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Functional Balance & Gait Balance in Normal Geriatric Population: By Gait Training with Multiple Task

Anwesh Pradhan[1], Rishi Raj[2], Gargi Ray Chaudhuri[3], Shabnam Agarwal[1], Tanusree Basak[1]

[1]Associate Professor, [2]PG Student, [3]Professor, Nopany Institute of Healthcare Studies, Kolkata, India

ABSTRACT

The main impact of pathologies in geriatric population is falling due to abnormal gait deviations. Thus, fear of falling reduces their mobility that prevents independent living in geriatrics. Mobility depends on person's ability and perception to complete a task. Multiple task training is an interaction of motor and somatosensory inputs. Improvement of gait in geriatrics depends upon the type of task and environment, potentially due to cognitive dysfunction and reduced cognitive performance.

Purpose of this study: Geriatric persons were trained with multiple task activity and mental tasking which may help them to improve their gait balance in the altered environment and eventually improve their gait task and reduced chances of fall.

Materials and Method: 40 normal geriatric individuals were taken in 2 groups. One group was trained with multiple task exercise while the other was trained with the same and cognitive task for the period of 4 weeks. Gait balance is measured by Berg balance score and Time up and go test.

Results: The independent t-test shows significant ($p<0.05$) difference between groups and the mean comparison shows multiple tasking with cognitive tasking has a better impact in improving gait balance in geriatric population.

Conclusion: Multiple tasks exercises with cognitive task can be used as a better tool to improve the gait balance than the multiple task exercises

Keywords: *Fall, Gait balance, Multiple task exercise, Cognitive tasking*

INTRODUCTION

A gradual but definite reduction in physiological capacity of different systems is observed in the process of aging, which leads to decrease in functional capacity of elderly and chronic disabilty.[1,2] Established Populations for Epidemiologic Studies of the Elderly (EPESE) indicated the physical disability is most prevalent in oldest-old based on linear relationship between disability and age.[3]

In elderly, 30% of people who are 65 years old are prone to fall about once a year. [4,5] Falling is an interaction of physical dysfunction, medications and environmental hazards that leads to over-balancing and gait impairments. Patla and Shumway-Cook describes Functional gait in eight environmental dimensions like time constraints, distance, ambient conditions, terrain characteristics, external physical load, attention demand, postural transitions and traffic. [6,7] Improvement of gait in geriatric population can be considered to make a person walk with a functional speed. It is evident that inability to perform concurrent tasks based on the gait dimensions is a contributing factor to instability and falls in older

Corresponding author:
Anwesh Pradhan
Associate Professor, Neuro Physiotherapy Department
Nopany Institute of Healthcare Studies, 2C Nando Mullick Lane, Kolkata, India, Pin-700006
Mobile: +91 9932874589
Email: anwesh0907@gmail.com

adults. In this context it has been suggested that gait training under multiple task conditions are necessary to optimize functional independence and reduce falls in elderly people. [8,9,10]

Multiple task training is an interaction of motor and somatosensory inputs. In multiple tasks such as narrow walking and obstacle walking, participants either stop their walking or take a longer time to complete their gait task due to loss of central capacity to carry out walking and maintain their balance simultaneously. Improvement of gait balance in geriatric population depends upon the type of task and environment, potentially due to cognitive dysfunction or because of reduced cognitive performance. [11]

Multiple task intervention is guided by pathology that underlies the gait deficit, helps to improve functional gait. In multiple task training, the visual attention task and mental task interferes with attention or postural control.

In India the size of the elderly population is fast growing. United Nations (1996 Revision) has indicated that 21% of the Indian population will be 60 plus by 2016. [12] NSS Survey on Employment-Unemployment (2007-2008) revealed that nearly 40% of the persons aged 60 years are working. [13] In rural areas 66% of elderly rural men & above 23% of elderly rural women still participating in economic activity, than in urban area whereas only 39% of elderly men above 7% of elderly women participating in economic activity. [14] So, improving their gait balance may help in improving the quality of life of geriatric population and the society as well both economically and socially.

Thus the purpose of this study is to find out the effects of gait training under multiple task conditions to improve functional balance and gait balance in normal geriatric population.

MATERIALS AND METHOD

Participants included were community dwellers of Kolkata of both genders, aged between 65-75 years, able to walk approximately 4 meters without any assistance. Institutional Human Ethics committee approved informed written consent was taken from the willing participants and then were randomly divided in 2 treatment groups (Group A & B). Both groups participants were practiced narrow walking and obstacle walking, additionally group B participants were given mental tasking to do along. All participants underwent 4 weeks training, 3 days per week, 45 minutes per session. Cardiovascular monitoring was done before and after the interventions for all the participants. [15,16,17]

Narrow Walking: Participants were asked to walk within 2 parallel strips marking on the floor of 4 meters distance. The width of the strips was determined by 4 cm less than their preferred step-width.

Obstacle Walking: Participants were asked to walk and step over 3 obstacles (a shoe box: 10cm high X 19cm wide X 33cm long), placed at starting, 2 meter mark and 4 meter mark in a stretch of 4 meter distance.

Mental Tasking: Participants were asked to walk (Narrow and obstacle walking), counting backward by threes from any starting number from 90 to 200 simultaneously. [18]

Outcome Measures: Demographic information was collected from all participants in pre-designed format. Berg Balance Scale (BBS) and Time up and go test (TUG) were performed to measure the functional balance and gait balance of the participants respectively. Both the measures are valid and reliable. [19, 20, 21, 22] All the participants were underwent a practice trial before testing.

RESULTS

Total 65 participants were screened based on inclusion and exclusion criteria. Out of which 46 were selected and 40 participants had given consent. Demographic data is given in Table 1. There was no drop out. BBS and TUG scores were taken before training started and after 4 weeks of training. Paired t test was used to compare the pre and post training scores in each group which shows significant ($p<0.05$) improvement in functional and gait balance in the geriatric people Table 2. Independent t test was used to compare the pre-post mean difference between groups which shows significant ($p<0.05$) improvement in TUG score and BBS score as well (Table 3).

Table 1: Demographic data of group A and group B

	Group A (n=20) Mean (SD)	**Group B (n=20) Mean (SD)**
Age (Years)	69.50 (2.91)	70 (3.29)
Gender (Male/ Female)	8/12	10/10
Height (cm)	160.26 (8.89)	160.90 (8.08)
Weight (Kg)	62.60 (6.15)	61.95 (5.81)

Table 2: Within group Pre and post training score analysis of TUG and BBS for group A and group B

		n	**Mean**	**SD**	**Pre-Post Mean (SD)**	**df**	**t value**	**p value**
Group A TUG	Pre training	20	36.17	7.63	4.10 (3.86)	19	4.75	<0.05
	Post training	20	32.07	7.53				
Group B TUG	Pre training	20	33.60	10.64	9.45 (3.82)	19	11.09	<0.05
	Post training	20	24.13	7.41				
Group A BBS	Pre training	20	34.95	5.50	-5.25(4.02)	19	-5.83	<0.05
	Post training	20	40.20	4.40				
Group B BBS	Pre training	20	33.90	6.40	-11.80 (4.63)	19	-11.40	<0.05
	Post training	20	45.70	3.74				

Table 3: Between group comparison for TUG and BBS values

GROUP	**Mean**	**Std. Deviation**	**Mean Difference**	**df**	**t value**	**p value**
GROUP A TUG post test	32.07	7.52982	7.94100	38	3.362	0.002
GROUP B TUG post test	24.13	7.40976				
GROUP A BBS post test	40.20	4.408	-5.500	38	-4.253	0.000
GROUP B BBS post test	45.70	45.70				

DISCUSSION

The functional balance of the geriatric person was evaluated with BBS and gait balance was evaluated by using TUG in this study. The comparison between pre post training BBS score and TUG score shows significant ($p<0.05$) improvement in functional balance and gait balance respectively in group A. Which indicates that narrow walking and obstacle walking is a effective training to improve balance in geriatric population. Walking ability is an integral part of many activities of daily living. Since many daily living tasks involve concurrent movements, measures of dual-task decrement are important. Full community ambulators display a significant increase in dual-task-related gait decrement. Yea-Ru Yang et al (2006) suggested that motor task related gait determinants are present for healthy subjects/individuals. [23] Narrow walking & obstacle walking are the motor task related gait determinants. In narrow walking an individual has to walk and maintain the balance in narrow base. Whereas in obstacle walking an individual has to overcome the obstacles in the path

and maintain his balance and walk. So, improving these determinants will improve gait. P. Silsupadol et al (2006) also showed that multiple task training improve gait in older adults better than single task training. [24] One possible explanation of this outcome is task co-ordination, which is required while walking. Here the participants used strategies to co-ordinate multiple task during walking, for example, walking in a plain surface but with narrow base and obstacle with in the path.

Motor skill acquisition is associated with the development of automaticity and induces neuroplastic changes in the brain. Debare. F. et al (2003) suggested, bimanual skill learning was associated with a shift of activation among cortico-subcortical regions, providing further evidence for the existence of differential cortico-subcortical circuits preferably involved during the early and advanced stages of learning. [25] They said that bimanual activation changes account for the transition from highly attention demanding task performance, involving processing of sensory information and corrective action planning, to automatic performance based on memory representations and forward control. In elderly people, coordinating and managing multiple tasks is crucial and reduced. So, training them in multiple tasks can improve their task coordination. Here in this study they improved their gait balance by doing task while walking. So narrow walking and obstacle walking can be a useful to improve gait balance in elderly person.

Participants of group B had undergone mental tasking along with narrow walking and obstacle walking which also showed effective ($p<0.05$) in improving balance in Geriatrics. Mental task requires more attention while performing. Various studies showed that in the dual task condition attention was substantially diverted from the visuomotor task when the balance was perturbed, presumably redirected to the control of the compensatory response required to re-stabilize. According to the task coordination and management hypothesis, ability to coordination and management of multiple task activity is reduced in older adults. It is believed that postural instability evokes cortical and autonomic reactions in addition to the primary compensatory response, and it is hypothesized that these responses may be related to underlying affective influences such as tonic physiological arousal. [26] Maki and McIlory concluded in their study that Physiological arousal may be a potential cofounder when attempting to understand the influence of attention on postural control. [27]

The comparison between the findings of both groups showed that mental tasking along with narrow walking and obstacle walking was more effective statistically ($p<0.05$) than narrow walking and obstacle walking. The mental task used in this study was type of math task which intend to increase both arousal and attention to be performed. So, the training procedure can improve both arousal and attention, thus improve the gait balance. The older adults may learn the procedure and compensatory mechanisms to maintain their postural stability during gait and improve the balance during gait. The changes in learning were associated with task-related changes in physiological arousal, and highlight the need to account for the potentially confounding influence of arousal when studying attentional effects. SmithRay RL, Hughes SL (2015) also showed similar effects where they hypothesized that walking abilities and cognitive function contribute to the multiple task effects on gait balance.[11]

As per neurophysiologic control of gait, the production of basic motor sequence is mediated by spinal cord mechanisms or central pattern generators which are neuronal networks capable of generating a rhythmic pattern of motor activity in the absence of phase sensory input from peripheral receptors. [28] So, multiple cortical and sub cortical areas contribute to functional gait. [29, 30]

CONCLUSION

It can be concluded in this study that the mental task and dual task training together can help or train a geriatric individual to stay aroused and attentive during walking and so the gait balance of that person is improved.

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