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Original Research Article

IMPACT OF DUAL TASK PERFORMANCE ON FEAR OF FALL AND GAIT PARAMETERS IN ELDERLY

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ABSTRACT

Background and objectives: The successful execution of dual task situations depends on many factors and is affected by physiological degenerative processes. The completion of a secondary task while walking can be considered as key contributor for falls in the elderly. The aim of the study was to investigate the impact of dual task performance on gait parameters, fear of fall among different age groups of elderly.

Methods: Sixty elderly subjects with independent gait were evaluated while doing simple walking and dual task walking with cognitive, motor and cognitive motor gait demand in the study. The gait parameters namely time, speed and cadence were assessed using 10 meter walk test. Followed by every task, fear of fall was assessed using visual analog scale-fear of fall.

Results: All the groups showed statistically significant difference in the gait parameters with addition of dual tasks. There was statistically significant difference among groups for number of step, time, speed and fear of fall (p value <0.01) for both simple and dual task. The mean dual task cost was highest in the dual task with cognitive-motor demand (49.35 ±0.418).

Conclusion: The findings of the present study suggest that under dual task demand, elderly population shows greater variability of gait and increase in fear of fall. The deficits in dual task walking increases proportionally with age.

KEY WORDS: Dual task. Elderly, Fear of fall, Gait parameters.

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INTRODUCTION

To fulfil numerous demands of a situation within a constrained period of time have become a challenge in a modern adult life. The performance of dual task such as walking and talking, walking while note-taking, driving and conversing, operating cell phone while talking refers to the simultaneous performance of two or more task that involves a primary task performance, which is the mainly focus of attention, and a secondary task, executed at the same time. Dual tasking is regarded as one of the prime examples of the application of executive functions [1]. Aging is assumed to be accompanied by particularly severe declines in executive functions, and this assumption has led to the prediction that older adults experience specific difficulties with dual-task situations [2].

The aging process is accompanied by alterations in the spatial and temporal parameters of gait

[3], such as reductions in gait speed and step length, as well as increases in step variability, double support time and step width [4], all of which have been correlated with a higher incidence of falls [5]. The automatic control of walking is impaired with age, and walking becomes an activity that demands attention and is therefore controlled by a cortical region [6].

A key factor in locomotor control is executive cognitive functioning and the deficits are associated with increased fear of falling [7]. Fear of falling (FOF) has been defined as an ongoing concern about falling, which ultimately limits the performance of activities of daily living [8]. The prevalence of FOF varies between 12% and 65% for independent elderly individuals without a history of falls, and 29% and 92% in those with a history of falls [9].

Dual-task situations nowadays are of increasing relevance. The successful execution of dual task situations depends on many factors and is affected by physiological degenerative processes. Dual task studies have been conducted among individual with Parkinson disease, Stroke, Ataxia, depressive elderly, healthy older adults, healthy young individuals and individuals with Alzheimer disease. The association of fall- related anxiety with dual tasking performance involving walking has not been adequately examined in older adults.

The current study was designed to investigate the impact of dual task performance on gait parameters, fear of fall among different age groups of elderly. As a secondary objective, this study intended to investigate the effect of the type of demand of the secondary task (motor, cognitive, associated) on fear of elderly and gait parameters in different age groups. Such a finding would extend the existing body of research on the general trend of dual task deficits among elderly population and how the dual task deficits is amplified by task difficulty and complexity.

METHODS

Place: Subjects were recruited from Federation of Senior Citizen Forums of Karnataka, Dignity Foundation, Little sister of the poor, Sevakshetra Hospital Geriatric Ward and RV College of Physiotherapy OPD walk-ins.

Participants: Elderly between the age group of 60-89 were assessed for eligibility criteria. Inclusion criteria were Mini Mental State Examination score greater than 23, Timed Up and Go test score equal or less than 14 sec, ability to walk independently and having adequate vision, hearing and understanding ability. Exclusion criteria were known history of any underlying neurological condition like parkinsonism, stroke, cerebellar dysfunction, severe visual and hearing impairment, Musculoskeletal ailments of lower extremity leading to instability and pain, orthostatic hypotension and vestibular disorders. The subjects were divided into three different groups according to age (Group A: 60-69, Group B: 70-79, Group C: 80-89), each group having 20 subjects. The information on subject characterization is shown in Table I.

All the subjects were informed about the nature of the study and written informed consent was obtained. The study was approved by the ethical committee of RV College of Physiotherapy.

Study Procedure: The gait parameters namely time, speed and cadence in both simple task and dual task were evaluated using 10 meter walk test. Dual task included motor demand, cognitive demand and associated cognitive-motor demand. Subjects was given a practice trial prior to the test. The data was collected by observation. Followed by every task, fear of fall (FOF) was assessed using visual analog scale-fear of fall. The VAS-FOF uses a numeric scale (1-10) to measure the perceived FOF after a fall. The subjects was instructed to select the number that best reflects the intensity of FOF experienced, with 1 representing no FOF and with 10 representing an extreme FOF [10].

The subject walked without assistance for 10 meters, with the time measured for the intermediate 6 meters to allow for acceleration and deceleration (Simple task). The timing was started when the toes passed the 2 meter mark and stopped when the toes passed the 8 meter mark. Test was performed at preferred walking speed. Sequentially, gait was assessed in the same space of 10 meters with the activity of cognitive demand. The subject was asked to recite the days of the week in reverse order during one minute and repeat it verbally while

walking.

After this, gait with motor demand was assessed where the subject then walked 10 meters with a table tennis ball placed in one of the pockets (there were bilateral pockets) and transferred the ball to the other one.

Finally, gait with the associated activity of cognitive and motor demand was assessed the subject, while walking verbally recited the days of the week in reverse order seen before and at the same time transferred the ball from one pocket to other.

Gait speed was calculated by the formula:

Speed = Total distance travelled by the body/ Total time taken to cover the distance (m/s)

Dual-task cost was calculated by dividing the difference between the time required to complete 10m walk test and 10m walk-DT by the time required to complete 10m walk test, expressed as a percentage. A positive cost indicates poorer dual-task performance.

Dual task cost = 10m-DT time – 10 m time/ 10 m time [11]

Statistical analysis: Sample size was determined through power calculation based on previous studies of dual task performance in elderly. With minimum change of 4%, CV 2.5%, 90% statistical power an overall sample of 60 was estimated at 5% level of significance. Sample was collected using purposive sampling technique.

The SPSS software (version 21.0) and Excel 2016 was used to analyze all the data. The normality of the data was tested using Shapiro-Wilk test. One-way ANOVA was used as a parametric test with age as a between group factor and tasks as a within group factor. Kruskall-Wallis tests were used for nonparametric data for between group comparisons. When the difference was statistically significant (pd"0.05), multiple comparisons were performed using the Tukey post-hoc tests. A significance level of 0.05(5%) was established. All the reliability intervals constructed during this study were with 95% of statistical confidence.

RESULTS

There was statistically significant difference among groups for all the gait variables and fear of fall. The mean cadence required to complete the task was highest in group C. All the age groups required the highest number of steps to complete dual task walking with combined cognitive motor demand (Table 2).In all the tasks, the mean speed was least in Group A when compared to other groups. The simple task had the best performance in all the groups followed by secondary task with motor demand. The mean speed was the lowest in secondary task with combined motor and cognitive demand for all the groups (Table 3).

The fear of fall was the highest in the dual task with combined cognitive and motor demand. The age group of 80-89 had the highest fear of fall (Table 4). The dual task cost was highest in secondary task associated with cognitive motor demand and least in the secondary task with motor demand (Table 5).

Table 1: Subject Characterization (Mean±SD).

	Group A (60-69)	Group B (70-79)	Group C (80-89)	p value
Age	65.85±2.134	74.5±2.705	84.7±2.81	
MMSE	28.6±1.23	27.25±1.55	25.29±1.422	<0.01
TUG	9.765±0.811	10.4±0.62	11.83±1.347	<0.01

Note: SD- Standard Deviation, MMSE- Mini Mental State Examination, TUG- Timed Up and Go test

Table 2: Gait performance related to cadence in the four tasks for different age groups.

Cadence		Mean	Median	SD	Q1	Q3	p-value	post hoc
	Group A	10.3	10	2.577	8.25	12	0.00*	0.136(A-B)
10MWT	Group B	12.1	12	2.245	10	14		0.000(A-C)
	Group C	15.25	15	3.754	12	18		0.004(B-C)
	Group A	11.9	11.5	2.808	10	13.75	0.00*	0.065(A-B)
Cognitive	Group B	14.8	15	3.019	12.25	17		0.00(A-C)
	Group C	18.5	18.5	5.558	15	23		0.013(B-C)
	Group A	10.9	11	2.553	8.25	12	0.00*	0.138(A-B)
Motor	Group B	13.25	13.6	2.807	10.25	15		0.00(A-C)
	Group C	16.9	16.5	5.467	13	20.75		0.111(B-C)
	Group A	12.7	12.5	2.975	11	15	0.00*	0.104(A-B)
Combined	Group B	15.55	16	3.12	14	18		0.00(A-C)
	Group C	19.75	20	6.172	16	23.75		0.009(B-C)

Note: SD- Standard Deviation, *indicates ANOVA, Q- Quartile, 10MWT- 10 metre walk test

Table 3: Gait performance related to speed in the four tasks for different age groups.

Speed		Mean	Median	SD	Q1	Q3	p-value	post hoc
	Group A	1.189	1.165	0.302	0.897	1.49	0.002^	0.079(A-B)
10MWT	Group B	0.987	1.04	0.24	0.769	1.183		0.003(A-C)
	Group C	0.87	0.86	0.311	0.71	0.948		0.427(B-C)
	Group A	0.934	0.88	0.26	0.698	1.18	0.001*	0.013(A-B)
Cognitive	Group B	0.856	0.82	0.226	0.618	1.01		0.001(A-C)
	Group C	0.758	0.73	0.296	0.595	0.905		0.612(B-C)
	Group A	1.05	1.12	0.246	0.78	1.26	0.003*	0.052(A-B)
Motor	Group B	0.856	0.82	0.226	0.618	1.048		0.002(A-C)
	Group C	0.758	0.73	0.296	0.595	0.9057		0.463(B-C)
	Group A	0.88	0.882	0.248	0.64	1.11	0.000*	0.012(A-B)
Combined	Group B	0.67	0.654	0.205	0.495	0.83		0.00(A-C)
	Group C	0.59	0.6	0.21	0.376	0.77		0.512(B-C)

Note: SD- Standard Deviation, Q- Quartile, 10MWT- 10 metre walk test, *indicates ANOVA, ^ indicates significance obtained from Kruskal Wallis test

Table 4: Gait performance related to fear of fall in the four tasks for different age groups

FOF		Mean	Median	SD	Q1	Q3	p-value	post hoc
	Group A	0.6	0	0.754	0	1	0.00^	0.222(A-B)
10MWT	Group B	1.05	1	1.02	0	1		0.000(A-C)
	Group C	1.8	2	0.696	1.25	2		0.019(B-C)
	Group A	1.25	1	1.16	0	2	0.00*	0.045(A-B)
Cognitive	Group B	2.55	3	1.468	1.25	3.75		0.00(A-C)
	Group C	3.9	4	2.22	2.25	5		0.036(B-C)
	Group A	0.9	1	1.021	0	1.75	0.00*	0.039(A-B)
Motor	Group B	2.05	2	1.468	1	3		0(A-C)
	Group C	3.2	3	1.765	2	4.75		0.039(B-C)
	Group A	1.75	2	1.25	1	3	0.00^	0.08(A-B)
Combined	Group B	3.05	3	1.71	2	4.75		0(A-C)
	Group C	4.85	5	2.455	3	7		0.010(B-C)

Note: FOF-Fear of Fall, SD- Standard Deviation, Q- Quartile, 10MWT- 10 metre walk test, *indicates ANOVA, ^ indicates significance obtained from Kruskal Wallis test

Table 5: Dual task cost.

DUAL TASK COST	Mean (Percent)	SD
Cognitive demand	35.23	0.336
Motor demand	16.32	0.187
Combined	49.35	0.418

DISCUSSION

Older adults often suffer disproportional performance costs when engaged in two tasks concurrently [6]. This study extends this work to the domain of Fear of fall along with gait parameters in different secondary tasks.

During dual-task performance, significant changes were evident in all the gait variables in all the age groups. The magnitude of the reduction in the gait speed and increase in time and cadence was highest in the age group of 80-89 years. This alteration in gait with dual task can be attributed to the age related changes in brain.

Older people are aûected by a general loss of brain mass and a distinctive atrophy of the frontal gray matter, as well as a white matter hyperintensity [12]. The fMRI studies showed a degradation of the cerebral cortex as a function of age. Notably, these studies demonstrated a reduction of gray and white matter in the prefrontal cortex [13] and an age-related mass reduction of the frontal lobe [14]. Additionally, a loss of central neurons and associated synaptic connections accrues, which leads to reduced processing speed and a deûcit in the ability to handle several processes simultaneously [15].

The findings of this study are consistent with previous studies [16-19] which observed the effects of dual task on gait parameters. The study by Andrew et al [20] observed a significant difference in gait velocity between the younger and the older group under dual tasking conditions. The data study showed that in the dual task conditions the gait velocity reduced by 18% in younger population and by 30% in the older population.

Relating to the fear of fall, group C had the highest fear of fall in dual tasking condition when compared to the other age groups and this fear of fall was more during the dual task with associated cognitive motor demand. The lowest mean MMSE score and the highest reduction in gait speed in this age group provides the possible explanation for this. This results is supported by the study by Verghese et al which specified that for a community dwelling elderly population in an urban setting adults were 28% more likely to fall if their gait speed was below 100 cm/s and 54% more likely to fall if their gait speed was below 70 cm/s. [21] Hence this provides an alternative explanation to the finding that the older people with higher dual task deficits are subjected to increase in fear of fall.

The findings of the present study indicates increase in dual task costs in all the three secondary tasks that implies a subject's decrease in performance of the tasks when the subject is asked to complete two task simultaneously. This decline in the performance can be associated with the theory of prioritization. When asked to walk and perform another task, certain subject groups may give inappropriate prioritization to the concurrent task, sacrificing attention resources needed for gait by using a "posture second" strategy [17]. The age related increase in dual task costs ranged from 16.32% to 49.35% which is higher than in the study performed by Lindenberger et al[22] where the dual task cost amounted to 15%. This difference in the dual task cost may be due to the difference in the type of dual task in the study by Lindenberger in which the subjects were given a visual memory task where words had to be memorized, and later reproduced, using visuo-spatial imagery.

The secondary task with combined motor and cognitive demand had the highest dual task cost. According to Cockburn, Haggard, Cock and Fordham, a secondary task with motor cognitive demand requires more cerebral connections and constant improving due to the complexity of the task. This provides the explanation for increase in the dual task deficits with increase in complexity of the demands [23].

The knowledge about influence of the secondary activity including motor, cognitive and combined motor cognitive demand in gait parameters and fear of falling aids in diagnosing patients with risk of falling. Added to this understanding the destabilizing effect of different secondary tasks on gait can be implemented in fall prevention strategies.

As limitations of this study, it can be established that this study did not take into account the level of education and the level of fitness that could have an impact in the cognitive and motor function. The study also did not measure the errors of the secondary tasks (mistakes while reciting the week days in reverse). There might be the possibility of the practice errors as the subjects were asked to walk the same distance for four times. Further studies in the similar lines may be conducted to investigate the effects of aging on dual-task performance in subjects with sedentary versus active lifestyle and subjects with and without cognitive impairment.

CONCLUSION

The findings of the present study suggest that under dual task demand, elderly population shows greater variability of gait and increase in fear of fall. The deficits in dual task walking increases proportionally with age. This reflects the reduced ability of successful execution of dual task, increase in gait instability and greater risk of fall with aging.

ABBREVIATIONS

DT- Dual Task

FOF- Fear of Falling

MMSE- Mini Mental State Examination

TUG- Timed Up and Go

VAS-FOF- Visual Analog Scale- Fear of Fall

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Conflicts of interest: None

REFERENCES

[1]. Maciel M, Silva A, Cyrillo F, Santos S, Torriani-Pasin C. Impact of Dual Task on Parkinson's Disease, Stroke and Ataxia Patients' Gait: A Comparative Analysis. Psicologia: Reflexão e Crítica. 2014; 27(2): 351-357.

[2]. Gothe K, Oberauer K, Kliegl R. Age differences in dual-task performance after practice. Psychology and Aging. 2007; 22(3): 596-606.

[3]. Montero-Odasso M, Bergman H, Phillips NA, Wong CH, Sourial N, Chertkow H. Dual tasking and gait in people with mild cognitive impairment. The effect of a memory-work. BMC Geriatrics. 2009; 41(9): 1-8.

[4]. Bridenbaugh SA, Kressig RW. Laboratory review: the role of gait analysis in seniors' mobility and fall prevention. Gerontology. 2011; 57(3): 256-64.

[5]. Kressig RW, Herrmann FR, Grandjean R, Michel JP, Beauchet O. Gait variability while dual-tasking: fall predictor in older inpatients? Aging Clin Exp Res. 2008; 20(2): 123-30.

[6]. Verghese J, Kuslansky G, Holtzer R, Katz M, Xue X, Buschke H . Walking while talking: effect of task prioritization in the elderly. Arch Phys Med Rehabil. 2007; 88(1): 50-3.

[7]. Al-Yahya E, Dawes H, Smith L, Dennis A, Howells K, Cockburn J, Cognitive motor interference while walking: a systematic review and meta-analysis. Neuroscience and Biobehavioral Reviews 2011; 35(3): 715-28.

[8]. Tinetti ME, Powell L. Fear of falling and low self-efûcacy: a case of dependence in elderly persons. J Gerontol. 1993; 48: 35–38.

[9]. Legters K. Fear of falling. Phys Ther 2002; 82(3): 264–272.

[10]. Scheffer A, Schuurmans M, vanDijk N, van der Hooft T, de Rooij S. Psychometric properties of the VAS-FOF, a visual analogue scale for fear of falling in older persons. International Journal Geriatric Psychiatry. 2011; 26(3): 284-91.

[11]. Beurskens R, Bock O. Age-Related Deficits of Dual-Task Walking: A Review. Neural Plasticity. 2012: 1-9.

[12].C. W. Nordahl, C. Ranganath, A. P. Yonelinas, C. DeCarli, E. Fletcher, and W. J. Jagust. White matter changes compromise prefrontal cortex function in healthy elderly individuals. Journal of Cognitive Neuroscience.2006;18(3): 418–429.

[13]. N. Raz, F. M. Gunning, D. Head et al. Selective aging of the human cerebral cortex observed in vivo: diûerential vulnerability of the prefrontal gray matter. Cerebral Cortex. 1997;7(3): 268–282

[14]. D. C. Park and P. Reuter-Lorenz. The adaptive brain: aging and neurocognitive scaûolding. Annual Review of Psychology.2009;60: 173–196.

[15]. C. L. Grady and F. I. Craik. Changes in memory processing with age. Current Opinion in Neurobiology.2000;10(2):224–231

[16]. Guedes RC, Dias RC, Pereira LSM, Silva SLA, Lustosa LP, Dias JMD. Influence of dual task and frailty on gait parameters of older community-dwelling individuals. Braz J Phys Ther. 2014 Sept-Oct; 18(5):445-452

[17].HausdorffS J, Schweiger A, Herman T, Yogev-Seligmann G, Giladi N. Dual-Task Decrements in Gait: Contributing Factors Among Healthy Older Adults. J Gerontol A Biol Sci Med Sci. 2008; 63(12): 1335-1343.

[18]. Moraes H, Deslandes A, Silveira H, Arcoverde C, Alve H, Laks J. Effects of motor and cognitive dual-task performance in depressive elderly, healthy older adults, and healthy young individuals: Dement Neuropsychol 2011; 5(3): 198-202.

[19]. Neider, M. B., Gaspar, J. G., McCarley, J. S. et al. Walking and Talking: Dual-Task Effects on Street Crossing Behavior in Older Adults. Psychology and Aging. 2011.

[20]. Priest A, Salamon K, Hollman J. Age-related differences in dual task walking: a cross sectional study. Journal of NeuroEngineering and Rehabilitation. 2008; 5(1): 29.

[21]. Meyer, Kirsten, "Gait Speed as a Fall Predictor for Elderly Patients in Rehabilitation" (2010).PT Critically Appraised Topics. Paper 20

[22]. U. Lindenberger, M. Marsiske, and P. B. Baltes. Memorizing while walking: increase in dual-task costs from young adulthoodtooldage. Psychology and Aging. 2000;15(3):417– 436

[23].Maciel M, Silva A, Cyrillo F, Santos S, Torriani-Pasin C. Impact of Dual Task on Parkinson's Disease, Stroke and Ataxia Patients' Gait: A Comparative Analysis. Psicologia: Reflexão e Crítica. 2014; 27(2): 351-357.

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