. Due to decline in both postural control system and attentional allocation abilities, particularly in older persons for whom postural control appears to be an attention-demanding task, such conditions detrimentally impact postural stability. Moreover, when a postural or cognitive task gets more difficult, there is a corresponding loss in

postural stability due to an increase in attentional effort (12). The quality of life for the elderly persons may not be significantly improved by simply reintegrating them into the community after a period of single task testing or training. Instead, this approach might contribute to increase in the number of fall incidents among elderly people because they overestimate their capacity for physical activity when put under multitask conditions. A recent systematic review suggested that dual task training is beneficial for mild to moderate PD patients in regard to balance and gait function such as cadence, step length and walking speed when compared to single task training. They also suggested dual task training to be a part of program for PD patients (13). Motor-cognitive dual task training program in persons with neurological disorders has shown better results considering cognition, balance and gait when compare to individuals performing single task training (14). Dual task training may be beneficial for patients with variety of clinical impairments, for instance studies have revealed improvements in balance and mobility among older adults with chronic stroke (15). Ferreira et al. in a cross sectional conducted on older people reported that people with Alzheimer's disease appear to have difficulty performing two tasks simultaneously and was unaffected in persons with major depression (16). Currently there is little evidence to support the use of dual task training programs to improve cognitive function, balance, and doing any activity while walking. Therefore, despite the fact that dual task training programs has shown improvement in multiple functions still the clinical relevance of training is still unclear (17). The purpose of current study was to investigate the effects of single task training in comparison to dual task training on balance performance and cognition in older adults.

Methodology:

This randomized control trial was conducted at Najjat trust old home Rawalpindi from May 2021 to October 2021. After approval from the ethics review committee of University Institute of Physical Therapy University of Lahore, Islamabad campus (Reference number UOL/UIPT/

IRB/EC/000100). The RCT was registered in Iranian Registry of clinical trial with number IRCT20210909052419N1.

Sample size was based on availability of participants in specific time frame. 68 participants were enrolled by convenient sampling technique. Those included were adults of age 50 years and above, able to ambulate independently walk without assistive devices, Mini-Mental State Examination (MMSE) score between 18 to 23 and score less than 50 on Berg balance scale. Participant who had recent history of fall within one year, unstable medical condition, significant visual and auditory impairments, Presence of other neurological or musculoskeletal conditions affecting balance, unwillingness for participation in the study were excluded.

After taking written informed consent from the participants who fulfilled the inclusion criteria, they were randomly divided by sealed envelope method using convenient sampling technique into experimental group (Dual task training group , n=34) and control group (Single task training group , n=34). Demographic were recorded and assessment was done at baseline and after 8 weeks using Berg balance scale (BBS), Time up and Go test (TUG), MMSE and MoCA. Participants of both groups performed the training 3 days a week for up to 8 weeks; 5 minutes warm up followed by 30 to 35 minutes training session and 5 minutes cool down which included stretching and range of motion exercises of upper and lower limbs. The STT group participants performed functional tasks that require balance like, tandem standing with eyes open and closed, transferring from one chair to another chair, single leg standing on alternate legs, walking with a reduced base of support, obstacle crossing. The DTT performed same balance tasks simultaneously with cognitive task. The detail of intervention given is written in table 1.

Statistical analysis: Statistical analysis was done by the SPSS. Shapiro-Wilk test was applied to check the normality of the data. All the quantitative data of this study follows the normality ($p \geq 0.05$). Wilcoxon signed rank test was used to analyse the differences between pre and post treatment within

each group and Mann Whitney test for between group comparisons.

Table1: Intervention Details.

Single task training (STT)		Dual task training (DTT) with fixed priority instruction	
Intervention	Duration	Intervention	Duration
Tandem standing with eyes open and closed Simultaneously.	30- 35 minutes per day	Tandem standing with eyes open and arm alteration along while spelling word backward	30- 35 minutes per day
Transferring from one chair to another chair Simultaneously.		Transferring from one chair to another chair spelling objects.	
Single leg standing on alternate legs.		Single leg standing on alternate legs while reading.	
Walking with a reduced base of support.		Walking with a reduced base of support while counting backward.	
Obstacle crossing.		Obstacle crossing while naming objects.	
Note: 5 minute for warm up and cool down during each session, 3 times/week for up to 8 weeks.			

Results:

Total 73 participants were assessed for eligibility. Among them 68 participants met inclusion criteria and were randomized into two equal groups. There were 34 participants in dual task training group, in which 3 participants lost follow

up due to worsening of symptoms and high blood pressure complain. From single task training group, two participants lost follow up. The detail of screening for recruitment, enrollment, randomization, follow-up and analysis is given in figure 1.

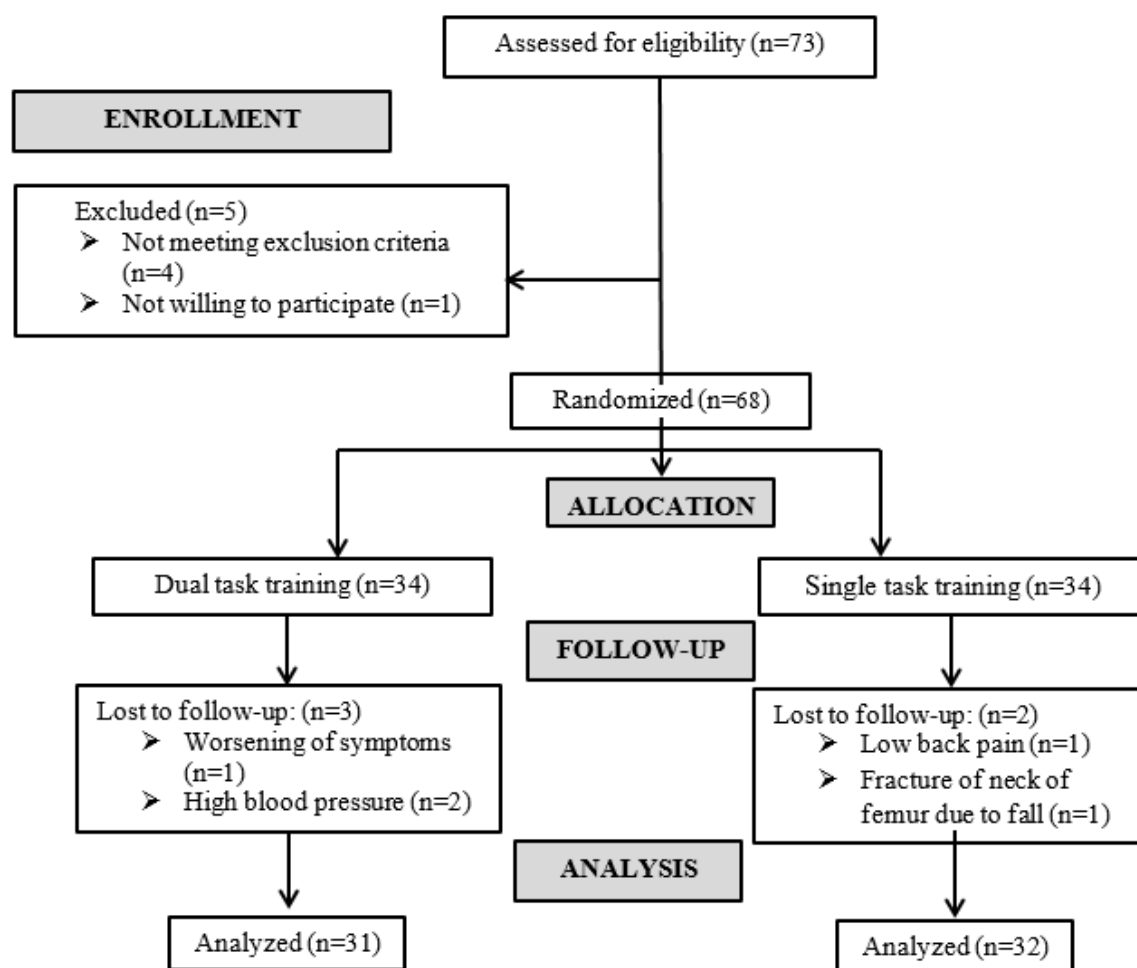


Figure 1: CONSORT flow diagram

Sixty-three (93.2%) participants were included in final analysis. The number of male participants was 37 (58.7%) and number of female participants was 26 (41.3%). The Mean age of participants was 64.05 ± 4.046 . Intergroup analysis showed significant improvement $p < 0.05$ in BBS, TUG, MMSE and scores of MoCA (Detail given in Table 1). Experimental group participants who performed dual task training activities showed significant improvement in BBS (pre mean 32.74 ± 2.50 , post mean 39.41 ± 3.07), TUG (pre

mean 21.22 ± 3.18 , post mean 14.25 ± 3.82), MMSE (pre mean 20.41 ± 1.33 , post mean 21.67 ± 1.07) and MoCA (pre mean 19.41 ± 1.45 , post mean 22.29 ± 1.88). Within group analysis of single task training group showed no significant improvement in BBS (pre mean 33.31 ± 3.06 , post mean 34.09 ± 3.08), TUG (pre mean 19.84 ± 3.36 , post mean 18.34 ± 3.07), MMSE (pre mean 20.81 ± 1.25 , post mean 20.87 ± 1.31) and MoCA (pre mean 19.41 ± 1.45 , post mean 20.15 ± 1.56). (As shown in table 2)

Table 1: Inter group analysis

Variable	Group n=63	Mean±SD	p-value
BBS pre	Experimental n=31	32.74±2.50	0.342
	Control n=32	33.31±3.06	
BBS post	Experimental n=31	39.41±3.07	0.001
	Control n=32	34.09±3.08	
TUG pre	Experimental n=31	21.22±3.18	0.093
	Control n=32	19.84±3.36	
TUG post	Experimental n=31	14.25±3.82	0.001
	Control n=32	18.34±3.07	
MMSE pre	Experimental n=31	20.41±1.33	0.240
	Control n=32	20.81±1.25	
MMSE post	Experimental n=31	21.67±1.07	0.019
	Control n=32	20.87±1.31	
MoCA pre	Experimental n=31	19.41±1.45	0.093
	Control n=32	20.00±1.27	
MoCA post	Experimental n=31	22.29±1.88	0.008
	Control n=32	20.15±1.56	

Table 2: Intra group analysis data presented as median score pre- post intervention after 8- weeks

Variable	Mean±SD	Median (IQ)	Z-value	P-value
Within group analysis of DTT group (n=31)				
BBS-pre	32.74±2.50	32.0 (4.00)	-4.875	.000
BBS-post	39.41±3.07	40.0 (4.00)		
TUG-pre	21.22±3.18	21.0 (5.00)	-4.872	.000
TUG-post	14.25±3.82	14.0 (7.00)		
MMSE-pre	20.41±1.33	20.0 (1.00)	-3.984	.000
MMSE-post	21.67±1.07	22.0 (1.00)		
MoCA-pre	19.41±1.45	19.0 (2.00)	-4.888	.000
MoCA-post	22.29±1.88	22.0 (2.00)		
Within group analysis of ST group (n=32)				
BBS-pre	33.31±3.06	34.0 (5.00)	-1.455	.146
BBS-post	34.09±3.08	34.0 (4.00)		
TUG-pre	19.84±3.36	19.0 (6.00)	-4.432	.006
TUG-post	18.34±3.07	18.0 (4.00)		
MMSE-pre	20.81±1.25	21.0 (2.00)	-0.513	.608
MMSE-post	20.87±1.31	21.0 (2.00)		
MoCA-pre	19.41±1.45	20.0 (2.00)	-1.067	.286
MoCA-post	20.15±1.56	20.0 (2.00)		

Discussion:

The results of current study revealed that 31 participants who performed dual task training for eight weeks showed significant improvements for Berg balance scale, time up and go test, mini mental state examination and Montreal cognitive

assessment scale in comparison to thirty-two participants in single task training groups for performance of balance and cognition.

Nahdiah Purnamasari et al evaluated the effects of four-week dual task training carried thrice a week, in reducing risk of fall among elderly. Berg Balance

Scale (BBS), Timed-Up-and-Go test (TUG), Tinetti Balance tool was used as measure for balance and fall risk in the participants. The mean age for study participants was 67.86 ± 5.44 . They showed significant improvements in balance and the risk of fall decreased after 12 exercise sessions. The study results were consistent with our results that dual motor cognitive tasks improves balance and reduce fall of risk in elderly (18). Jardim et al in their clinical trial conducted on community dwelling older adults to determine effects of dual task training exercise for 75 minutes, twice weekly on functional capacity and cognition. They suggested that combination of physical exercise training with cognitive stimulation results in reduction of age-related cognitive impairments, improves visual attention, muscle strength, quality of life and overall physical fitness of elderly people. Whereas no significant improvements were seen in control group participants (19). Dementia and age-related cognitive decline can be prevented when physical activity which preserves structure of neuron combined with cognitive activity which works on neural plasticity and physiology of neuronal circuits. The combined actions of cognitive stimulation and physical activity at same time shows better results to mitigate the effects of aging (20). Ebrahim Norouzi and colleagues investigated the effects of dual task training on working memory and balance in older people. The mean age of participants was $68.31 \pm SD 3.83$ years. The study results showed improvements in balance performance and memory domain (8). Hayrunnisa et al suggested that eight weeks of dual task training program improve balance, muscle strength, walking parameters and reduces fear of fall in older persons above 60 years of age. The study results showed improvement in berg balance scale, time up and go test, fall efficacy scale (21). Raichlen et al conducted an RCT to test dual task walking performance in community dwelling healthy older adults. They reported that twelve week of aerobic exercise simultaneously performed with different cognitive training tasks results in improved cognitive function (22). Our findings are consistent with another randomized control trial that included forty older healthy adults with a purpose to determine the effects of

combined physical-cognitive game-based training. They concluded that twelve week training program showed improvements in cognitive function and also decreased the risk of fall in older adults (23).

Conclusion:

The study concludes that eight weeks of dual task training program improve balance and cognition in older adult.

Limitation:

The study lacks long term follow up due to which the sustained effects of single-task and dual-task training on balance and cognitive outcomes could not be assessed. Biological or neurophysiological biomarkers were not included in the study, which precludes examination of how the functional changes were achieved.

Recommendation:

Large, multicenter randomized controlled trials with longer follow-up periods conducted in future to assess the long-term effects of improvements in balance and cognitive function. It is also recommended to compare training intensity and training protocol and also to add functional outcome measures, like fall incidence, quality of life, and activities of daily living to enhance the clinical relevance of the results.

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