Comparing the Effect of Two Different Dual Task Training Conditions on Balance and Gait in Elderly

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ABSTRACT

AIM: *Aim of this study is to assess the appropriate strategy between (two) different dual task (cognitive-motor and motor-motor) for improving balance and gait in elderly people.*

Methodology: *60Subjects were randomly selected from the community who volunteered to participate in the study. Subjects were randomly assigned in to three interventions: cognitive-motor dual task training, motor-motor dual task training and single balance training. Subjects were received 45 minute individualized training sessions3 times a weeks. Outcome measure; BBS, POMA, OPQOL were collected at before and after intervention.*

Results: *Subjects in all groups improved on the BBS, POMA and OPQOL. When we compared the three groups, we found that cognitive-motor dual task training was far superior than either motor- motor dual task training and balance training. Significant improvement in balance , gait and quality of life (p<0.05) Also out of motor-motor dual task training and balance training, balance training group showed better improvements.*

Conclusion: *It can be concluded from our study that the cognitive –motor dual task training is better than motor-motor dual task training and balance training over the balance, gait and quality of life in elderly.*

Keywords: *Berg Balance Scale (BBS), Performance Oriented Assessment Scale (POMA), Older People Quality Of Life (OPQOL) and Aging.*

INTRODUCTION

Aging progressively impairs sight, vestibular input, and somato-sensory information, which results in a reduction of environmental perception and precision of movements. Aging also impairs functioning of movements by reducing the number of muscle and nerve fibres, which bring a reduction to muscle strength and power.[1]For these

reasons, individuals who are 50 years old may start to experience manifestations of imbalance and body instability. Therefore, simple activities like standing up or rising from a chair may become limited or even dangerous, because they are dependent on both gait and balance.[1]. Approximately 30% of older adults experience a fall each year. Falls often lead to a decreased quality of life and in some cases falls even lead to death.[2] Part of all falls in older people occurs during activities when attention needs to be divided between postural control and other tasks, such as when walking while maintaining a conversation. A possible explanation is that attention resources are limited and postural control is more attention demanding in older adults than in young adults. Also, older adults may prioritize tasks differently..Although activities of daily living often require maintaining balance during performance of several concurrent task, balance is most often trained under single task condition . Single task training involves practicing functional task requiring balance (e.g. standing, walking and transfer) in isolation, in effort to increase the challenge to balance during the performance of functional task. It has been suggested that training balance under both single and dual task condition is necessary to optimize functional independence and reduce fall in elderly.[3]. Interventions that improve dual task balance performance are critical health care need. Studies have shown the positive effect of training on balance and gait in several population including older adult and individual with stroke.[3] Cognitive-motor dual task training has proven more effective in improving dual task

motor performance than single task training suggesting that the training of task coordination process is beneficial for control of gait and balance entails attentional capacity as commonly shown using dual-task methodology. Cognitive dual task training protocol that has shown significant neuro-plastic changes and transfer effects in healthy older adults.[4]

It has been proved that dual task training is beneficial than single task training in elderly but the types of dual task used have not been investigated. It is required to know which type of dual task (cognitive-motor or motor-motor) will be much beneficial for improving function, balance and quality of life in elderly.

METHODOLOGY

60 Subjects were recruited from various old age homes, senior citizen forum and local community from Ludhiana, India on the basis of inclusion and exclusion criteria.5 subjects were drop out due to personal reason.Following subjects inage 50 to 70 years, ability to walk 10 meter independently with or without assistive device, able to do simple count, history of fall in last 2 years were included and subjects with diagnosed history of any musculoskeletal or neurological impairment, visual and auditory impairment, M.M.S.E below 23, Using of medication known to impair balance and terminally ill and with history of postural hypotension were excluded. Subjects were instructed about method and purpose of the study and after that consent form was taken from each subject .Selected subject were randomly divided into 3 groups by chit method; cognitive-motor

dual task training(A), Motor-motor dual task training(B) and single task balance training(C) groups.

Outcome measure; Three outcome measures BBS, POMA, OPQOL were used to see the effectiveness of the trainings compared to pre intervention values, after 4 weeks of intervention.

Intervention
GROUP-A

Cognitive-Motor Task Training: All subjects in this group received dual task training including one motor and another cognitive task for 45 min, 3 times a week, for 4 weeks.Subject walked 10 m while counting backward from 100. During task subject instructed to concentrate on both gait and counting simultaneously. Subject performed 3 rounds then 3 min rest was given. After rest subject was instructed to clear obstacle between walkway like cones, rope, and wooden blocks without counting.

GROUP B

Motor- Motor Task training: All subjects in this group received dual task training including two motor tasks. Training was given for 45 min, 3 times a week for 4 weeks.Subject asked to narrow walk with short steps 10 m while holding a ball in both hand with comfortable speed and performed 3 rounds, after 10 m walk, 3 minute rest was given

GROUP C

All Subjects in this group received balance training for 45 min 3 times a week for 4 week.

Training starts with 5 min warm up and 5 min cool down remaining 35 min for balance training

Semi Tandem: Subject asked to stand with one foot ahead of other as if taking step and hold for 10 to 30 sec.

Full Tandem: Subject asked to stand with heel of one foot directly in front of toes of other foot .hold it for 10 to 30 sec.

Standing on One Foot: Subject asked to stand on one foot and hold it for 10 to 30 sec.

Lateral and Forward Reaching: Subject asked to reach forward and lateral and touch the wall.

Tandem Walking: Subject asked to place one foot directly in front of other. Touching heel to toe and then hold. Repeat this with foot in front.

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Fig 1.1: Cognitive-motor dual task   Fig 1.2: Motor-motor dual task   Fig 1.3: Balance training; Counting backward while walking Holding a ball during walking Tandem walking

Post intervention

After 4 weeks of intervention, all subjects were again assessed on BBS, POMA and OPQOL

RESULTS

- Data was analyzed using SPSS version-11.5.
- Paired t-test was done to compare pre and post intervention reading of BBS, POMA& OPQOL within groups ANOVA test was done to compare
- pre and post reading of BBS, POMA & OPQOL in between gps.
- Level of significance was set at 0.05
- Data was analyzed for 55 subjects with mean age 62.5.

Within Group Analysis:

Table.2.1: Comparison with in Groups using paired t-test

Groups		95% confidence interval of the difference		t	Sig. (2-tailed)
		Lower	Upper		
Group A	BBS	-8.722	-6.225	-12.578	.000
	POMA	-5.027	-3.184	-9.360	.000
	OPQOL	5.749	9.093	9.324	.000
Group B	BBS	-6.311	-3.806	-8.563	.000
	POMA	-3.450	-1.962	-7.707	.000
	OPQOL	.433	6.272	2.435	.027
Group C	BBS	-5.763	-3.185	-7.292	.000
	POMA	-5.075	-3.031	-8.330	.000
	OPQOL	4.636	6.943	10.541	.000

Results showed that subjects in all the intervention groups improved on BBS, POMA and OPQOL.

Between Group Analysis:

Table 2.2: Between groups analysis using ANOVA

	F value	Sig.
BBS	3.662	.033
POMA	3.823	.028
OPQOL	.153	.858

Multiple Comparisons using post hoc tukey's test

Table 2.3: Multiple comparison of BBS score post therapy

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group 1	Group 2	3.873*	1.519	.036	.21	7.54
	Group 3	3.000	1.476	.115	-.56	6.56
Group 2	Group 1	-3.873*	1.519	.036	-7.54	-.21
	Group 3	-.873	1.519	.834	-4.54	2.79
Group 3	Group 1	-3.000	1.476	.115	-6.56	.56
	Group 2	.873	1.519	.834	-2.79	4.54

*.The mean difference is significant at the 0.05 level.

Table 2.4: Multiple comparison of POMA Score post Therapy

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group 1	Group 2	2.916*	1.088	.026	.29	5.54
	Group 3	2.000	1.057	.151	-.55	4.55
Group 2	Group 1	-2.916*	1.088	.026	-5.54	-.29
	Group 3	-.916	1.088	.678	-3.54	1.71
Group 3	Group 1	-2.000	1.057	.151	-4.55	.55
	Group 2	.916	1.088	.678	-1.71	3.54

*.The mean difference is significant at the 0.05 level.

Table 2.5: Multiple Comparison of OPQOL Post Therapy

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Group 1	Group 2	-.536	3.949	.990	-10.06	8.99
	Group 3	-2.053	3.838	.855	-11.31	7.21
Group 2	Group 1	.536	3.949	.990	-8.99	10.06
	Group 3	-1.517	3.949	.922	-11.05	8.01
Group 3	Group 1	2.053	3.838	.855	-7.21	11.31
	Group 2	1.517	3.949	.922	-8.01	11.05

*. The mean difference is significant at the 0.05 level.

ANOVA showed statistically significant differences in post-therapy mean BBS, POMA and OPQOL. Between groups analysis showed that group A i.e. cognitive-motor dual task training was better than other two groups for improving balance, gait and quality of life. Also balance training was better than motor-motor dual task training

DISCUSSION

In our study we tried to compare the effect of cognitive-motor dual task and motor-motor dual task training for improving balance, gait and quality of life in elderly. We also tried to see the effect of dual task training over balance training (single task condition). Three outcome measures BBS, POMA, OPQOL were used to see the effectiveness of the trainings compared to pre intervention values. After 4 weeks intervention programme subjects in all training group significantly improved on all the three outcome measures.

Our results show that all the three training techniques are effective in improving balance, gait and quality of life in elderly. When we compared the three groups, we found that cognitive-motor dual task training was far superior than either motor- motor dual task training and balance training. Also out of motor-motor dual task training and balance training, balance training group showed better improvements.

COGNITIVE –MOTOR DUAL TASK TRAINING

In our study we found that cognitive-motor dual task training showed significant improvement in balance, function and quality of life in the elderly. The ability to divide one's attention between two or more concurrent task is an important aspect of functional movement during activity of daily living. Executive function (sustained attention) is important to dual task ability.[5] This improvement is due to the fact that ability to maintain balance under dual task condition relies on successful interaction between neural mechanism that regulate postural control and those that regulate the coincident cognitive or motor task.[6] Similarly, GalitYogev et al. 2011 in their four week programme of one-on-one training including walking while performing several distinct cognitive task observed that gait speed and gait variability improved significantly during dual task with variable prioritization (alternate focus on cognitive and motor task) possibly because dual task gait training enhance divided attention abilities during walking.[7]Similar studies supports our studies .[3,8,9,10,11,12]

MOTOR- MOTOR DUAL TASK TRAINING

In our study we also found a significant improvement in motor -motor dual task training group.This significant effect is due to the same mechanism as of cognitive motor dual task training but motor-motor dual task is moreautomatic and requires less amount of attention. Two tasks together allow participant to develop task coordination skills, integration and coordination between two tasks which is acquired during dual task training is crucial for improving dual task performance. Performance of dual tasks requires information processing capacity that allows the efficient allocation of attention between two tasks. The focus on the body movement during execution of motor skill is relatively ineffective because it interferes with automatic control processes.[13]Jaqueline M et al (2000) depicted that similar task share the same motor control processing mechanism and therefore less resources are used during simultaneous performance of similar task than are used during simultaneous performance of disparate motor task.[14] similarly another study by Roberta B et al also found effect of exercise and training on function motor performance in stroke then concluded that training method design to stimulate motor learning In our study we found during motor-motor dual task training improves the balance and function in elderly through motor re-learning.[15]

BALANCE TRAINING

The third training protocol; the balance training; also showed improvement in all the three parameters in elderly which has already been well proved in the literature. Thus our results strongly support the existing literature that balance training is an effective technique to improve balance, gait and QOL in elderly. The possible reason is that during balance training balance control is multisystem process requiring critical input from vestibular, visual and proprioceptive system information regarding body position, gravity,

musculoskeletal activity, tactile and visual feedback and other input provides the nervous system with the information required to maintain balance during balance training. In several studies has been proved the balance training enhance the ability to sense the joint position in space, it improve mental and neural functioning which in turns improves motor functioning and balance.[16,17,18,19,20]

COGNITIVE- MOTOR DUAL TASK VERSUS MOTOR-MOTOR DUAL TASK

In our result we found that cognitive- motor dual task training more improved then motor –motor dual task training. The improvement in cognitive – motor dual task training is due to that it needs high demand of motor process on attention resources and it involves both cognitive and motor skill.Another reason is that in cognitive-motor dual tasks training there are two session, one is backward counting while walking and another session is obstacle clearance in form of ladder, cone and wooden block. The above make cognitive motor dual task more complex and high demand attentional resources were required and due to this subject's attention was shifted between two tasks and while in motor- motor dual tasks there were two similar task hence subjects focused their attention only on one task respectively i.e. while holding a ball or walking.

DUAL TASK TRAINING VERSUS SINGLE TASK BALANCE TRAINING

According to the task automatization hypothesis, practicing only one task at a time (single task training) allow participants to automatize the performance of individual task. As a result the processing demand required to perform the task is decreased, leading to more rapid development of skills.[3] Single task training has low demand than dual tasks training. Single task training does not permit the con-current performance of two tasks, where as dual tasks training allow the co-ordination of various tasks via simultaneous performance of two or more tasks.[3]

COMPARISON BETWEEN BALANCE TRAINING AND MOTOR –MOTOR DUAL TASK

Our result found that balance training is improved more than motor-motor dual tasks training. The possible reason is that initially when two tasks are performed simultaneously, the performance often deteriorates, with concomitant increase in reaction time.[21]and due to this increase in reaction time, motor-motor dual task training group showed a decline in the performance. According to capacity sharing model, the information processing capacity is divided into two portions when performed simultaneously. Once information processing capacity exceeded, dual task interference occurs and resulting in declination of performance of one or both of the task.[22] This could be due to the fact that may the intervention time was sufficient enough for the subjects to show desired effects. Intervention for longer duration could show better results. Although several studies have shown that the dual task training is more effective for improving balance but in our study one of the reason for less

improvement as compared to balance training is that subjects were walking with holding a ball so his more concerned was on the ball and not on walking. Due to that subject was taking more time during motor-motor dual task training and their performance deteriorating. A further research is warranted to clarify this result.

Study Limitation: First limitation isQuantitative measurement of gait parameter had not done. There are several other measures that could be used e.g. center of mass and center of pressure inclination angle have been shown to be a sensitive measure of balance control during gait in elderly. And second is Sample size was small in the study. If the number of subjects would be more, then the results would be better enhanced. And third limitation is among motor-motor dual task and balance training improvement was less due to time insufficient.

CONCLUSION

It can be concluded from our study that the cognitive –motor dual task training is better than motor-motor dual task training and balance training over the balance, gait and quality of life in elderly.

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