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Effect of task-oriented circuit training on balance, gait speed and functional ability in community dwelling elderly

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ABSTRACT

Background and Purpose

Falls in the elderly are a major cause of morbidity and mortality-the consequences often extending far beyond minor injury to significant loss of functional independence and death. Exercise intervention in form of task-oriented exercise programme is now recognized as a new strategy to improve functional status of chronic stroke individuals. Organizing training into a circuit with series of workstations is safe and can result in improvements in muscle strength, gait speed, walking distance, stair climbing, and transfers. So, the purpose of this study was to see the effect of task oriented circuit training on balance, gait speed and functional ability of community dwelling elderly.

Study Design

A pre-post experimental design was used in this study.

Subjects

60 community dwelling elderly adults (> 65 years of age) participated in the study. These subjects were randomly allocated to one of the two groups: Group 1 (n=30) was given task-oriented circuit training and Group 2 (n=30) was given general balance and mobility training.

Methods

The balance performance of the subjects was evaluated on Berg Balance Scale, gait speed was calculated using 10 Metre Walk Test and functional ability was calculated using Timed Up and Go Test. Each group performed program of exercise training and then ended up the session with 5 minute cool down period.

Results

The subjects in both the groups were benefitted from the exercise intervention with a significant improvement in post-intervention balance, gait speed and functional ability scores as compared to their pre- intervention scores. On comparison between the two groups, there was statistically significant difference between post-intervention scores of Berg Balance Scale, 10 Metre Walk Test and Timed Up and Go Test.

Conclusion and Discussion

This study concluded that both Task-Oriented Circuit Training and General Balance and Mobility Training were effective in improving balance, gait speed and functional ability of community dwelling elderly but it becomes more effective when task-oriented circuit training is incorporated as a training program.

Keywords: Balance, Gait speed, Functional ability, Task-oriented circuit training, Community dwelling elderly, Fall

INTRODUCTION

Everybody falls and falling is a universal event which is experienced by all at all stages of life. Most of the falls in children and young adults, are having less consequences and have generally less or no impact on the functioning of body. But falls in the elderly, by contrast accounts for major cause of morbidity and mortality. The consequences of falls in elderly can often extend far beyond minor trauma to significant loss of functional independence and death [1] the rate of falls can increase up to 60% with the advancing age [2].

In elderly population, falls are a well-known problem and it has been reported in studies that one in three people aged 65 years and over fall once or more each year [3] and about 50% of them will suffer recurrent falls [4]. Several studies have investigated the physical consequences of falls, such as hip fractures (1%), fractures at other sites (3%) or brain injury (2%) [5]. Gait changes and poor balance ability are among the major fall risk factors [6].

Epidemiological studies of falls in the elderly have indicated that falls are a multi-causal phenomenon with a complex interaction between intrinsic factors (e.g., advanced age, specific diseases, gait disorders) and extrinsic factors (e.g., environmental and housing conditions). Among the intrinsic factors, researchers have identified decreased balance and mobility skills as very strong predictors of the likelihood for falls [5]. Hallmarks for successful aging by community-dwelling older adults include appropriate gait speed (Montero-Odasso, 2005) and balance confidence (Powell & Myers, 1995).

Gait and balance disorders have been consistently identified in multiple reviews as among the strongest risk factor for falls.6About 10-25% of falls are associated with poor balance and gait abnormalities. Functional mobility is a term used to reflect the balance and gait manoeuvres used in everyday life (e.g., getting in and out of a chair, walking, turning) [7].

It has been shown task specific circuit training is effective in many neurological conditions like stroke and multiple sclerosis [8, 9]. Circuit training is a technique in which exercises are performed in successive stations with either a predetermined number of repetitions or for a set duration. Exercise intervention in form of task-oriented exercise programme is now recognized as a new strategy to improve functional status of chronic stroke individuals [10].

But none of the studies have investigated the effect of task-oriented circuit training on balance, gait speed and functional ability of community dwelling elderly. Keeping this in view the study was designed to see the effects of task-oriented circuit training on balance, gait speed and functional ability in community dwelling elderly and to establish the feasibility of task-oriented circuit training in elderly.

SYSTEM MODEL

Task-oriented circuit training is based on the motor learning theory proposed by [10] and consists of tasks that can help motion abilities for daily living. These task-oriented exercises also encouraged participants to bend, turn and reach to limits of stability [24] In addition such exercises help the individual regain strength and control of lower limbs which may enable them to take more weight through the weakened legs [24, 28]. The improvement in the balance function may be attributed to the presentation of repetitive motor tasks that produce an improvement in performance called adaptation, which is an important element of balance function [28]. Carr and Shepherd suggested that training can be organized into a circuit with a series of workstations designed to strengthen affected muscles and provide the opportunity for task practice (C.M. Dean 2000).

Task-oriented circuit training is based on workstations that reproduce physical activities that the subject usually performs during daily living (i.e. walking, climbing stairs, maintain balance) with the aim of promoting motor learning and task retention [9] investigated the effects of task specific exercises on balance ability in patients with stroke and found significant improvements. Subjects were selected according to inclusion and exclusion criteria and informed consent was obtained and general assessment was done.

PREVIOUS WORK

There was significant improvement in balance of elderly after a task specific exercise [25]. Also reported that there was a mean improvement of 0.07m/sec in gait speed and there was an improvement in TUGT scores in stroke people in stroke people after having the sessions of task-oriented circuit class training [26]. Means also reported improvement in balance and mobility of elderly after a general balance and mobility training program [27]. Furthermore, Kim also reported that dynamic balance was increased after task specific exercise76. Strategic target exercise is superior to conventional exercise for elderly [29]. Specific balance training programmes have a greater effect on balance function than general exercise programmes [25].

Previous researches have shown that a task-specific program was effective for improvement of standing, functional movement, balance, muscle endurance and gait. C.M. Dean (2000) reported that there was improvement in walking speed in chronic stroke people after a task related circuit training. There was a mean improvement of 0.07m/sec in gait speed in stroke people after having the sessions of task-oriented circuit class training. Sherrington, English also showed that group training with a series of workstations (known as circuit training) offers benefits in terms of gait speed, walking distance, stair climbing and transfers compared with other commonly used forms of physiotherapy. The task specific training reflects the concept of neuroplasticity and motor learning. These training programs are well known as effective approaches, since activities consisting of functional tasks could interact with the related organs in the programs. Studies of the pilot study of showed clinically relevant changes in walking speed.

C.M. Dean 2000 also reported that that there is a reduced time taken to complete TUG test. Lotte Weavers reported that there was an improvement in TUGT scores in stroke people after having the sessions of task-oriented circuit class training. Previous studies have shown that task-oriented circuit training is a good method to improve locomotors function and mobility in stroke survivors.

METHODOLOGY

Selection and Description of Participants

Sixty community dwelling older adults took part in this study. The group 1 receiving task-oriented circuit training consisted of 23 males and 7 females with a mean age of 70.03 ± 4.22 years while the group 2 receiving the general balance and mobility training consisted of 23 males and 7 females with a mean age of 71.06 ± 4.62 years. The two groups were comparable with respect to age, height and weight. The subjects were gathered through a sample of convenience of sixty older adults took part in this study. The subjects were collected through a Geriatric Camp organized at Indian Spinal Injuries Centre, Vasant Kunj, Residents of Vasant Kunj, New Delhi and relatives of in-patients of Indian Spinal Injuries Centre volunteered for the study. The study was approved by Institutional Ethical Committee (IEC). Subjects who fulfilled the inclusion and exclusion criteria and were ready to attend the exercise program regularly were selected. The subjects were included on the following criteria;

1. Community dwelling elderly and not institutionalized or hospitalized
2. Age: ≥ 65 years (Male/Female) [11,12]
3. Subjects having Mini Mental State Exam score of ≥ 24 [11-13]
4. Activities specific balance confidence scale score greater than 67% [14]
5. Subjects who were able to ambulate independently without assistive devices [13, 15, 16]

The subjects were excluded on the following criteria

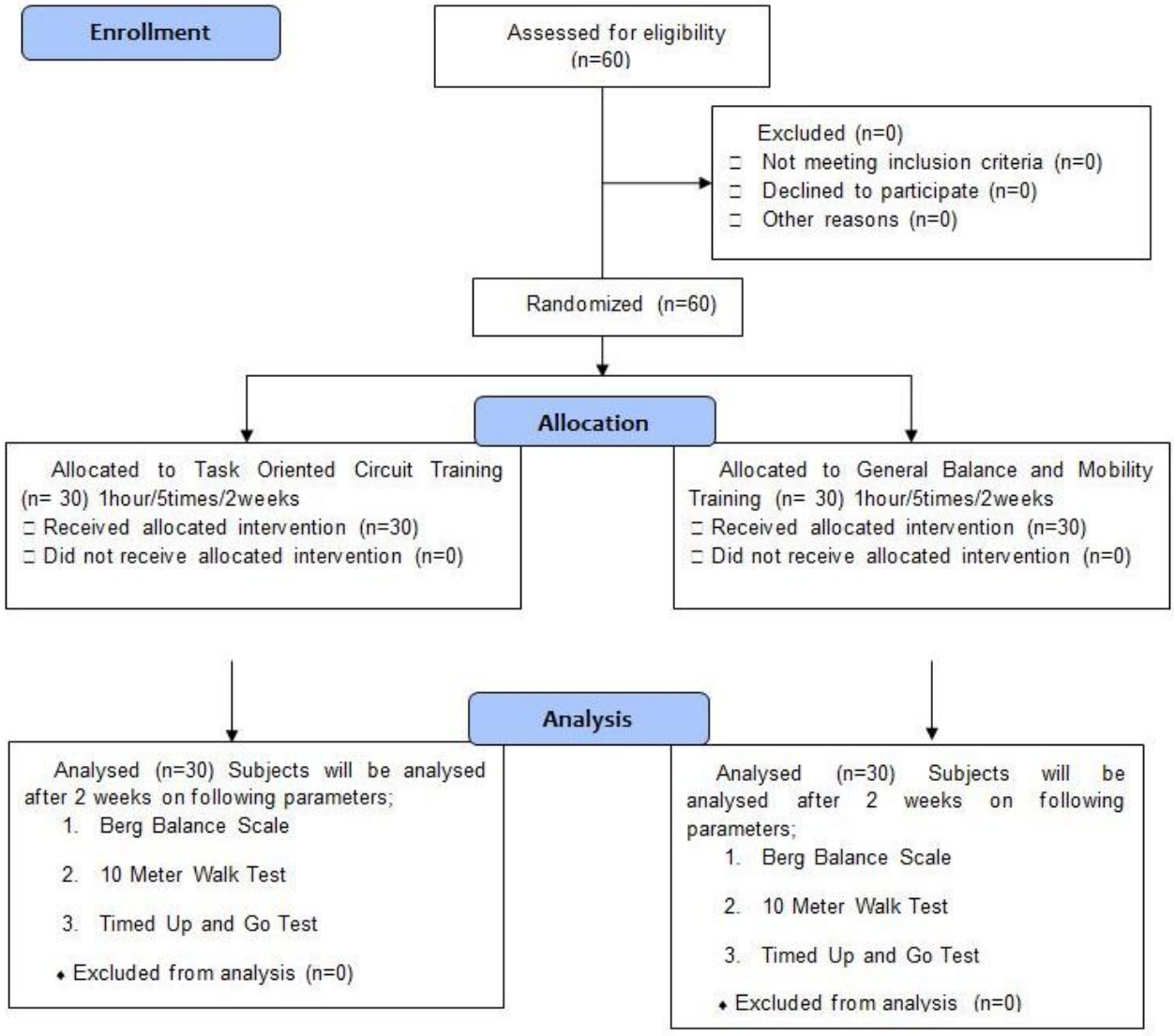
1. Subjects with musculoskeletal diseases /deformities of lower limbs [17].

2. Subjects with neurological disorders like stroke, traumatic brain injury, Parkinson's disease, etc. [11, 17].
3. History of unstable cardiac disease / pathologies, history of cardiac surgery [11, 13, 17, 18]
4. Subjects having moderate to severe depressive subjects (Geriatric Depression Scale Score >8). [18, 19, 20]
5. Subjects who had a recent fall within six months [13, 21]
6. Uncorrected hearing and visual impairments[11, 15, 22]
7. Receiving physical therapy or any other exercise programme at the same time [11, 13, 15]
8. Subjects who has an unstable medical condition / illness that may interfere with the exercise program [13, 23]

CONSORT

TRANSPARENT REPORTING of TRIALS

CONSORT 2010 Flow Diagram



PROCEDURE

A pretest and posttest experimental design was used. The subjects were invited to participate in the study and were then randomly assigned to one of the two groups. A detailed explanation of the procedure was given after which subjects signed the informed consent. Subjects were then assessed on the three scales - Berg Balance Scale (BBS), 10 Meter Walk Test (10MWT), and The Timed Up and Go Test (TUGT).

The group 1 performed exercises like Stepping, Slalom, Tandem exercise, Goals, Obstacles, Long step and Treadmill. Progression is done by increasing the number of repetitions completed in 3 minutes at a workstation and increasing treadmill speed. The group 2 performed exercises like Flexibility exercises (5 repetitions, 15-sec hold), strengthening exercises—lower limb muscles (elastic band: 1 set of 8–10 repetitions for each leg), Postural exercises (10 repetitions, 10- sec hold), Coordination exercises, Survival manoeuvres and Treadmill. There was a 5 minutes of each warm up and cool down exercise included in each group. These exercises focus on major group of muscles during the protocol (quadriceps, hamstrings, hips, calf, neck, back muscles). After two weeks of training with five sessions per week, the subjects were again assessed on above mentioned scales.

RESULTS

Statistics were performed using SPSS software version 21. A student's t-test was used to analyses the difference between the pre intervention scores of group 1 and group 2, pre and post interventions of group 1 and group 2 and difference in post intervention scores between group 1 and group 2. A significance level of $p<0.05$ was fixed.

The group receiving the task-oriented circuit training (Group 1) consisted of 23 males and 7 females with a mean age of 70.03 ± 4.22 years while the group receiving the general balance and mobility exercises (Group 2) consisted of 23 males and 7 females with a mean age of 71.06 ± 4.62 years. Both the groups were matched in terms of age, height and weight (Table no.4)A student's t-test was used to compare the performance of subjects of group 1 and group 2 on Berg Balance Scale (BBS), Gait Speed and Timed Up and Go Test (TUGT) prior to the intervention program. The analysis of pre-intervention scores of Berg Balance Scale between group 1 (Mean= 47.6, S.D. = 2.42) and group 2 (Mean = 48.16, S.D. = 2.13) did not show any significant difference (t-value =-0.90, p = 0.37) indicating that both groups were matched in terms of Berg Balance Scores. The pre-intervention scores of Gait Speed between group 1 (Mean = 1.07, S.D. = 0.13) and group 2 (Mean = 1.03, S.D. = 0.14) did not show any significant difference (t-value = 1.31, p = 0.19) indicating that both groups were matched in terms of Gait Speed. The pre-intervention scores of timed up and go test between group 1 (Mean = 9.59, S.D. = 0.93) and group 2 (Mean= 9.67, S.D. = 1.05) did not show any significant difference (t-value = -0.30, p = 0.76) indicating that both groups were matched in terms of their timed up and go test scores.

The comparison of post-intervention scores of berg balance scale between group 1 (Mean = 53.76, S.D. = 2.19) and group 2 (Mean = 50.6, S.D. = 1.02) show significant difference (t-value = 9.57, p = 0.01). The comparison of post-intervention scores of gait speed between group 1 (Mean = 1.33, S.D. = 0.12) and group 2 (Mean = 1.16, S.D. = 0.08) also show significant difference (t-value = 4.56, p = 0.02). The comparison of post-intervention scores of timed up and go test between group 1 (Mean = 7.65, S.D. = 0.79) and group 2 (Mean = 8.87, S.D. = 0.75) also show significant difference (t-value = -5.69, p = 0.01).Significant difference was also seem between in the pre-intervention and post-intervention scores of berg balance scale for group 1 (t-value = -and p = 0.01) and group 2 (t-value = -10.11 and p = 0.02). Pre-intervention and post interventions scores of gait speed group 1(t-value = -11.58 and p = 0.01) and group 2 (t-value = -8.78 and p = 0.01) and timed up and go test group 1 (t-value = 13.32 and p = 0.01) and group 2 (t-value = 5.79 and p = 0.02) were also significant. Results reveal that both the groups showed improvement in all the parameters but group 1 showed more marked improvement as compared to group 2.

Table 1 Comparison of Pre- intervention scores of Berg Balance scale (BBS), Gait Speed (GS) and Timed Up and Go Test (TUGT) for Group 1 and 2 (Un-Paired t-test)

Variables	Pre-Intervention score Group 1 (n=30)		Pre-Intervention score Group 2 (n=30)		t- value	p-value
	Mean ±	S.D	Mean ±	S.D		
Berg Balance Scale (BBS)	47.63 ±	2.42	48.16 ±	2.13	-.90^{NS}	0.37
Gait Speed (GS)	1.07 ±	0.13	1.03 ±	0.14	1.31^{NS}	0.19
Timed Up and Go Test (TUGT)	9.5 ±	0.93	9.67 ±	1.05	-0.30^{NS}	0.76

Table 2 Intra group comparison of Berg Balance scale (BBS), Gait Speed (GS) and Timed Up and Go Test (TUGT) Scores (Paired t-test)

	Pre-intervention scores		Post-intervention scores			
Group Variables	Mean ±	S.D	Mean ±	S.D	t- value	p-value
Group 1 BBS	47.63 ±	2.42	53.76 ±	1.25	-15.3*	0.01
GS	1.07 ±	0.13	1.33 ±	0.13	-11.50*	0.01
TUGT	9.59 ±	0.93	7.65 ±	0.70	13.32*	0.01
Group 2 BBS	48.16 ±	2.13	50.06 ±	2.09	-10.11*	0.02
GS	1.03 ±	0.14	1.16 ±	0.17	-8.78*	0.01
TUGT	9.67 ±	1.05	8.87 ±	1.12	5.79*	0.02

Table 3 Comparison of Post- intervention scores of Berg Balance scale (BBS), Gait Speed (GS) and Timed Up and Go Test (TUGT) for Group 1 and 2 (Un-Paired t-test)

Variables	Post-Intervention score Group 1 (n=30)		Post-Intervention score Group 2 (n=30)		t- value	p-value
	Mean ±	S.D	Mean ±	S.D		
Berg Balance Scale (BBS)	53.76 ±	2.19	50.06 ±	1.02	9.57*	0.01
Gait Speed (GS)	1.33 ±	0.12	1.16 ±	0.08	4.56*	0.02
Timed Up and Go Test (TUGT)	7.65 ±	0.79	8.87 ±	0.75	-5.69*	0.01

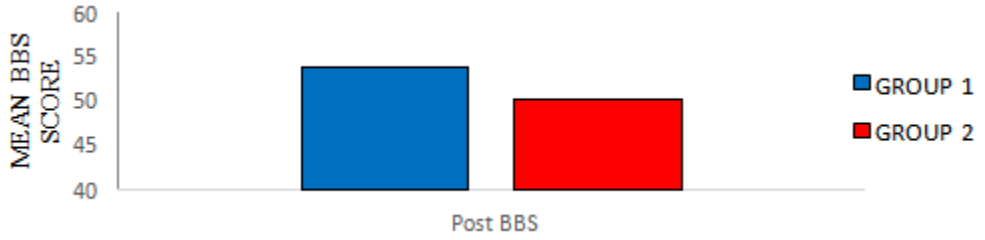


Figure 1 Comparison of Post-intervention Berg Balance Scale (BBS) scores between Group 1 and 2

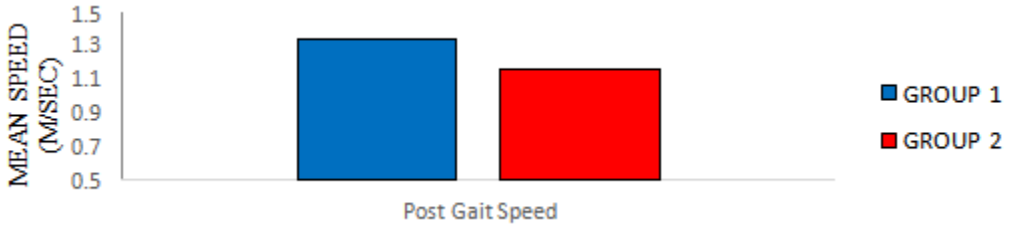


Figure 2 Comparison of Post-intervention Gait Speed (GS) scores between Group 1 and 2

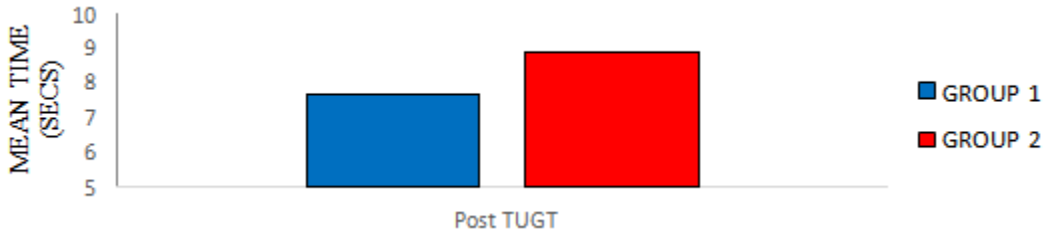


Figure 3 Comparison of Post-intervention Timed Up and Go Test (TUGT) scores between Group 1 and 2

DISCUSSION AND CONCLUSION

Task-Oriented Circuit Training Group and General Balance and Mobility Training group were benefitted from the exercise program with a significant improvement in the post intervention scores of group 1 and group 2 on Berg Balance Scale, Gait Speed and Timed Up and Go Test as compared to their pre intervention scores. This can be seen in (Table 2). The possible reason for the improvement in group 1 could be composition of tasks they practiced. Components of training protocol of group 1 included tasks like stepping up and down, touching a target placed in front with foot, tandem walking, long walking, obstacle crossing and moving zigzag through the cones with the ball, etc. Stepping up and down exercises are also likely to train an individual's balance, since the movements involved present a threat to stability [24].

On comparison between Task-Oriented Circuit Training Group and General Balance and Mobility Training Group, there was a statistically significant difference in the post intervention scores of Berg Balance Scale, Gait Speed and Timed Up and Go Test of group 1 than group 2 (Table 3). Task-oriented circuit training group has shown significant greater improvement in all the three scales of assessment as compared to general balance and mobility training group (Figure 1, 2, 3). This reveals that the participants receiving the Task-Oriented Circuit Training program did better on all three outcome measures than General Balance and Mobility Training program.

Recent evidence suggests that skill training is closely related to increased corticospinal excitability; a finding not revealed with resisted training. Importantly, neural adaptations caused by training seem to be maintained for long periods of time, thus further implicating the importance of task specificity. Therefore, we propose that, if the goal of exercise for older adults is to gain function, training that incorporates task-specific movements may be needed to optimize benefits. One factor that might have attributed to improved scores in group 1 participants was the composition of tasks they practiced. These task-oriented exercises also

encouraged participants to bend, turn and reach to limits of stability [24]. In addition such exercises help the individual regain strength and control of lower limbs which may enable them to take more weight through the weakened legs [24, 28]. The improvement shown in group 2 was less than group 1 in all outcome measures. A possible explanation could be that movement to the limits of stability was not an integral component nor were walking on different surfaces, turning and other rotational elements.

The task specific training reflects the concept of neuroplasticity and motor learning. These training programs are well known as effective approaches, since activities consisting of functional tasks could interact with the related organs in the programs. The results suggest that task oriented circuit training program is more effective than general balance and mobility training group in improving balance, gait speed and functional ability of community dwelling elderly. This helps us in identifying a more appropriate training program for improving balance, gait speed and functional ability in community dwelling elderly and finally help in reducing the risk of future falls in community dwelling elderly.

LIMITATIONS

It is a little difficult to generalize the results because of small sample size and shorter duration of timings. The findings cannot be generalized to elderly people living in nursing homes or hospital settings, frail elderly. Results of present study might not generally apply to people living in rural settings, as community barriers and transport facilitators differ across urban and rural areas, and have a great impact on levels of functioning and disability. Lastly, follow up of the participants could not be taken.

FUTURE SCOPES

This study was conducted for a short duration of time with a small sample of subjects. Future research can be done on a larger scale. Further studies can be done on elderly living in rural areas, frail elderly and diseased population like Parkinson's disease and follow up of the training program can be taken.

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