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Effect of Dual Tasking on Gait and Balance in Geriatric Population: An Observational Study

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Abstract

Background: Aging is a process of growing old which describes a wide array of physiological changes in the body system. With aging, structural changes of the brain occur, especially in the prefrontal areas, which have been associated with the Executive function and attention systems. Dual tasking demands divided attention which increases chances of fall in Geriatric people.

Aim: To evaluate whether Gait or Balance which one is more sensitive for dual task activity in geriatric population and detecting changes in Gait and Balance performance.

Materials and methodology: 57 Participants with the age group of 60-84 years (70.51 ± 6.33) took part in the study. Each participant performs 10 meter walk test and berg balance scale. Gait parameters and BBS Score were measured as a baseline data. Then perform 10 MWT and BBS with cognitive and motor task (Dual Task). All gait and balance parameters were documented during dual task activity.

Results: The result shows statistical significant ($p<0.05$) effect of dual task on both Gait and Balance parameters. During dual task activity time and cadence were increased but speed, step length and stride length were reduced. BBS Score were also reduced.

Conclusion: Dual tasking affects Gait and Balance both, Where Balance is more affected than Gait in Geriatric population.

Keywords: Dual task; Berg balance scale; 10 m walk test; Cognitive task; Motor task; Geriatric

Introduction

Aging is a process of growing old which describes a wide array of physiological changes in the body system. It is a biological procedure of becoming older without being afflicted by disease. Aging involves gradual, progressive and spontaneous deterioration of most physiological functions [1]. Elderly are defined as being 65 years of age or elder [2]. A fall is often defined as a situation in which the older adult falls to the ground or is found lying on the ground.

Risk factors

Risk factors associated with the occurrence of falls in elderly are classified as intrinsic or host factors and extrinsic or environmental factors [3].

Intrinsic factors:

- Poor balance
- Weakness
- Foot problems
- Visual impairment

Extrinsic factors:

- Poor lighting
- Slippery surface
- Obstacles
- No safety equipment
- Loose carpets

Executive functions is an umbrella term for cognitive processes that regulate, control and manage other cognitive processes, such as planning, working memory, attention, problem solving, verbal reasoning, inhibition, mental flexibility, task switching and initiation and monitoring of actions.

With aging, structural changes of the brain occur, especially in the prefrontal areas, regions that have been associated with the Executive Function and attention systems Therefore, it is not surprising that elderly subjects may show difficulties in dual tasking, in general and when walking while performing another task, in particular simultaneous performance of two attention-demanding tasks not only causes a competition for attention, it also challenges the brain to prioritize the two tasks. Person's attention is divided during dual task activity that may lead to increase the chances of fall in geriatric people.

So, the research questions of this study will:

1) Do dual task affect the gait and balance in geriatrics people?
2) From gait and balance which one is more affected by dual task?

Methods

57 Ambulatory older adults taken from different old age homes of Ahmadabad with age group are >60 years. Ethics review was obtained

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from institute review board. Participant has Ability to walk household distances without assistive devices, Short Portable Mental Status Questionnaire ≥ 8 (for cognition), Berg Balance Scale Score is >40 (for balance) and excluded if they have Progressive neurological conditions, Hearing loss and visual impairment or any medical conditions that restrict the participation.

The participants were taught how to perform cognitive and motor task.

Cognitive task

Counting backward by 3's OR verbal fluency.

Motor task

By holding a tray with two glasses.

Balance and dual task

Participant performs BBS and measures the total score for baseline data. Dual task: Perform any one of the above mentioned cognitive task along with that perform BBS with holding 2 glasses of tray and measure the Balance outcome measures with dual task.

Gait and dual task

Participant walks at 10 m distance and measure the gait parameters (speed, time, cadence, step Length, stride length) for baseline data. Dual task: Perform any one of the above mentioned cognitive task along with that walks at 10 m distance with holding 2 glasses of tray and measure the gait outcome measures with dual task.

Results

Total 57 (Male-39, Female-18) subjects with the age group of 60-84 years were taken with mean age 70.51 year and SD 6.33. SPSS version 20 was used for the data analysis. The statistical analysis used was descriptive analysis to find Mean and standard deviation. Level of significance was kept at 5% (alpha=0.05) and power 80 % (beta=0.84).

Tests used to compare the values of outcome measures

Outcome Measure	Tests used to Compare within Outcome Measures	Tests used to Compare between Outcome Measures
10 Meter Walk Test	Wilcoxon Signed Ranks Test	Mann Whiteney U-Test
BBS	Wilcoxon Signed Ranks Test	Mann Whiteney U-Test

Discussion

This study extends the findings obtained by Jacob et al. [4] which indicates that balance is affected by dual task and Hall et al. [5] indicates that cognitive task complexity results in greater degradation of gait. In advance, present study compares which one of the two: gait or balance is affected more during dual task activity.

Result showed statistical significant effect of Dual Task in all Gait parameters (Time, Speed, Cadence, Step length, Stride length) and Balance (BBS Score) but BBS showing greater affection then Gait parameters.

Berg Balance Scale measures a number of different aspects of balance, both static (item no. 1, 2, 3, 4, 6, 7, 8, 9) and dynamic (item no. 5, 10, 11, 12, 13, 14) .In this study, Dual Task has significant impact on item No. 7, 10, 11, 12, 13 and 14 ($p<0.05$) of BBS so dynamic balance is more affected.

The findings of this study reveal that the elderly subjects were more sensitive to Balance than Gait. There was significant effect of Dual Task on gait and Balance ($p<0.05$) But Balance Mean (2.96) is greater than Gait parameters Mean (Time=1.44, Speed=0.14, Cadence=1.44, Step length=0.15, Stride length=0.29) (Tables 1a-1e and Figures 1a-1e). One possible explanation for this finding is that the dual task activities (balance+Dual tasks) were much more difficult than the tasks (Gait+Dual task) given to the participants because the balance skills of the participants in the dual-task were continually challenged and this may have resulted in a reduced confidence in performing daily tasks. This means that elderly subjects adopted a more conservative balance strategy to maintain stability or walking. The older adults decrease their stride-length but maintain their gait speed at the cost of increasing their cadence (Tables 2a and 2b and Figures 2a and 2b).

Clark et al. [6] suggested that decline in letter and category verbal fluency occurs in geriatrics but performance of letter fluency is more affected than category fluency, decline in generating words from semantic categories after middle age is partially dependent on processing speed,

TIME (s)					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
7.68	1.53	9.26	2.28	-5.93	0.001

Mean differences in time during baseline and dual task activity. Effect of dual task on time was done with use of Wilcoxon signed ranks test which shows significant difference ($p<0.05$)

Table 1a: Difference in time during baseline and dual task activity.

TIME (s)					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
7.68	1.53	9.26	2.28	-5.93	0.001

Mean differences in speed during baseline and dual task activity. Effect of dual task on speed was done with use of Wilcoxon signed ranks test which shows significant difference ($p<0.05$)

Table 1b: Differences in speed during baseline and dual task activity.

CADENCE					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
12.75	0.17	14.16	2.67	-5.843	0.001

Mean differences in cadence during baseline and dual task activity. Effect of dual task on cadence was done with use of Wilcoxon signed ranks test which shows significant difference ($p<0.05$)

Table 1c: Differences in cadence during baseline and dual task activity.

STEP LENGTH (ft.)					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
1.58	0.25	1.43	0.25	-5.912	0.001

Mean differences in step length during baseline and dual task activity. Effect of dual task on step length was done with use of Wilcoxon signed ranks test which shows significant difference ($p<0.05$)

Table 1d: Differences in step length during baseline and dual task activity.

STRIDE LENGTH (ft.)					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
3.16	0.49	2.86	0.49	-5.781	0.001

Mean differences in stride length during baseline and dual task activity. Effect of dual task on stride length was done with use of Wilcoxon signed ranks test which shows significant difference ($p<0.05$)

Table 1e: Differences in stride length during baseline and dual task activity.

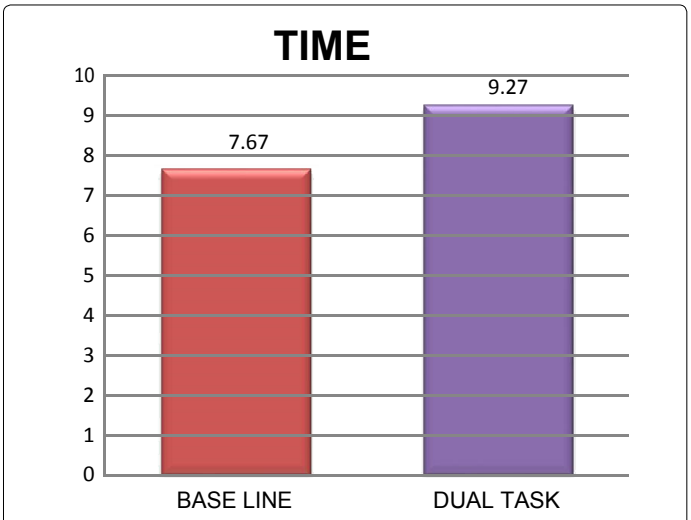


Figure 1a: Difference in time during baseline and dual task activity.

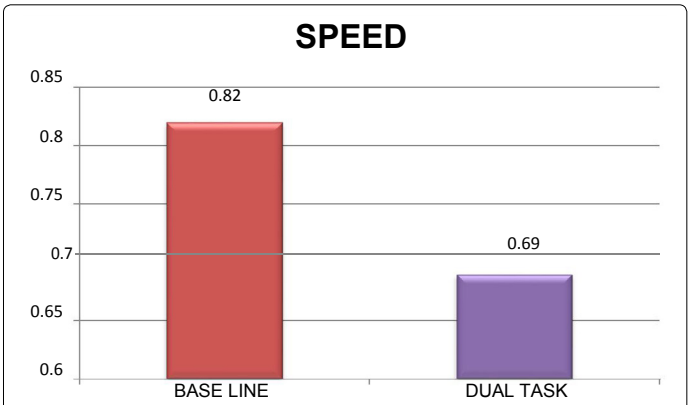


Figure 1b: Differences in speed during baseline and dual task activity.

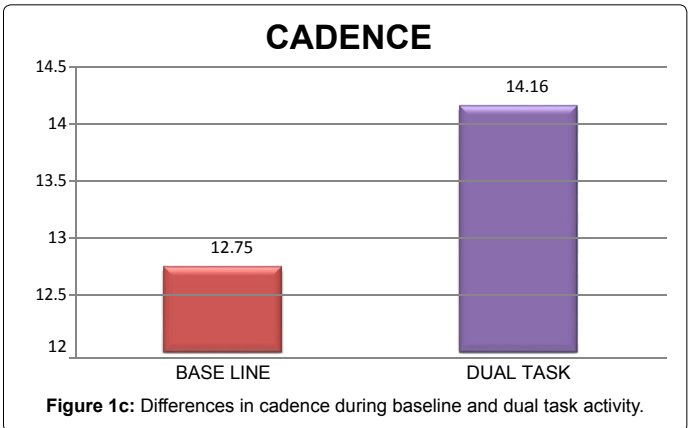


Figure 1c: Differences in cadence during baseline and dual task activity.

but not on verbal knowledge. The decline in processing speed influences the rate of generation of words and therefore the advantageous effect of age on letter fluency.

It is postulated that under dual-task situations, people share processing capacity among tasks. More than one task is performed at any given moment; thus, there is less capacity for each individual task and performance is impaired that is "Capacity Sharing" [7].

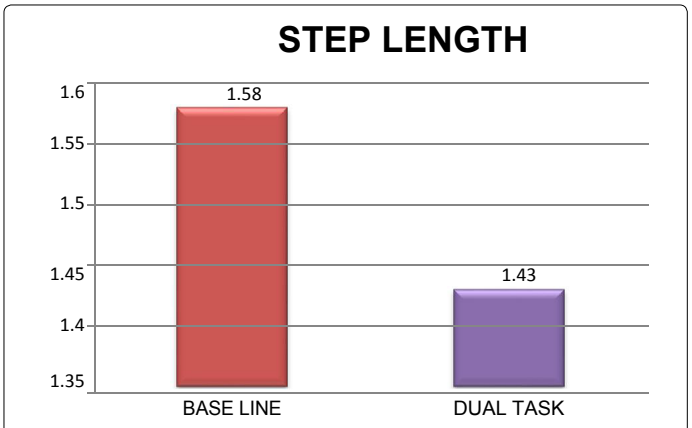


Figure 1d: Differences in step length during baseline and dual task activity.

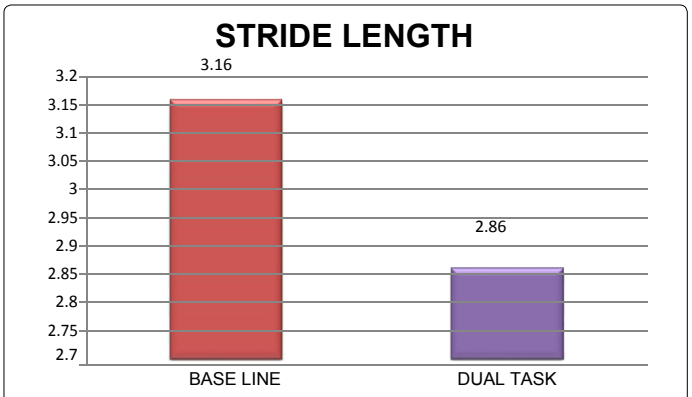


Figure 1e: Differences in stride length during baseline and dual task activity.

BBS SCORE					
Base line		Dual Task		Z value	p value
Mean	SD	Mean	SD		
50.95	3.44	47.88	4.22	-5.993	0.001

Mean differences in BBS score during base line and dual task activity. Effect of dual task on BBS was done with use of Wilcoxon signed ranks which shows significant difference ($p<0.05$).

Table 2a: Differences in BBS Score during baseline and dual task activity.

COMPONENTS OF BBS						
Item	Base line		Dual Task		Z value	p value
	Mean	SD	Mean	SD		
1	50.95	3.44	47.88	4.22	-5.993	0.001
2	4.00	0.00	3.96	0.19	-1.414	0.157
3	4.00	0.00	3.98	0.13	-1.000	0.317
4	3.95	0.23	3.92	0.23	-1.000	0.317
5	3.95	0.23	3.95	0.23	0.000	1.000
6	4.00	0.00	3.96	0.19	-1.414	0.157
7	3.93	0.32	3.84	0.49	-2.236	0.025
8	3.82	0.47	3.68	0.74	-1.653	0.098
9	3.96	0.19	3.91	0.34	-1.732	0.083
10	3.95	0.23	3.82	0.47	-2.070	0.038
11	2.84	1.05	2.54	0.96	-2.575	0.010
12	3.95	0.23	3.54	0.50	-4.796	0.001
13	2.91	1.58	2.11	1.70	-4.069	0.001
14	1.91	1.42	0.98	1.36	-5.159	0.001

Mean differences in various components of BBS during baseline and dual task activity. Effect of dual task on BBS component was done with use of Wilcoxon signed ranks which shows significant difference ($p<0.05$) in item No. 7, 10, 11, 12, 13, 14

Table 2b: Differences in various components of BBS during baseline and dual task activity.

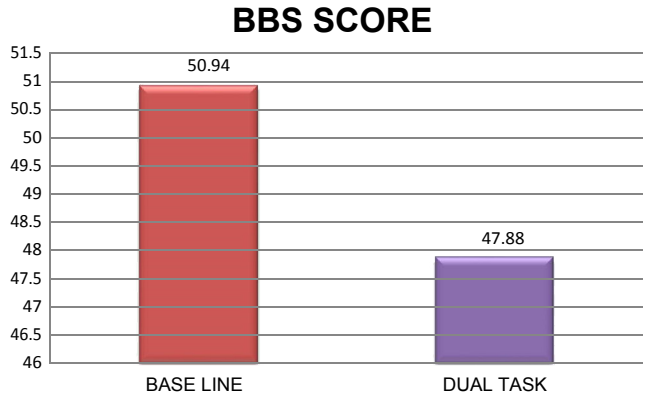
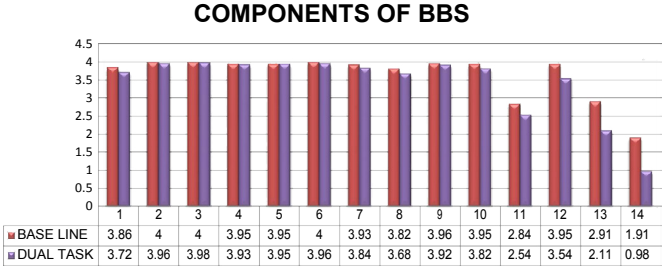
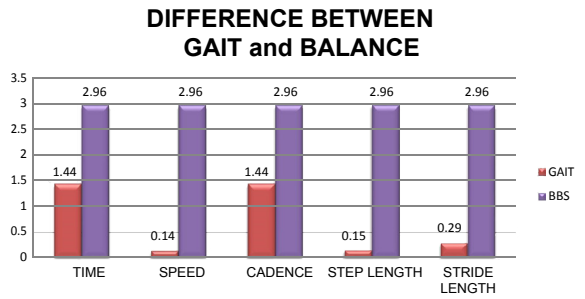


Figure 2a: Differences in BBS score during baseline and dual task activity.





Mean differences in BBS score and all Gait parameters during dual task activity.

Effect of dual task on gait parameters and BBS was done with use of Mann Whiteney U-test which shows significant effect ($p<0.05$) but mean difference of BBS is greater than all Gait parameters.

Figure 2b: Differences in various components of BBS during baseline and dual task activity.

Conclusion

Dual tasking affects Gait and Balance both, where Balance is more affected than Gait in Geriatric population.

Implication for Practise

Gait and Balance training under dual task condition would put further challenge on elders with impaired Balance and previously inactive older adults so given under observation.

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