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To compare effect of dual task training on treadmil v/s conventional balance exercises on balance and risk of fall in the elderly community dwellers

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ABSTRACT

Background and Aims

This study is to see how effective dual task training on treadmill on balance and risk of fall is and to compare its effectiveness with conventional balance exercises. In geriatric population, balance is the most commonly affected due to age related changes in the brain. Also they experience falls or build fear for it due lack of coordination and strength, therefore, loss of balance. Since dual task on treadmill will help in improving co-ordination as motor and cognitive tasks are involved, it can be used to improve balance. As doing our daily chores includes dual tasking every time, following study is undertaken on geriatric population as they are most prone for falls.

Method

A comparative study was done on 30 individuals of Talegaon Dabhade (age 65 and above) which were divided into two groups by simple random sampling. In experimental group 15 individuals were given dual task training on treadmill for 6 weeks in 18 sessions (3times/week). The control group of 15 individual was given conventional balance exercise. Pre and post outcome measures were taken on BBS, DGI and MFES.

Results

The scores increased more in experimental group than control group in BBS with p value of 0.0293, in DGI p value of 0.0001 and in MFES p value of 0.0285 which are statistically significant. Therefore, in this study we can say that dual task training on treadmill is more effective than balance exercises.

Keywords: Dual task training on treadmill, Balance, Conventional exercises.

INTRODUCTION

The major problems in geriatric population are falls and fall related physical consequences. As they are more prevalent, falls may lead to fear of fall, reduce mobility and function, as well as decreased sense of confidence in walking independently [1]. Most probably falls occur during walking, often in a familiar environment. Many recent studies have shown that walking requires the integration of higher-level cognitive functions such as attention to successfully ambulate in complex environments while

simultaneously carrying out different tasks. The age-related loss in muscle power has emerged as a useful predictor of disability and falls in older people. In this population, the requirements to produce explosive and rapid movements often occurs whilst simultaneously performing other attention-demanding cognitive or motor tasks, such as walking while talking or carrying an object.

The term "dual task" (DT) refers to the ability of an individual to perform 2 tasks simultaneously, for example, cognitive and motor tasks. Studies have shown that dual tasking affects the walking pattern in all subjects to some degree, young and older adults[2]. Age-associated alterations in executive function in older adults are associated with gait disturbances and an increased sensitivity to DT. Based on the evidence on the interaction between motor and cognitive function and the need to explore the potential of intensive motor cognitive training in a population who are at a high risk for falls, we posited that an intervention that combines cognitive training while walking on a treadmill that also enables a progressive intensive gait training paradigm which will enhance DT walking abilities in older adults[3]. Therefore, the aim of this study is to evaluate the benefits of treadmill training while practicing DT on motor and cognitive functions in older adults with a history of falls.

Balance is defined as maintaining the center of gravity (COG) over the base of support [1](BOS). Exercising to improve your balance and gait are important aspects of geriatric care. Improving your ability to walk and move can prevent injuries and falls and increase quality of life. Many balance and gait exercises are easy enough to perform at home and do not require additional equipment [1].

Impairments in both mobility and cognition are common in many elderly individuals, making previously automatic movements more attention demanding. Divided attention, the Ability to respond to multiple stimuli simultaneously, is frequently affected more than other domains (e.g., sustained attention). Divided attention is necessary to successfully perform 2 tasks concurrently (i.e., dual tasks), such as a cognitive and a motor task (e.g., walking and talking). The addition of a cognitive task to mobility tasks to gait or balance has been shown to amplify gait variability in elderly individuals. Impairments in divided attention may prevent individuals from allotting appropriate attention resources to balance and gait, reduce adaptability to challenging environments such as obstacles and uneven paths, and may contribute to fall risk. Despite documented deterioration in gait and balance under DT conditions, there are few intervention studies that address this deficit. Available studies are marked by variability of training type and duration. Similarly, DTT improved balance during cognitive activities to a greater extent than mobility training alone in healthy individuals.

METHOD AND MATERIALS

Study Design

- Type of study- comparative study.
- Sampling- by random sampling.
- Study population- geriatric population.
- Setting- in and around Talegaon Dabhade.
- Sample size- 30 individuals.

[Experimental group: dual task training on a treadmill- 15 individuals.]

[Control group: balance exercises -15 individuals.]

Materials

- Treadmill
- Standard height chair with back and arm support
- A stepper
- Hurdles
- Soft ball of medium size
- Cones

Inclusion Criteria

- Individuals above the age group of 65 years of both genders.
- Individuals who could walk independently for 10 minutes.
- Individuals with BBS score less than 41 and MFES score less than 110.

Exclusion Criteria

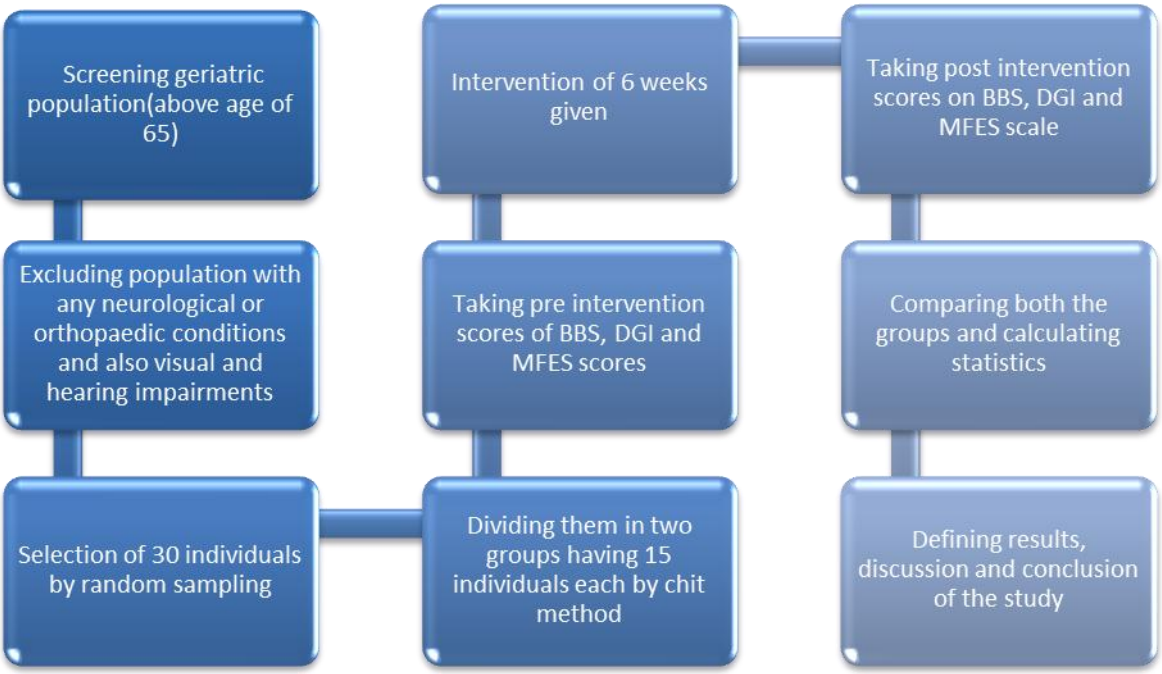
- Individuals with neurological or orthopedic conditions (exception-OA knee till grade 2 and NRS less than 5).
- Individuals having hearing or visual impairments.

Outcome measures

- BBS- Berg Balance Scale.
- DGI- Dynamic Gait Index.
- MFES- Modified Falls Efficacy Scale.

METHODOLOGY

A Comparative study was done in 30 individuals of geriatric population (age 65 and above) of Talegaon Dabhade which were then divided into two groups by simple random sampling. Following scales were taken to assess their balance and risk of fall: BBS, DGI and MFES. 10 individuals were selected each for dual task training on treadmill and convention balance exercises.



PROCEDURE

On the occasion of geriatric day (6th September), all the geriatric individuals visiting MAEERS Physiotherapy college for the camp where screened by measuring scales like BBS, DGI and MFES. Then 30 individuals meeting the criteria were selected and grouped into two by chit method. Entire schedule for their group was explained and consent was taken prior to initiating study. 18 sessions were conducted in 6 weeks (3 sessions per week) for each group.

Group A: Experimental group- Dual task training on treadmill

The experimental group consisted of 15 individuals to whom the study was well explained and consent was taken. Then 6 weeks intervention was done with 3 sessions per week. They were made to walk on treadmill while cognitive task were performed simultaneously.

First table describes the motor progression during the 6 weeks of the training: each training session started with 5 minutes of warm-up exercises that included ROM ex. of extremities. After a few minutes break, participants continued walking on the treadmill while performing different cognitive tasks. Gait speed and duration gradually increased during training sessions.

MOTOR PROGRESSION			
WEEK	**SESSION**	**WALKING DURATION**	**SPEED OF TREADMILL**
1	1	8 MINS	70% OF NORMAL PACE
	2	8 MINS	70% OF NORMAL PACE
	3	8 MINS	70% OF NORMAL PACE
2	4	10 MINS	80% OF NORMAL PACE
	5	10 MINS	80% OF NORMAL PACE
	6	10 MINS	80% OF NORMAL PACE

3	7	12 MINS	90% OF NORMAL PACE
	8	12 MINS	90% OF NORMAL PACE
	9	12 MINS	90% OF NORMAL PACE
4	10	14 MINS	100% OF NORMAL PACE
	11	14 MINS	100% OF NORMAL PACE
	12	14 MINS	100% OF NORMAL PACE
5	13	16 MINS	110% OF NORMAL PACE
	14	16 MINS	110% OF NORMAL PACE
	15	16 MINS	110% OF NORMAL PACE
6	16	18 MINS	120% OF NORMAL PACE
	17	18 MINS	120% OF NORMAL PACE
	18	18 MINS	120% OF NORMAL PACE

Second table describes the cognitive progression during the 6 weeks of the training: each training session started with 5 minutes warm-up walking. After a few minutes break, participants continued walking on the treadmill while performing 3 different cognitive tasks: (1) listening to a short story and answer questions, (2) verbal fluency: phonetic verbal fluency (i.e., words starting with the letter A) and semantic verbal fluency (i.e., names of countries), and (3) arithmetic tasks (i.e., multiplication table exercises). Each training session consisted of 3 bouts of walking: warm-up and 2 walking bouts with cognitive load. Training duration in the first session started at about 17 minutes and increased gradually up to 47 minutes throughout the program.

COGNITIVE PROGRESSION				
WEEK	**SESSION**	**AUDITORY CUE**	**VERBAL CUE**	**ARITHMATIC CUE**
1	1	4MINS	2MINS	2MINS
	2	4MINS	2MINS	2MINS
	3	4MINS	2MINS	2MINS
2	4	6MINS	2MINS	2MINS
	5	6MINS	2MINS	2MINS
	6	6MINS	2MINS	2MINS
3	7	6MINS	3MINS	3MINS
	8	6MINS	3MINS	3MINS
	9	6MINS	3MINS	3MINS
4	10	8MINS	3MINS	3MINS
	11	8MINS	3MINS	3MINS
	12	8MINS	3MINS	3MINS
5	13	8MINS	4MINS	4MINS
	14	8MINS	4MINS	4MINS
	15	8MINS	4MINS	4MINS
6	16	9MINS	4MINS	4MINS
	17	9MINS	4MINS	4MINS
	18	9MINS	4MINS	4MINS

Performing cognitive task while walking (Arithmetic cuing)

Walking on treadmill with listening to auditory cues

Group B: Control group- Conventional balance exercises

The individuals in control group were given exercises in group. All the 18 sessions were conducted in six weeks every alternate day. Total time for these sessions was 45 minutes each. Total 5 dropouts were observed till the last session. Exercises include the following-

1. Sit to stand and stand to sit
2. One-leg stance
3. Toe-touching in standing and return to upright
4. Heel raises and toe-walking
5. Overhead and side-to-side reaching
6. Rotating right and left while standing and rotating while walking
7. Tandem standing and walking on line
8. Fast walking
9. Slow walking
10. Obstacle avoidance

11. Stop and go and turning on command
12. Navigation of uneven terrain
13. High stepping or marching
14. Backward walking
15. Side stepping
16. Picking up objects from different heights or levels and placing them on different heights or level
17. Heel walking
18. Ramp ascent or descent
19. Stair or curb ascent or descent
20. Walking while carrying objects of different sizes and weights
21. Catching and throwing ball or soft object
22. Kicking ball

All the exercises were progressed in the sequence on weekly basis reducing the repetition of previous ones. The last session consisted of all exercises. First session started with 10 exercises with 10 repetitions each.

Tandem standing

Side to side reach outs

ANALYSIS AND INTERPRETATION OF DATA

The study was completed in 6 weeks out of 30 individuals of them complete the entire 18 sessions. Post reading of both the intervention on berg balance scale, dynamic gait index and modified falls efficacy scale showed positive results.

PAIRED t TEST		**MEAN**		**SD**		**P VALUE**	**t VALUE**	**SIGNIFICANCE**
		PRE	**POST**	**PRE**	**POST**			
EXPERIMENTAL GROUP	BBS	36.8	46.2	4.5	3.8	0.0205	8.817	significant
	DGI	14.8	23.3	1.14	0.72	0.0173	7.837	significant
	MFES	114.3	133.67	10.84	4.2	0.0304	6.567	significant
CONTROL GROUP	BBS	37.4	42.8	5.4	5.2	0.0001	6.53	extremely significant
	DGI	17.3	19.6	2.7	1.7	0.0135	2.47	significant
	MFES	113.3	129.3	12.8	6.8	0.0001	8.031	extremely significant
UNPAIRED t TEST		MEAN		SD		P VALUE	t VALUE	SIGNIFICANT
		EXP	CONTROL	EXP	CONTROL			
	BBS	46.2	42.8	3.8	5.4	0.0293	1.971	significant

DGI	23.3	19.6	0.7	1.7	0.0001	7.465	extremely significant
MFES	133.67	129.53	4.2	6.8	0.0285	1.984	significant

Table no.1: Demographic data

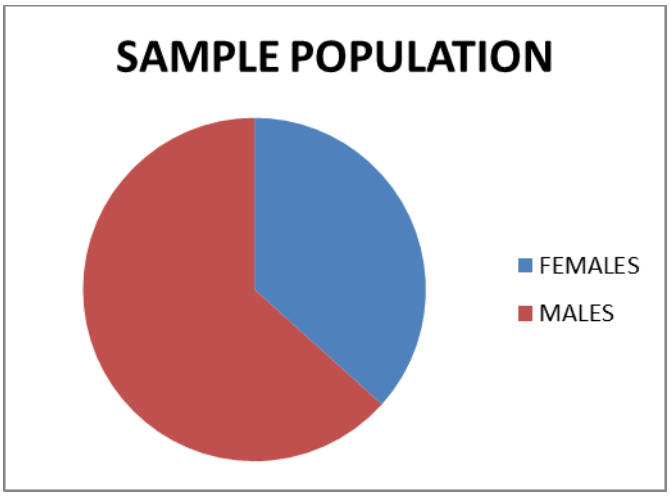


Table no.2: Pre and Post Mean for BBS

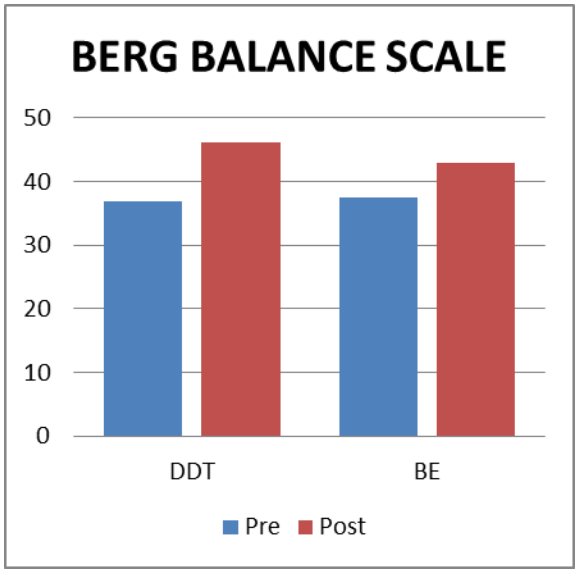


Table no.3: Pre and Post Mean for DGI

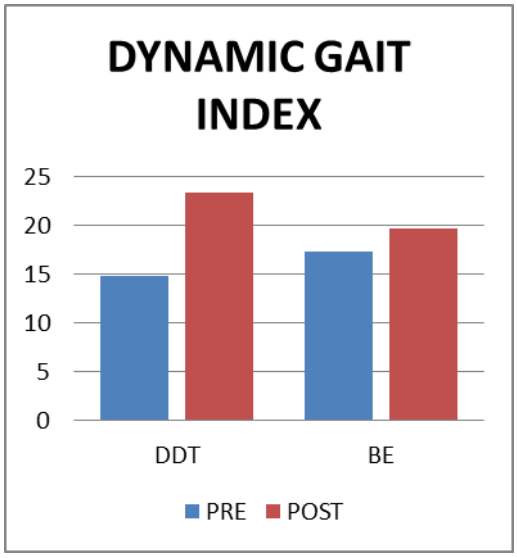
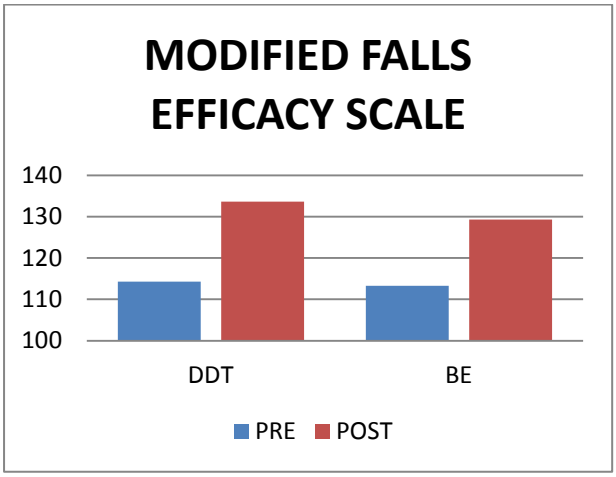


Table no.4: Pre and Post for MFES



The above mentioned table shows mean, standard deviation, p value, t value and significance for the readings mentioned in previous tables. When the paired t test was applied to check results of pre and post readings they showed significant values for both the groups in all the three scales. For berg balance scale in experimental group the p value was 0.0205 which is considered significant with t value 8.817 and 14 degrees of freedom where as for control group the p value was 0.0001 with t value 6.53 and 14 degrees of freedom which is considered extremely significant.

Similarly for the scale dynamic gait index the experimental group and control group both had significant p values 0.0176 and 0.0135 respectively. The modified falls efficacy scale for the experimental group showed p value 0.0305 with t value 2.47 and 14 degrees of freedom where as for control group the p value is 0.0001 with t value 8.031 and 14 degrees of freedom which is considered extremely significant.

For the comparative result for both the groups was calculated on the basis of their post intervention readings which also showed significant result. The static balance measure with berg balance scale showed positive results in both the groups and P value calculated was 0.0293 which is considered significant having t = 1.971 with 28 degrees of freedom.

Dynamic balance was measured with dynamic gait index showed significant P value 0.0001 having t=7.465 with 28 degrees of freedom.

The dual task training helped subjects to gain more confidence improving their scores in modified falls efficacy scale with P value 0.0285 which is significant having t=1.984 with 28 degrees of freedom.

DISCUSSION

This study was done on the geriatric population above the age group of 65 for improving balance and reducing risk of fall by performing dual task training on treadmill on 20 individuals. This was then compared to group of 20 individuals performed conventional balance exercise. After six weeks of intervention the improvement in balance measures was consistent with previous reports in elderly fallers. As a group, the change in the BBS and DGI scores resulted in meaningful clinical and statistical difference, suggesting relevant improvement in balance.

The correlation found post-intervention further highlighted the possibility that the combined motor-cognitive training enhanced improvements in both the domains which influenced each other and created a functional change. The results of the study shows that subjects of dual task training and balance exercises both have benefited from the intervention with significant improvement in post-intervention balance scores on berg balance scale, dynamic gait index as well as modified falls efficacy scale. The post intervention scores were more significant in experimental group than the control group. So the dual task training was found to be more effective in improving balance in older adults. One of the factors that may have contributed to improved scores could be the task coordination and management theory proposed by Kramer et al [2]. According to this theory practicing two tasks together allows participants to develop task coordination skills. There is automatization of tasks which decreases the demand required to perform the task, hence rapidly developing the skills.

A study performed by *Nora E. Fritz, PT, DPT,* in his study after DTT for 10 to 12weeks, the healthy elderly demonstrated improvements in reaction time on a lower extremity motor task, Community Balance and Mobility Scale and reduced fear of falling [5]. Also DTT for 6 weeks resulted in greater improvement in memory performance compared with controls who received only walking training in elderly individuals with risk of fall. Elderly adults with balance impairment had 4 weeks of DTT which showed improvements in cognition on the Stroop and both single and DT walking. Variable training (i.e., instructions to prioritize either the motor or cognitive task) was more effective for improvement of mobility and cognitive outcomes under DT conditions than fixed-priority or single-task conditions, and hence maintained the gains. This variable-priority effect has been noted in cognitive-cognitive DT training programs of healthy adults, where individuals trained with variable-priority instructions learned tasks faster and performed better than those who received fixed-priority instructions. Segev-Jacubovski et al in a systematic review exploring the use of DTs to identify elderly fallers suggested that DTs may have added benefit in the assessment of fall prediction and should be studied further. Moreover, in an exploration of gait, falls, and cognition, concluded that combining motor and cognitive therapies should be included in clinical practice to improve mobility and reduce safety in older adults.

CONCLUSION

The present findings suggest dual task training on treadmill training is feasible for older adults who are at a risk of fall and enhances balance, cognitive function, and functional mediators related to fall risk. Improved scores of BBS, DGI and MFES were seen more in dual task training than conventional exercises.

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