Comparison of Single Task and Dual Task Balance Training on the Quality of Life of Elderly with Balance Impairment

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Abstract

Background: Aging is the decline in efficiency of various physiological processes which is continues and irreversible. The age related changes affect maintenance of balance control in steady state balance, reactive balance and anticipatory balance. The purpose of the study was to find out the effectiveness of single task and dual task balance training in improving the quality of life among elderly with impaired balance.

Objectives: To compare the effectiveness of single and dual task training in improving the quality of life of elderly with balance impairment and to compare the single and dual task balance training in elderly with impaired balance

Study Design: Pre-post experimental study design

Method Thirty-four elderly adults with impaired balance were assigned into two groups, one group underwent single task training and other dual task training of about 4 weeks. Baseline measurement were taken pre and post training by using TUG, BBS and SF-36.

Results: Dual task training was more effective in improving quality of life and balance in elder adults with impaired balance than the single task training. The TUG scores showed improvement in both the groups. The group which performed dual task training showed significant difference from pre to post measure that with mean 0.51(p=0.005). The single task training group showed an improvement of mean 0.337(p=0.069). The SF-36 score showed significant improvement in both the groups except certain components.

Conclusion: Dual task training improves quality of life and balance in elderly adults with impaired balance than single task training.

Key Words : *Elderly, Single Task, Dual Task, Tug, Bbs, Sf-36, Impaired Balance.*

Introduction

Aging can be defined as a biological reality, which has its own dynamic, beyond human control. In the developed world, chorological age plays a chief role where the age of 60 and above are roughly considered equivalent to the age of retirement as well called as the beginning of old age. [1]

Other social defined aging considered accompanying the loss of roles and physical decline in an individual. Thus many developing countries termed old age as the point when active contribution is no longer possible. Classification of aging varied

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between countries and overtime. [1]

Aging affects all physiological processes which are usually irreversible changes over by 3rd and 4th decades of life.[2] The physiological changes in avoidance with aging shows changes in different organ systems.[3] Thus the process of aging is associated with a decline in the integrity of many physiological systems. When comparing with young healthy subjects there will be age related neurodegenerative changes within neuromuscular control and reduced resolution of sensory inputs resulting in sensory signals which are contaminated with greater noise and physiological delays. Thus due to aging there will be decline in postural stability as well, which is due to the increasing deficits in the control system including lower sensitivity of sensory inputs central processing will be slow and decreased motor control output power. These lead to compensatory modification of the control like functional adaptations to somatosensory and vestibular loss. [3]

Thus the selection of a balance recovery program depends on many factors such as the availability of sensory information as well as environmental and physiological context. Approximately 30% of elderly people sustain a fall each year.

As being 60years of age or older is defined as elderly[2] where geriatrics were specially focused on elderly people's health care.

India is the second most populous country in the world which has 76.6 million people at or over the age 60, which constitutes above 7.7% of total population. Thus India has second largest number of elderly in the world. In India the elderly population is expected to increase from 77 million in 2001 to 179 million in 2031 and further to 301million in 2051. Thus proportions are to reach 12% in 2031 and at 2051 it will be 17%. It is estimated that the prevalence of fall in India is 14-53%, which is a common cause of morbidity and mortality among the elderly. About 20% have risk of fall at age of 60 and above in a year and 35% per year among those 75 and older.[1]

Falls are considered one of the major problems among all the age groups considering the medical and psychological problems. Falls is defined as the inadvertently coming to rest on the ground, the floor or other lower level excluding intentional change to rest in furniture, wall or other objects.

The major cause of morbidity and mortality in elderly are the recurrent falls and are features of poor physical and cognitive status. Intrinsic factors including medication use, postural instability neuro cardio vascular instability and dementia are the cause of increased fall risk in elderly. Several studies have been done on both home living and institutionalised population to define risk factors associated with falls. The extrinsic factors were poor lighting, slippery surface and inappropriate furniture.[4]

Balance control is the foundation of a person's ability to move and function independently. Balance control has been defined as the ability to maintain the body's centre of mass within the base of support. Maintaining balance involves sensory detections of positional changes through sensory inputs, integration of sensory motor information within the central nervous system and execution of appropriate musculoskeletal responses. The deterioration of their systems with aging can lead to balance impairment and falls.[5]

The age related changes affect maintenance of balance control in steady state balance [i.e. the ability to provide background postural tone and remain balanced during quiet stance], reactive balance [i.e. the ability to recover from an unexpected perturbation to balance] and anticipatory balance [i.e. the ability to anticipate and minimize instability associated with performance of tasks].[5]

It has been suggested that age related impairment of different sensory systems and an impaired ability to detriation of the proprioceptive system and ankle muscles weakness can delay the reactive postural responses. In addition, age related changes in the visual system leads to a reduced ability to use visual information to alter gait patterns in anticipating of

upcoming obstacles in the walking path.[5]

The control of balance, whether in static or dynamic conditions, is an essential requirement for daily activity. It has been long known that postural control is sub served by neural pathways of spinal and supra spinal levels that constitutes reflexes and synergies. These reflexes and synergies form the basis for a fast response to body perturbations generate hip abductors and hip adductors torque are responsible for the observed lateral sway during quiet stance.[5]

Health issues of older people have recently been emphasized owing to the rapid aging of society. Limited exercise capacity, reduced vital capacity, poor muscular strength, restricted flexibility, decreased bone mass and glucose intolerance manifest during the aging process. These physiological changes lead to loss of physical function and dependence on assistance in performing activities of daily living, requiring hospitalization or extended hospital stays and reducing longevity. This transitional state is called frailty and may negatively impact physical, psychological and social functions. The complex interactions between the dimensions of frailty cause poor quality of life.[6,7]

Exercise is a key intervention for improving physical functions in older adults. Exercise slows down the physiological changes associated with aging, promotes cognitive health and complements the management of chronic disease in the older adults. Exercise is beneficial in improving physical functions. Exercise not only reduces fall rate but also slows down deterioration in the ability to perform ADLs and maintain QOL.[7]

Single task training involves practicing functional tasks requiring balance (example: standing, walking, transfer) in isolation. In previous researches, the therapist may vhary the condition to increase the challenge to balance during performance under which the subject practices for example: changing the availability of sensory cues [reduce visual cues by asking the participants to close your eyes] or support surface conditions [example: walking on a flat surface versus an inclined surface].[8]

In dual task method, the individuals have to perform two tasks simultaneously, which includes cognitive task and postural control and vice versa. It has been shown that the ability to maintain postural stability is reduced when performing two or more task and thus deficits is increased in elderly population with balance impairment.[8] Dual-task experiments show alterations in the performance of the postural task, the cognitive task, or both tasks. In other words, the demands of controlling postural tasks can lead to a reduction in the capacity to perform a concurrent attention ally demanding cognitive task. Reciprocal effects of cognitive tasks on the postural tasks have also been observed. For example, a significant change in gait parameters (e.g. a significant increase of double-support time) was seen when a memory task and a fine motor task were executed concurrently during walking.[5]

The BBS is a widely used clinical test of a person's static and dynamic abilities. For functional balance test, the BBS is generally considered to be gold standard. The TUG is used to measure the mobility, balance to evaluate functional walking ability. Three studies have reported there is excellent inter rater reliability for TUG.[5,9]

The Mini Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. The MMSE is effective as a screening tool for cognitive impairment with older, community dwelling, hospitalized and institutionalized adults.[6]

The SF-36 is a widely used questionnaire for measuring self-reported physical and mental health status. The item and scale-level statistical analyses supported that SF-36 has validity and reliability to use in India.[9,10]

Earlier studies have shown that there is significant improvement in balance after the single task balance training. According to the task automatization hypothesis, practicing only one task at a time (single

task training) allows participants to automatize the performance of individual tasks. As a result, the processing demand required to perform the tasks is decreased, leading to more rapid development of skills.

The previous studies about dual task training reports that there is significant change in balance from pre to post intervention. The dual task balance condition training program was found to be more effective in improving balance in older adults with balance impairment. It could be based on task co-ordination and management theory proposed by Kramer et al. According to this theory practicing two tasks together (not a single task practice) allows participants to develop task co-ordination skills.[8,11]and possible explanation of this outcome is that the efficient integration and co-ordination between the two tasks acquired during dual task training is crucial for improving dual task performance.

Even though both the single task and dual task training programs were equally effective at improving balance and walking performance under single task conditions, dual task training programs were superior to single task training in improving walking under dual task contexts. However, a study by Patima et al suggest that only the participants in single task balance training group increased their self-reported confidence when performing ADLs. One possible explanation for their finding is that the activities (balance +cognitive) given to the participants in dual task training groups were much more difficult than the tasks (only balance tasks) given to the participants in the single task training group.[8,11]

As a result, the balance skills of participants in the dual task training groups were continually challenged and this may have resulted in a reduced confidence in performing daily tasks. Balance improvement is a major contributor to falls in adults and a growing body of evidence has confirmed the importance of cognitive factor impaired balance among older adults. Many reports have shown that some form of physical training is associated with greater functional independence and fewer falls.[12]

Balance training is an essential part of any fitness plan. Balance training makes the body aware of its orientation in a given space. Training also allows the body to move more fluidly and reduce the risk of falling significantly. When training for balance, the whole body must work together which will improve coordination, stability of joints and also improve the reaction time which prevents injuries.

There was a study done in India to find out the effectiveness of single and dual task balance training to improve the balance, but there is no study conducted to find out the effect of single task and dual task training in improving the quality of life. The result of this study would implicate a better exercise programs for the elderly population and can help the older adults to age gracefully and enjoy a fall free excellent quality of life and thereby reduce the morbidity rate in elderly. Therefore, the purpose of the study was to find out the effectiveness of single task and dual task balance training in improving the quality of life among elderly with impaired balance.

METHODOLOGY

STUDY DESIGN: This study was pre-post experimental study design which intends to find the effect of dual task and single task training on balance and quality of life in elderly.

Source of Data: Geriatric centre

Sample Method: Convenience sampling

Sample Size: Based on SD in group 1 (1.88)4 and SD in group 3 (1.74)4 with mean difference 2. If its size is 1.104, α error 5%, power 90%, for 2 sided hypothesis sample size per group is 17 (in each group), that is the total sample size is 34. 15

Method of Data Collection: Participants were recruited from various home care facilities, those who having balance impairments. Participants who fulfilled the inclusion criteria and were ready to attend exercise programs regularly were selected.

Intervention

A consent form was given to all the participants who fulfilled the inclusion criteria. All the participants were assessed with:

1. BBS to measure balance
2. TUG to measure the mobility and balance
3. SF-36 to measure the quality of life

The pre and post assessment of the above scales was taken, and then all participants received 45minute individualized training sessions, 3 times a week for 4 weeks.

The participants were divided into two groups A and B. Group A received single task balance training and Group B received dual task balance training (with fixed priority). The single task involves practicing functional tasks requiring balance such as standing with the eyes opened or closed simultaneously, walking in straight line and in uneven surface, transferring from bed to chair simultaneously.

The dual task training group received the same set of balance task as single task training group, while simultaneously performed cognitive tasks. The dual task involves reading while standing on single leg, carrying a cup of water while walking, calculating while walking, recollecting the words while walking and complete the proverbs while walking. The cognitive tasks included were calculation, recollecting the words, making of sentences etc. The participants in this group were instructed to maintain attention on both postural and cognitive task at all times.

Procedure

The study was conducted among the healthy elder adults in the Ollavanahalli, old age home, Mangalore. Prior to participation, the participants were explained about the study and an informed consent was taken from the participant. Participant were screened for the inclusion and exclusion criteria and those who fulfilled the criteria were included in the study.

The participants were divided into two equal groups. First group (group A) was trained with the single task balance programs and the second group (group B) was trained with the fixed priority dual task balance training program.

The single task balance training included

1.Tandem standing with eyes open and closed simultaneously for about 10 minutes.

2.Transfering from one chair to another chair simultaneously.

3.Walking with a reduced base of support.

4.Single leg standing on alternate legs for about 8 minutes.

The dual task within fixed priority training included

1.Semi tandem standing with eyes open and arm alteration along with spelling out words of object in front.

2.Semi tandem standing with eyes closed and arm alteration commented by the trainer.

3.Semi tandem walking with counting the numbers backward from 10 to 1

4.Single leg standing with counting the numbers backward from 10 to 1

5.Backward walking along with counting the numbers backward.

Figure 1: The single task, transferring from one chair to another chair simultaneously.

Figure 3 Semi standing with eyes open

Figure 3 Semi standing with eyes open

Outcome Measures

BBS to measure the balance

TUG to measure the mobility and balance

SF-36 to measure the quality of life

Inclusion Criteria

1. Subjects with age of 60 years or above

2. Subjects with history of one fall within the previous year

3. Independent ambulatory with ability to walk 10m without assistance

4. Subject who scored greater 24 on MMSE

5. Subject with score less than 52 on BBS

6. Subjects willingness to do physical exercise in 4 weeks with regular attendance

Exclusion Criteria

1. History of any other severe neurological, musculoskeletal and cardiovascular conditions that affect balance

2. Any history of dizziness, depression

3. Any uncorrected severe visual and hearing impairment which will affect balance

Materials and Tools

Stop watch, chair [with and without arm rest], paper and pencil, certain familiar objects

Results

Statistical analysis was done using SPSS IBM version 22. The descriptive statistics were reported as mean (SD) for continuous variables and frequency (%) for categorical variables.

The paired t test (unpaired and paired) was used to analyse the data. A 'P- value' ≤ 0.05 was considered statistically significant.

Table 1 data of participants mean age and gender details

	Group	N	Mean	Std. Deviation
AGE	Dual task (GROUP B)	17	65.88	3.887
	Single task (GROUP A)	17	68.47	6.053

Table 2 group A and B sex cross tabulation

			SEX			Total
			F		M	
Group	Dual task (GROUP B)	Count % within group	11 64.7%		6 35.3%	17 100.0%
	Single task (GROUP A)	Count % within group	13 76.5%		4 23.5%	17 100.0%
Total		Count	24		10	34
		% within group	70.6%		29.4%	100.0%

Pre and post intervention of TUG scores:

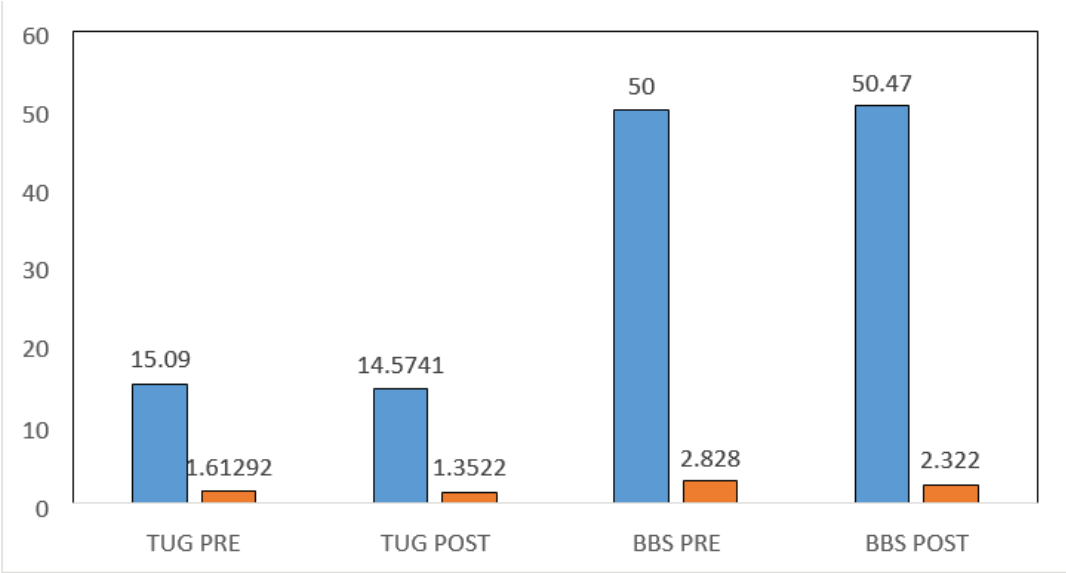


Figure 1: data of pre and post TUG and BBS of dual task

The TUG scores showed improvement in both the groups. In which the group performed dual task [figure 4] programme showed significant difference from pre to post measure that about mean 0.51(p=0.005). The single task [figure 5] training group showed an improvement of mean 0.337(p=0.069).

Pre and post intervention of BBS:

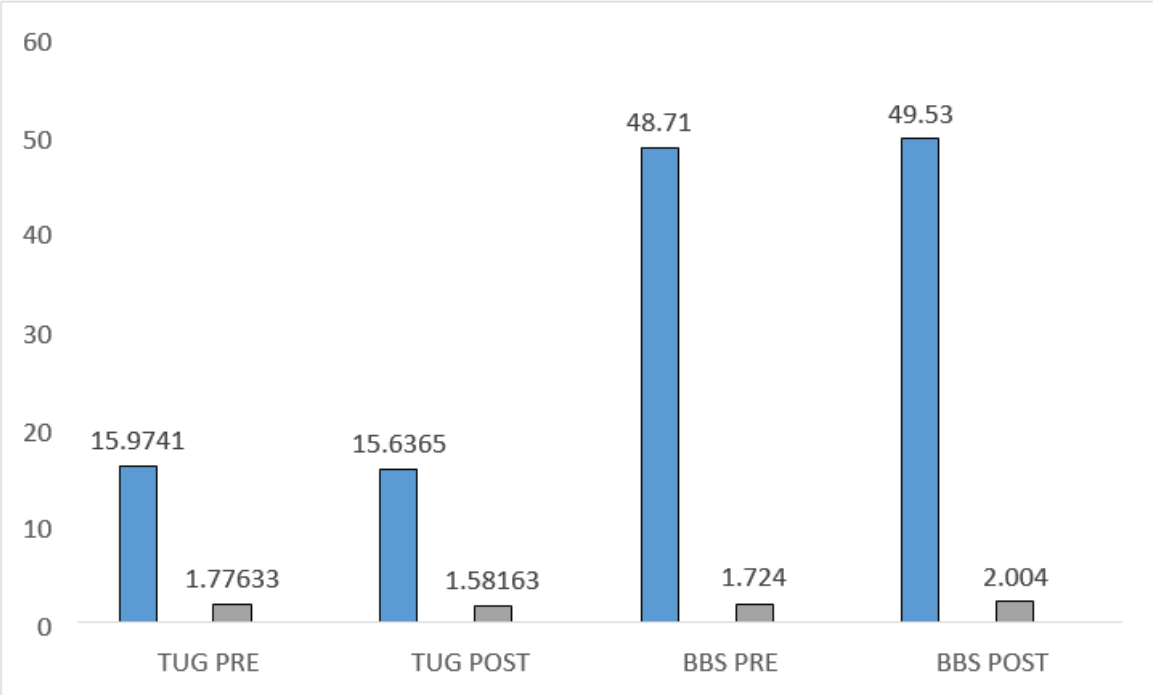


Figure 2: data of pre and post of TUG and BBS of single task group

The results of BBS showed that there is improvement in balance under both training groups in which single task training group showed significant improvement after the training. The dual task programme group showed an improvement of mean 0.47(p=0.149), whereas the single task group showed significant improvement in balance from pre to post intervention, the mean of BBS pre to post was 0.82(p=0.001).

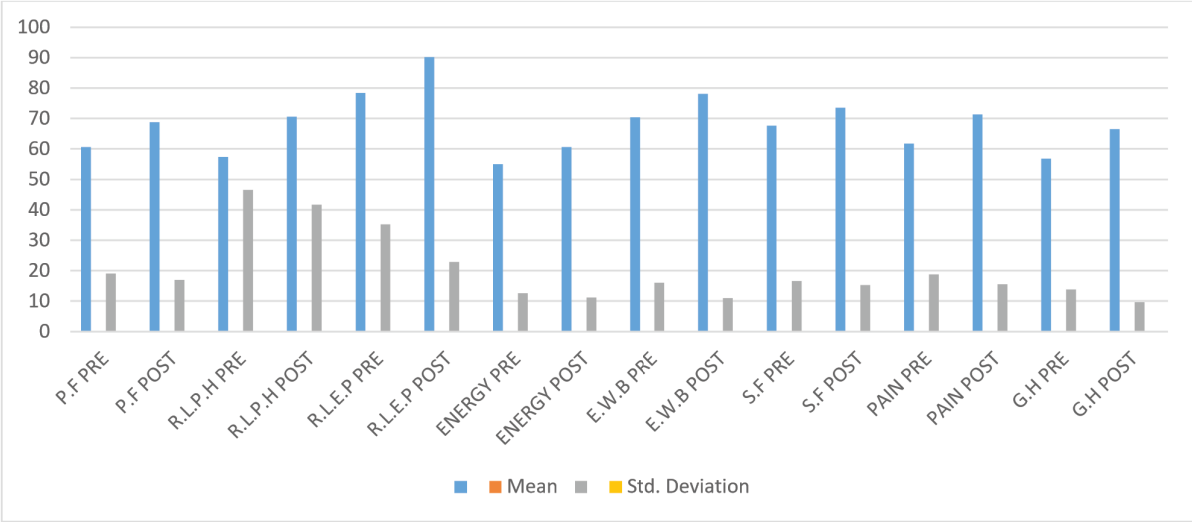
Pre and post intervention scores of SF-36

Both the group showed significant improvement after the intervention. The 8 components of SF-36 were:

1. Physical functioning (P.F)
2. Role of limitation due to physical health (R.L.P.H)
3. Role of limitation due to emotional health (R.L.E.P)
4. Energy/ vitality (ENERGY)
5. General health perception (E.W.B)
6. Socail functioning (S.F)
7. Pain (PAIN)
8. General mental health (G.H) *functioning, PAIN, G.H= general mental health*.]

Figure 3 data of pre and post of SF 36 under dual task training

In which the dual task group [figure 6] showed significant difference in 7 components except 1. The physical functioning improved from pre to post intervention with mean 16.176 (p=0.000). The role of limitation due to physical health also showed significant difference from to pre to post intervention. The other components such as vitality [mean



9.11, p=0.001], social functioning (mean 9.5, p=0.001), pain (mean 7.05, p=0.004), general health (mean 13.5, p=0.000) also showed significant improvement after the intervention. Were the role of limitation in emotional health did not show any significant difference (mean 13.7, p=0.110). Thusas per the results the physical functioning and general health of the older adults had showed better improvement after the dual task training.

Figure 4 data of pre and post of SF 36 under single task training

[PRE=Pre value (before the training), POST=Post value (after the training) P.F=Physical functioning, R.L.P.H=Role of limitation due to physical health, R.L.E.P=Role of imitation due to emotional health, ENERGY=Vitality, E.W.B=General health perception, S.F=Social functioning, PAIN, G.H= general mental health.]

The quality of life of single task training group [figure 7] also showed significant difference after the intervention. The physical functioning (mean 8.2, p=0.000), role of limitation due to physical health (mean 13.3. p=0.024), vitality (mean 5.58, p=0.004), general health perception (mean 7.76, p=0.000), social functioning (mean 5.8, p=0.041), pain (mean 9.5, p=0.000), general health (mean 9.7, p=0.001) showed significant difference after the training. But the role of limitation in emotional health did not show any significant difference(p=0.083).

The result showed that both the groups had significant improvement after the intervention program. Both the groups had improved their quality of life and balance. In which dual task group showed faster improvement than the single task group within the 4week training programme

Discussion

This experimental study provides the evidence that an individualized training program is effective in improving quality of life and balance under dual and single task context in older adults with balance impairment. After a 4-week intervention program participants in both the training groups significantly improved performance on TUG and BBS.

Overall the quality of life of both the groups improved in much better way. According to Patima et al there was effective improvement in balance under dual task condition[8] and Syamala et al also states

that the dual task training is more effective in older adults.[14] The overall TUG scores reduced after the intervention in dual task group (15.69 to 14.57) and in single task group (15.97 to 15.63), were dual task training had showed significant improvement in TUG.

The BBS results shows that there was improvement in balance after the training in both the groups in which dual task group had a change from 50 to 50.4 and single task group had a change of about 48.7 to 49.5, even though single task and dual task training program were equally effective at improving balance and quality of life. Whereas single task group showed significant improvement in balance in BBS results. In which the quality of life scores by SF-36 were also showed improvement in older adults after the training in both the groups.

In fact, in this study the participants who received dual task training and single training showed significantly better QOL after the training, whereas dual task group showed much better improvement than single task group. This finding suggest that older adults are able to improve their QOL under dual task conditions only after specific types of training and that training balance under single task conditions may not generalize to balance control during dual task context. The results provide empirical evidence to support other dual-task training studies that have focused on healthy young adults and patients with stroke. Research by Pellecchia et al demonstrated that dual-task training was superior to single-task training in improving dual-task balance performance in healthy young adults (aged 18-46 years).[19] In Pellecchia's study, participants in the single-task training group practiced the balance task (quiet standing on the foam pad) and the cognitive task (counting backward by threes) separately whereas participants in the dual-task training group were required to perform both tasks concurrently. The results showed that postural sway under dual-task conditions (as measured by the total distance travelled by the centre of pressure) decreased after dual-task training. Similarly, work by Yang et al has also shown the positive effect of dual-task training program on balance performance in patients with chronic stroke (aged 45-80years). However, in this current study result and in the Pellecchia's study, the group A received the single-task training but the participants in Yang etaI's group A did not receive any training.

In addition, only motor tasks, not cognitive tasks, were used during training in their study. Participants in the dual-task training group in their study received ball exercise training such as walking while holding a ball, walking while kicking a ball, and walking while bouncing a ball. Thus, it is still unclear whether the type of task (motor vs. cognitive) that is performed concurrently with the balance tasks in the exercise programs affects the type and magnitude of training benefits on dual-task balance performance. None of the studies have examined the effect of dual-task training or the effect of instructional set on dual-task balance performance in the elderly population.

Alternatively, according to the task automatizationhypothesis practicing one task at a time allows individual to automatize the performance of such individualized tasks. Kramer et al also states that efficient improvement on dual-task performance was the result of both automatization of an individual task and the development of task coordination skills.

This study found that it was feasible to implement individualized dual task training combining with a variety of cognitive tasks in community dwelling older adult's people with impaired balance.

We also found that the older adults could in fact adhere to the instructional sets regarding attentional focus. They successfully allocated their attention to the task in which they were instructed. Thus results may generalize to similar older adults with impaired balance, excepting those who with significant neurological and musculoskeletal problems.

Conclusion

The present study concluded that dual task training is more effective in improving quality of life and balance under dual task context in older adults with balance impairment than single task training.

Although in our results we could found that both the training groups showed significant improvement in quality of life, in which dual task with fixed priority showed much improvement than single task training.

Thus, the alternate hypothesis stated in the beginning of the study, that is, Dual task condition balance training acts as better technique from single task balance training in older adults with balance impairment, have been proved.

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Source of Funding: Self

Conflict of Interest - Nil.

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