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ORIGINAL ARTICLE

EFFECTIVENESS OF DUAL TASK TRAINING WITH MENTAL PRACTICE IN IMPROVING THE BALANCE AND COGNITION IN ELDERLY POPULATION	Search engine: **www.ijmaes.org**

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ABSTRACT

Background of the study: According to the study done by "Program On The Global Demography Of Aging At Harvard University – August 2016", India's aged population (age 60 and older) has dramatically increased and is three times higher than that of the population as a whole. Balance and cognitive issues are common problems that elderly face in their daily life as they can make elderly more prone for falls. **Objective of the study**: To determine the efficacy of dual task training with mental practice in improving balance and cognition of elderly population. **Methodology**: 30 subjects with age > 65 were participated in this study. Subjects were divided in to two equal groups with 15 samples in each group. Group A performed Dual task training, mental practice and conventional balance exercises and Group B performed conventional balance exercises. Both group performed the exercises for four (4) weeks. Outcome was measured before and after the treatment using BBS and MMSE. Analysis were done using Wilcoxon Signed Rank Test and Mann Whitney U Test. **Results**: There is significant difference in balance and cognition in elderly population after practicing dual task training along with mental practice. **Conclusion :** For the elderly with balance and cognitive impairment, dual task training along the mental practice can advantage the balance and cognitive function.

Keywords: Balance, Cognition, Elderly, Dual task training, Mental practice.

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INTRODUCTION

According to a study done by "Program On The Global Demography Of Aging At Harvard University – August 2016", India's aged population (age 60 and older) has dramatically increased and is estimated that it is three times higher than that of the population as a whole[1]. As age progresses, there will be changes in structure and neurophysiology of major systems in our body and these changes will contribute to the weakness, fatigue, movement difficulties, balance issues and cognitive decline in elderly population[2-4]. Cognitive processing has an important role in balance[5]. Higher order cognitive functions are called upon while walking[6-10]. Therefore, with aging when these cognitive domains are affected, walking and balance become less automated and more cognitively taxing[11]. Also, in our day to day life in order to perform Activities of daily living (ADL), we need a simultaneous performance of concurrent tasks while maintaining balance [12]. Older people will find it difficult and will become more prone to falls.Drew W. R. Halliday et.al (2017) in his work on Comparing executive function, evoked the hemodynamic response, and gait as predictors of variations in mobility for older adults has elucidated that a decline in executive functioning is an important factor for falls in elderly population[13]. There are studies that emphasize the importance of exercise in elderly. In a study by Mazzeo RS et.al (1998) the importance of exercise has been explained and according to it Exercise is the only key to stay strong, energetic, and healthy as a person gets get older[14.]

Dual task training is defined as the ability to perform two or more cognitive and motor activity while maintaining postural control[12]. As age progresses gait pattern will be affected. For example: walking speed and stride length decreases, while lateral sway and stride time variability increase with age[15-17]. Among these changes some are compensatory, others are used for stabilizing posture and few others are dysfunctional and correlates to the accidental falls[18]. This observed deterioration has been attributed to a variety of causal factors, notably cognitive decline[19, 20]. This is supported by the fact that age related gait changes are more pronounced in people with cognitive impairment and that too under dual task conditions[21,22]. Dual task training is a neurorehabilitation strategy used to investigate the interaction between cognitive processing and motor performance[23]. As the cognitive activities are controlled by the prefrontal areas, with training there'll be increased PFC activity which might be able to prevent or moderate age-related changes to the brain [24]. Neuronal activation can lead to increased regional cerebral blood flow in frontal areas[25, 26]. In addition to this, other factors associated with the transport of certain blood-borne factors have been shown to be increased in brain areas in the presence of increased neural activity, like growth factor-1 (IGF-I) input in activated regions. IGF-1 modulates neuronal growth, survival, neural excitability, and cognitive function[27].

Mental practice refers to the process of mental or cognitive imagining of some aspect of the performance of a task or skill in the absence of any associated, overt physical actions (Fell & Wrisberg, 2001)[28]. Mental practice facilitates retention of the skill in older adults only, indicating that mental practice was especially beneficial for older adults (Jarus & Ratzon, 2000)[38]. This approach increases activation of the neural circuits in motor areas related to planning and preparation i.e., supplementary

motor area, the primary motor cortex, the inferior parietal cortex, the basal ganglia, and the cerebellum and decreases activation in primary motor areas[32-37].

As for maintaining balance, cognitive aspects such as executive function and working memory are needed. Dual task training along with mental practice can help the elderly to combat the cognitive problems associated with the balance.

Need of the Study: The purpose of the study is to implement a best rehabilitative program for the elderly with balance and cognitive issues.

Aim and objective of the study: To determine the efficacy of dual task training with mental practice in improving balance and cognition of elderly population.

HYPOTHESIS

Null hypothesis: There is no statistically significant difference in elderly population when dual task training is combined with mental practice.

Alternate hypothesis: There is statistically significant difference in elderly population when dual task training is combined with mental practice

METHODOLOGY

Study Setting: Old age homes in and around Trivandrum.

Study Design: Pre versus posttest experimental design

Study Duration: The study was conducted for a duration of 4 weeks.

Sample Size: 30 subjects who satisfied the inclusion and exclusion criteria were selected.

Sampling procedure: Purposive sampling method

Inclusion Criteria:

- Normal elderly including males & females from 65 years onwards.
- BBS score ≤ 42 suggesting balance impairment.
- Subjects having balance impairments with significant history of ≥ 2 fall.
- Able to understand verbal instructions
- Able to walk 9 meters without any assistive device.

Exclusion Criteria:

- Any severe cardiovascular disease such as uncontrolled hypertension or orthopedic problems such as osteoarthritis and osteoporosis etc. which affects their day-to-day routine activities.
- Smoking or alcohol intake.
- Any neurological problems such as cerebral disorders, stroke, Parkinson's disease,
- Significant hearing & visual impairments.
- Any speech deficits interfering the survey.
- Subjects using tranquilizers, heavy drugs.
- Unstable seizure disorders interfering the survey.

Outcome Measure: Berg Balance Scale, Mini Mental Status Examination.

Procedure: Subjects who fulfilled the inclusion and exclusion criteria were recruited for the study. Informed consent was taken from all the included subjects before starting the study. Individuals were totally explained about the procedure. 30 participants were then recruited by purposive sampling method to Group A and Group B. A pretest assessment of balance and

cognitive function were taken using BBS and MMSE. Group A subjects were then assigned to follow dual task activities for 15 min, mental practice for 15 min along with conventional exercises for 22min for a period of 4 weeks, 3 sessions per week for a total of 52 min. Group B subjects were assigned to follow conventional exercises for 22min for a period of 4 weeks, 3 sessions per week for a total of 22 min. At the end of program subjects were reassessed by BBS and MMSE. Finally pre and posttest findings were computed statistically and analyzed.

Exercise Protocol

Group A (Experimental Group): This group performed Dual task training, Mental practice and conventional balance exercises.

DUAL TASK TRAINING GROUP[40,54]	MENTAL PRACTICE[28,54]
1. Naming objects while standing on a compliant surface. 2. Backward recitation of words while standing tandemly. 3. Counting backwards while transferring from one chair to another. 4. Naming words starting with a particular letter while walking backwards. 5. Mathematical subtraction while walking forwards.	1. Mental imagery of walking in real life situations: uneven surface, confined space. 2. Tandem walking 3. Practice walking at variable speeds 4. Obstacle crossing, bending and changing the direction 5. Mental relaxation

Group B (Control Group)

CONVENTIONAL BALANCE PROGRAM[52,53]
1. Flexibility: Calf, hamstring, quadriceps, hip flexors & hip adductors (15 sec hold and 5 repetition). 2. Strength: Abdominal (curl ups), spinal extensors (prone extension), hip abductors (side lying with a weight around the ankle), hip extensors (in prone), hamstring (prone knee flexion) and quadriceps (knee extension in high sitting): all movements are given for 10 repetitions. 3. Postural control: Stepping in all direction, reaching to limits of stability in different position (kneeling, half kneeling, standing: on hard surface and foam surface), step up and down, tandem standing and walking, single limb standing (eyes open and closed). 4. Endurance: Walking for 12 minutes at self-selected comfortable pace on a level surface.

RESULT

OUTCOME MEASURES	MEAN		STANDARD DEVIATION		MEAN DIFFERENCE	P VALUE	Z VALUE
	PRE TEST	POST TEST	PRE TEST	POST TEST			
BBS	30.60	37.13	2.501	2.642	6.53	0.000	-3.493
MMSE	21.60	26.13	1.121	1.125		0.000	-3.508

Table 1: Pretest Vs Post Test BBS and MMSE scores in Group A

OUTCOME MEASURES	MEAN		STANDARD DEVIATION		MEAN DIFFERENCE	P VALUE	Z VALUE
	PRE TEST	POST TEST	PRE TEST	POST TEST			
BBS	30.27	32.53	2.738	2.722	6.53	0.000	-3.578
MMSE	21.67	23.20	1.047	1.265		0.000	-3.508

Table 2: Pretest Vs Post Test BBS and MMSE scores in Group B

OUTCOME MEASURES	GROUP	MEAN SUM	SUM OF RANKS	MANN WHITENY U TEST	P VALUE
BBS	A	21.13	317.00	28.000	0.000
	B	9.87	148.00		
MMSE	A	22.60	339.00	6.000	0.000
	B	8.40	126.00		

Table 3: Comparison of Group A and B between post test values of BBS and MMSE

The pre-test and post-test mean value tables (Table-1,2) shows that both group has significant improvement. Table 3, compares the posttest values of BBS and MMSE in group A and group B and shows that both group has improvement. Although improvement was seen in both groups, Group A (dual task training, mental practice) improved better when compared to Group B (conventional group).

DISCUSSION

This study was conducted to investigate the changes in balance and cognition of elderly after implementing dual task training and mental practice.

30 Subjects those satisfying the inclusion criteria were recruited for the study. Subjects were then allocated to two groups- group A and group B, 15 in each group. Each subject was well explained about the procedure of the intervention and the possible risks involved. A written informed consent from each subject was obtained. Subjects in group A received experimental treatment of Dual task training and mental practice along with conventional therapy. Subjects in Group B received Conventional treatment alone. All subjects well tolerated the interventions given and no one was dropped out of the study.

Balance was measured using a reliable tool, Berg Balance Scale and cognition was measured with MMSE.

All outcome measures were collected before and after the intervention protocol. In both groups, Wilcoxon test was used to compare pre and posttest values. The post test scores of both groups were analyzed using Mann Whitney u test. The results of the study shows that after four weeks of training with the dual task training and mental practice patient had shown a drastic improvement.

An increased incidence of falls among older adults is one of the most serious problems of mobility impairment. Previous studies have shown that with aging there will be changes in cognition and that these changes can contribute to balance impairment in the elderly population[29, 30].studies have reported that the main cognitive domains (working memory and executive functioning) that are linked to balance are severely affected with aging. Therefore there is a need for rehabilitation to these areas for a better balance outcome. Therefore I used a multimodal treatment which included Dual task training, mental practice and conventional treatment together for the elderly population.

Hisayo Yokoyama et al., (2015) conducted a randomized control trial to know the effectiveness of cognitive-motor dual-task training on cognitive function and plasma amyloid β peptide 42/40 ratio in healthy elderly persons. The results of the study had found that Cognitive-motor dual-task training was more beneficial than single-task training alone in improving broader domains of cognitive functions of elderly persons[39] Patima Silsupadol et.al in a study to compare the effect of 3 different approaches to balance training on dual-task balance found that Dual-task training is effective in improving gait speed under dual-task contexts in elderly individuals with impaired balance and single-task training may not generalize to balance performance under dual-task conditions[40]. These aforementioned studies all show that dual task training is a better rehabilitative approach which by activating the executive domains in the prefrontal cortex can help in improving the

balance in elderly than a single task training[39,40].

Zeynab Taheri (2014) in his experimental study examined the potential usefulness of mental practice for improving Static and Dynamic Balance in the Community-Dwelling Elderly and they concluded that mental practice may hence be an important therapeutic tool to improve both static and dynamic balance in elderly[31]. Studies by several others suggest that mental practice by the activation of the areas involved with working memory can help in improving balance[32-,37].

The results of the present study were measured using BBS and MMSE. BBS is having internal consistency, reliability, interrater reliability, and construct validity in elderly population[41]. The objective of using the BBS in this study was to provide an uncomplicated, standardized, quantitative assessment of Balance before and after interventions in Group A and Group B.

Based on the statistical analysis in experimental group (Group A) the pretest mean value with the standard deviation of BBS was 30.60±2.501with minimum value of 27 and maximum value of 35 and of posttest mean value with the standard deviation was 37.13±2.642, with a minimum value of 33 and a maximum value of 41, Mean difference was 6.53 z value was -3.493 and p value was 0.000. The test result shows that there is a statistically significant difference between pretest and posttest values of BBS in the experimental group. Based on the statistical analysis in Control group (group B), pretest mean value with the standard deviation of BBS was 30.27±2.738 with a minimum value of 26 and a maximum value of 34 and of posttest mean value with standard deviation was 32.53±2.722, with a minimum value of 29 and a maximum value of 36 .Mean difference was 2.26, z value was -3.578 and p value was 0.000. The test result shows that there is a statistically significant difference between pretest and post-test values of BBS in control.

While comparing Group A and Group B, the mean rank for Group A was 21.13 and group B was 9.87.The sum of rank for group A was 317.00and for group B was 148.00, Mann Whitney U value was28.000, the P value was 0.000. The result of the study shows that there is a statistically significant difference between the posttest mean rank of BBS in Group A and Group B. The posttest mean rank of BBS shows that Experimental Group (Group A) shows significant improvement in Balance than Control Group (Group B). Ching-Yi Wang et.,al (2006) conducted a study to investigate the psychometric properties (acceptability, internal consistency reliability, interrater reliability, construct validity) and identify the most challenging items of the Berg Balance Scale (BBS) for elderly people living in the community and found that internal consistency reliability, interrater reliability, and construct validity of the BBS are adequate for measuring balance in community-dwelling older adults.

With aging, there will be changes to working memory too. These changes can contribute to balance issues. Mental Practice is an effective intervention for improving working memory[43-45].

The objective of using the Mini Mental Status Examination in this study before and after the interventions in Group A and Group B was that it is one of the most valid outcome measures of for measuring cognition in elderly population[42]. Based on the statistical analysis in the experimental group (group A), pretest mean

value with a standard deviation of MMSE was 21.60±1.121with a minimum value of 20 and a maximum value of 23 and of posttest mean value with a standard deviation was, 26.13±1.125with minimum value of 25 and maximum value of 28.Mean difference was 4.53, z value was -3.508 and p value was 0.000. The test result shows that there is statistically significant difference between pretest and posttest values of MMSE in experimental group. Based on the statistical analysis in control group (group B), pretest mean value with standard deviation of MMSE was 21.67 ±1.047 with a minimum value of 20 and a maximum value of 23 and of posttest mean value with standard deviation was, 23.20±1.265 with minimum value of 21 and maximum value of 25. Mean difference was 1.53, z value was -3.508 and p value was 0.000. The test result shows that there is a statistically significant difference between pretest and posttest values of MMSE in control group. While comparing Group A and Group B, the mean rank for group A was 22.60 and for group B was 8.40 .The sum of ranks for group A was 339.00 and for group B was 126.00 Mann Whitney U value was 6.00, the p value was 0.000.The result of the study shows that there is a statistically significant difference between the posttest mean rank of MMSE in group A and group B .The posttest mean ranks of MMSE shows that experimental group (Group A) shows significant improvement in cognition than in control group (group B). The use of MMSE as an objective quantitative outcome measure has been endorsed by a number of studies. Tom N. Tombaugh in 1992 conducted a comprehensive review on The Mini-Mental State Examination and found that the Reliability and construct validity were judged to be satisfactory. For moderate to severe cognitive impairments and for lower levels for mild degrees of impairment, measures of criterion validity showed high levels of sensitivity .Content analyses also revealed that MMSE was highly verbal, and not all items were equally sensitive to cognitive impairment. Items measuring language were judged to be relatively easy and lacked utility for identifying mild language deficits. Overall, MMSE scores depends on age, education, and cultural background, but not gender[42].

These results are in agreement with other studies in which it was demonstrated that dual task training with mental practice when compared to no intervention or with dual task training different to this intervention, have been effective for elderly.

The interventions used in this study are Dual task training, mental practice and conventional treatment. There are numerous studies which had shown the effectiveness of dual task training. With dual task training the most prominent changes will occur in the prefrontal cortex.. The main functions involved with the Prefrontal cortex are memory, executive functioning attention, emotion as well as playing a role in a variety of other complex cognitive functions[46-48].For an effective balance maintenance the proper functioning of prefrontal cortex is necessary. With aging there will be decline in cognitive ability and that is related to disuse of certain cognitive functions and a corresponding reduction in brain activity[50].Previous studies have mentioned that with increased activity of the PFC might be able to prevent, or moderate, age-related changes to the brain[49,24]. With Neuronal activation an increase of regional cerebral blood flow can occur[25,26]. In addition to increased blood flow in active areas, transport of other factors like certain blood-borne factors

have been shown to be increased in brain areas in the presence of increased neural activity[27].

Mental practice has been defined as the mental or cognitive imagining of some aspect of the performance of a task or skill in the absence of any associated, overt physical actions. In a study investigating the effect of age on mental practice, mental practice was found to be beneficial in the acquisition of a bimanual coordination task for older adults. Mental practice facilitated retention of the skill in older adults only, indicating that mental practice was especially beneficial for older adults (Jarus & Ratzon, 2000). Fell and Wrisberg (2001) conjectured the mechanism of action of mental practice as involving minute muscle contractions of the involved muscles in the imagined activity stimulated by impulses from the brain, encoding of the movement patterns within the brain, and by activating, rehearsing, and reinforcing internal imagery[51].

The results of the study indicates that although both treatment groups show significant improvement on balance and cognition, Group A who performed dual task training, mental practice and conventional treatment improved more significantly on comparing with Group B .This shows that the effectiveness of dual task training with mental practice is more pronounced and so it can used as a better rehabilitation protocol for elderly population with balance issues.

CONCLUSION

The study compared the effectiveness of dual task training with mental practice in improving balance and cognition of elderly population. Group A and Group B received the interventions accordingly and were tested both before and after interventions and found that dual task training and mental practice when combined and provided for elderly population can help in improving balance and cognition than conventional treatment alone.

Limitations

1.As the long term sustenance effects of training were not assessed so follow up may further be done in future, 2.Both gender were included; progression may vary in different genders, 3. Blinding of therapist was not done, 4. Small sample size, 5.The use of a convenient sampling prevented random selection, so the results may not be applicable for all elderly population

Recommendations

1.Effects on improvement of Activities of daily livings may be assessed in future, 2.Further research is recommended in a larger population. 3.The impact of factors such as trauma, neurological or orthopedic impairment, or progressive disability on the efficacy of dual task training with mental practice has to be considered, 4.Randomized controlled trial shall be done

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