Original Article

Effect of Training Turning Activity along with Cognitive Task on Balance Performance of Elderly Individuals

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Abstract

Background and Objective: Falls and falls related injuries are leading cause of morbidity and mortality in elderly that significantly impair their functional independence. Decreased balance and gait performance, secondary to decline in strength, cognition, somatosensation, visual and vestibular function are being held as major factor for falls in elders. Recent studies have shown that most of falls sustained by elderly are during steering activities like turning while walking. Present study was undertaken to investigate the effect of teaching steering activity along with cognitive exercise on balance and gait performance in elderly.

Methodology: A sample of 30 elderly, aged between 65-85 years, were included in study and were equally divided in to 2 groups i.e. Group A (control: n=15) and Group B (study patients: n=15), respectively. Group A received standard balance exercise training whereas Group B received balance exercises that also included turning activity training with concurrent cognitive task for 4 weeks. Outcome measures included the Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Timed Up and Go Test (TUGT), 180^{o} Turn time and Step Number in 180^{o} turn time during TUGT were measured in both pre and post 4 weeks of intervention.

Results: Post 4 weeks of intervention, Group B showed significant improvement in BBS (t= 15.04), DGI (t= 18.50), TUGT (t= 8.51), 180^{o} Turn time (t= 8.28), Step Number in 180^{o} turn (t= 7.24). Similarly Group A also showed significant improvement for scores of BBS (7.63), DGI (13.22), TUGT (4.23), Step Number (3.05) except for 180^{o} Turn time where non-significant differences were found (t= 1.89). Further, inter-group analysis demonstrated that Group B exhibited greater improvement than Group A in scores of BBS (t= 2.29), DGI (t= 4.36), TUGT (t= 3.99), except for Step Number in 180 degree turn (t= 1.58).

Conclusion: The present study concludes that inclusion of concomitant training of turning activity and cognitive task in the balance exercise program for elderly is more efficacious.

Key words: Falls, balance training, turning difficulty, steering activity.

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Introduction

Balance is a ffundamental skill which is important for the safe performance of many activities that acquiesce older people to remain independent in their community.[1] As the individual ages, there is deterioration in balance systems that exert negative impact on the performance of multi-tasking ability of individual in indoor and outdoor and this is further accentuated in elderly when they are faced with tasks requiring dividing attention and one of such task is walking or turning in a crowd or on a busy road crossing.[2,3]

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Turning is now predominantly identified in episodes of falling in mobility impaired population and disruption of turning control can lead to multiple falls in older individuals.[4,5] Turning is one of the fundamental components of mobility requiring "higher cognitive and attention functions (CNS) to make anticipatory postural muscle adjustments, decelerate the forward motion, coordinate axial body-segment reorientation to the new direction of travel, and maintain dynamic balance within the base of support while continuing the ongoing step cycle".[6,7] Approximately 35-45 steps in daily activities have been associated with turning.[8] Staggering during turning activity have been associated with high risk of falls, ultimately leading to hip fractures and these are the sixth cause of death among patients aged over 65.[9-11] Elderly individuals use step strategy, with longer turn duration and greater number of turn steps while changing the direction and walk significantly slower than the young adults when they face turning in their travelling pathway.[12-14]

Most of balance training programs undertaken aim at improving functional mobility of older adults by mainly training single task or dual task activities in straight line but training specifically 'steering' activities like that of turning is lacking in most of them. There is need to investigate the effect of teaching steering activity along with cognitive exercise.

Material and Methods

Sample: Thirty elderly including both males and females aged between 65-85 years were recruited in study. Subjects who were independent in ambulation and Activities of Daily Living (ADLs) but having history of fall, having balance and gait difficulty as depicted by Berg Balance (BBS) Score between 35-48, Dynamic Gait (DGI) Index score between 15-20, Timed Up and Go Test (TUGT) score greater than 10, having difficulty in turning as indicated by turn time during 180^o turn in TUGT and number of steps taken during 180^o turn in TUGT, were included in the study. Subjects exhibiting balance impairment other than age related changes, marked musculoskeletal impairment, history of any injury/surgery of back or lower limb and subjects who had marked difficulty in understanding and comprehension or taking medications affecting equilibrium and balance were excluded from study. Informed written consent prior to participation in study was obtained from each participant and they were explained in detail about the nature of the study.

Ethical approval: Study was approved by Ethics Committee of Department of Physiotherapy, Punjabi University, Patiala.

Design: This study was experimental in nature with pre and post test design. Participants were randomly allocated to two groups i.e. Group A (n=15) age (77.73 ± 4.41) years and Group B(n=15) age (76.4 ±5.35) years respectively (Table 1). Baseline measurement of outcome measures i.e. Berg Balance Scale (BBS)[15], Dynamic Gait Index (DGI)[16], Timed Up and Go Test (TUGT) [17,] Total TUG time, 180^o turn time**,** Number of steps in 180^o turn was taken for each participant prior to commencement of training and then again at the end of four weeks of intervention.

Table 1. Demographic details and baseline measurements of participants in two groups

Demographic	Age	BMI
	Mean ± SD	Mean ± SD
Group A (n = 15)	77.73 ± 4.41	25.33 ± 1.36
Group B (n = 15)	76.4 ± 5.35	25.3 ± 1.60

Intervention: Group A performed standard balance exercises. Balance training included exercises- Standing on firm surface with feet apart, heel stand, toe stand, marching on firm surface, semi tandem stand, walking forward and backward with normal base of support.[18] Group B performed balance exercises same as in Group A but with more emphasis on turning activity and concurrent cognitive task. Exercises included for this group - Standing on firm surface with feet apart, heel stand, toe stand, marching on firm surface, semi tandem stand, walking forward and backward with normal base of support, turn 360 degree on a circle marked on floor along with cognitive task, turn around obstacles with normal base of support, turn around obstacles in tandem walk with concurrent cognitive task, walk and sudden turn on verbal command, walking in a figure-of-eight marked on floor with concurrent functional motor task and cognitive task (naming words, counting backwards, serial subtraction of 3, spelling words backwards).[18-22] Each of these tasks was performed for 5 repetitions. The difficulty level of exercise was increased gradually, with the goal being set just above the patient's ability level to perform it. Rest intervals were given whenever required for the total of 5 minutes in one treatment session. The intervention was given for 4 weeks, everyday regularly for 4 days a week under supervision of researcher, rest 3 days of week at home. Subjects were instructed to perform these exercises once a day. In this way session lasted for 45 minutes to 60 minutes. 5-10

minutes of warm up and cool down was performed by the subjects before and after the exercises respectively. At the end of the four weeks period, participants were re-tested on the same balance and gait tests used in the pre test session.

Data Analysis: All statistical analysis was done using Microsoft Excel 2008. Mean and Standard Deviation (SD) were used to prepare summary statistics. Paired't'-test and unpaired 't'-test was used for intra-group and inter-group analysis respectively. Results were calculated by using 0.05 level of significance.

Results

Pre-intervention BBS, DGI, TUGT, Turn time during TUGT, and Step No. during TUGT showed no significant difference and proves the pre-intervention group homogeneity (Table 2). Pre and post-intervention comparison for BBS, DGI, TUGT, Step number in 180° Turn did shows significant difference whereas pre and post-intervention scores of 180° Turn time during TUGT showed significant difference only for group B (Table 3, Fig 1). Further comparison of improvement scores (inter-group analysis) showed significant difference for BBS, DGI, TUGT between group A and group B. Inter-group analysis for Step No. in 180° turn showed no significant difference between group A and group B (Table 4, Fig 2).

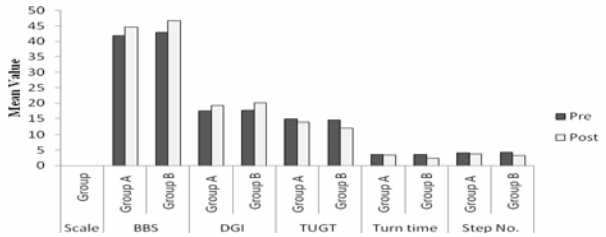

Fig. 1. The comparison of mean values of pre and post-intervention scores of BBS, DGI, TUGT, Turn time and Step No. for group A and group B.

Table 2. The Pre-intervention group comparison between Group A and B

Scales	Control (Group A) Mean ± SD	Experimental (Group B) Mean ± SD	t' value
BBS	41.86 ± 3.27	42.93 ± 4.39	0.75^{NS}
DGI	17.6 ± 2.02	17.73 ± 2.01	0.18 ^{NS}
TUGT	14.84 ± 2.78	14.64 ± 3.61	0.16 ^{NS}
Turn time during TUGT	3.55 ± 1.07	3.64 ± 1.12	0.21 ^{NS}
Step No. in 180° Turn	4.2 ± 0.67	4.26 ± 0.59	0.28 ^{NS}

NS = Non-Significant; $t_{(28, 0.05)} \leq 2.048$

Table 3. The intra-group comparison of BBS, DGI, TUGT, Turn time, Step No. of pre and post-intervention in both groups (n = 15 each group).

Scales	Group	Pre-intervention value (Mean ± SD)	Post-intervention value (Mean ± SD)	't' value
BBS	Group A	41.87 ± 3.27	44.60 ± 3.58	7.63*
	Group B	42.93 ± 4.40	46.67 ± 4.42	15.04*
DGI	Group A	17.60 ± 2.03	19.27 ± 1.83	13.22*
	Group B	17.73 ± 2.02	20.20 ± 1.86	18.50*
TUGT	Group A	14.84 ± 2.79	13.82 ± 2.23	4.23*
	Group B	14.64 ± 3.62	12.06 ± 3.19	8.51*
Turn time	Group A	3.56 ± 1.08	3.38 ± 1.02	1.89^{NS}
	Group B	3.64 ± 1.12	2.47 ± 1.13	8.28*
Step No.	Group A	4.20 ± 0.68	3.80 ± 0.77	3.05*
	Group B	4.27 ± 0.59	3.27 ± 0.46	7.24*

*significant; P<0.05

Table 4. The comparison of improvement scores (inter-group analysis) of BBS, DGI, TUGT, Turn time during 180 degree turn, Step No. in 180 degree turn after 4 weeks of intervention between Group A and Group B.

Scales	Group A (Mean ± SD)	Group B (Mean ± SD)	't' value
BBS	2.73 ± 1.39	3.78 ± 0.96	2.29*
DGI	1.67 ± 0.49	2.47 ± 0.52	4.36*
TUGT	1.64 ± 0.93	2.58 ± 1.17	3.99*
Step No.	0.4 ± 0.50	0.1 ± 0.53	1.58^{NS}

*Significant; P<0.05

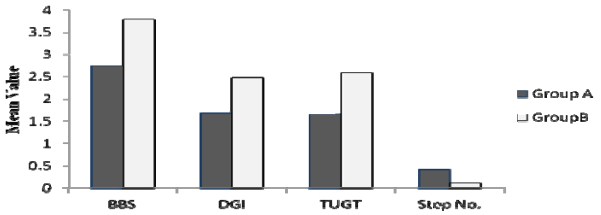

Fig. 2: The comparison of improvement scores (inter-group analysis) of BBS, DGI, TUGT, Step No. in 180° turn after 4 weeks of intervention between Group A and Group B

Discussion

Turning is of particular importance in older adults as falls and fall related injuries are eight times more common during turning than straight walking.[9,10,24] Major morbidity of falls in elderly includes hip and other fractures that require prolonged bed rest or hospitalization. Most of Balance-Gait programs incorporate training straight-ahead balance and gait activities while specifically teaching turning component of locomotion is largely missing in them. Present study was undertaken to investigate the effect of training of repetitive turning activity in elderly on their balance and gait performance. As a motor task, turning is challenging task as it always requires some amount of cognitive process therefore, participants were made to perform turning activity along with cognitive tasks.[14]

Results of the present study depict that both control (Group A) as well as experimental (Group B) group improved significantly in balance performance of functional tasks after 4 weeks of intervention as indicated by significant increase in mean value of post BBS scores. The findings of the present study are in accordance with the studies by Harada et al (1995), Steinberg et al (2003) and Nitz and Choy (2004) where authors have significant improvement in BBS scores after balance training.[18,26,27] They ascribed this to the effect of specific and individualized balance intervention program. In another study by Steadman et al (2003), significant post exercise improvement in BBS scores was observed in both intervention group versus control group.[28] They also observed that independent of strategy, both the groups significantly improved in balance and mobility while intervention group showed greater improvement in increased confidence in walking outdoors and indoors.

Similar findings were observed in present study for performance of gait in both experimental and control group after 4 weeks of intervention. The results of present study are in agreement with study of the Shumway-Cook et al (1997) on older adults where both exercising groups showed improved gait performance with reduction in fall risk (indicated by significant improvement on DGI, Tinetti mobility test, 3 minute walk test scores) as compared with control group.[29]

These improvements in performance of balance and gait (improved BBS and DGI scores) can be accredited to individualized exercise program which ensured greater adherence of patient to exercise and more personal care and supervision of researcher. Further on inter-group analysis between Group A and Group B, significant improvement was seen in experimental group on those items of BBS and DGI which were related to turning, such as 360 degree turn, 180 degree turn than control group. This improvement may be ascribed due to repetitive training of turning activity and concurrent cognitive task in addition to the balance exercises for participants in experimental group. Such task encouraged participants to turn more easily and in less time as compared to the control exercise group.

Similar trend in findings was observed in present study for functional mobility and fall risk as measured on the TUGT in both control and experimental groups after 4 weeks of intervention. These results are in accord with findings of the Kuptniratsaikul et al (2011) on elderly (with a history of previous fall).[30] In another study conducted by Madureira et al (2007) significant improvement in TUGT was seen in elderly who underwent 12 months balance training of 40 hours (1 hour/week).[31] Further on inter-group comparison, experimental group showed greater improvement on TUGT scores than Group A, this can be accredited to the addition of training turning activity concurrently with cognitive task that had helped participants of experimental group to become more proficient to complete 180 degree turn in less time.

Turning ability of participants was further measured by recording time and number of steps taken in completing 180 degree turn in Timed Up and Go test (TUGT). Results showed that control and experimental group decreased their number of steps in completing 180 degree turn suggesting improved ability in turning. Whereas turn time required to complete 180 degree turn during TUGT decreased significantly only in experimental group. Morgan et al, had used TUGT along with turn time and number of steps as a measure of turning ability and to describe movement characteristics in older adults and authors believed that these measures can serve as useful and sensitive indicators of turning difficulty while walking.[20] In the present study control group showed improvement only in step number whereas experimental group improved significantly both in turn time and number of steps taken for completion of 180 degree turn in TUGT. Thus it means as a whole turning ability (measured in terms of number of steps and time taken) improved in experimental group and this may be attributed to the addition of concurrent cognitive task along with motor task (repetitive turning activity) in real context.

Conclusion

The study interprets that inclusion of repetitive turning activity along with cognitive task in elderly with balance impairment showed significant improvement on balance score when compared with those who received conventional balance exercises only. It is clear that issue of balance impairment and falls is complex and multi-factorial in elderly persons. The health professionals should be able to recognise and differentiate these factors to plan and implement appropriate improvement and overwhelming treatment approach. Important consideration which is surfacing is role of cognition in maintenance of physical function. There is need to correctly identify the cognitive decline so that change in physical activity is not misinterpreted and to appropriately address and train physical activities like walking, turning along with cognitive task so that functional independence of older adults can be maintained at optimal level.

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