International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 8 | Issue 2 | Apr - Jun - 2020
www.ijamscr.com

Research article *Medical research*

Influence of physical and cognitive capacity on task prioritization during the gait-related dual-task performance in elderly: A comparison

Atiya Shaikh[1], Komal Patel[2], Nimesh Gupta*[3]

[1]*Associate Professor, M.P.T (Neurosciences), PhD Scholar KEM Mumbai, DESBJCOP, Pune.*
[2]*M.P.T (Neurosciences), DESBJCOP, Pune.*
[3]*M.P.T Student (Neurosciences), DESBJCOP, Pune.*

***Corresponding Author**: **Nimesh Gupta**
Email id: gnimesh896@gmail.com

ABSTRACT

Purpose and objective

To find influence of cognitive and physical capacity of elderly on task prioritization during dual-tasking as there is conflicting evidence about whether the elderly prefer posture first or cognition first strategy while doing dual-tasking.

Method

164 elderly were divided into 4 groups as per their physical and cognitive capacity using MoCA (Montreal Cognitive Assessment) and TUG (Time Up and Go) scores (1-balance affected and cognition normal (BACN), 2 -balance normal and cognition affected (BN CA), 3- balance normal and cognition normal (BN CN), 4- balance affected and cognition affected (BA CA). They were evaluated with n-back test and Time up and go cognitive (TUG-COG) for dual-tasking in motor and cognitive domain respectively. The interference pattern was analyzed for each group.

Result

Mutual interference was observed in each group.

Conclusion

Motor and Cognitive capacity of an individual does not affect task prioritization in the elderly.

Keywords: Dual-task, Interference pattern, Elderly, Task Prioritization.

INTRODUCTION

Aging is a progressive, physiological, and dynamic process. India shows a sharp increase in the elderly population [1]. Falls are the major geriatric health problem [2, 3]. Every year 10% falls results in serious injuries [4]. This leads to disability, hospitalization, and premature death in the elderly [5]. Fear of falling (FOF) is another factor that leads to high levels of anxiety, increased dependency, and poor quality of life [6]. 30-55% of the elderly have FOF and restrict their daily day to day like walking activity leading to premature hospitalization and isolation [7, 8].

In everyday activity, walking is integrated with other tasks such as using phones, etc. This is termed as dual-tasking [9, 10]. Walking in older people is said to be influenced by cognitive and motor capacity [11, 12]. Age-related deficits of gait might be compensated by cognitive strategies and if a person has reduced cognitive capacity thus, may have limited access to this type of compensation, thus leading to multiple gait deviations, instability, and high risk of falls [13]. Dual-tasking for such a person is difficult and thus, may increase fear and risk of falls [11, 14]. Relative change in performance associated with dual-tasking is called a dual-task effect (DTE). It is calculated as dual-task cost (DTC) [15]. There are conflicting studies about the strategy chosen by a person while doing dual-tasking. Some say an elderly prioritizes motor tasks over cognitive tasks [16], while some contradict them by concluding that individuals prioritize cognitive tasks over motor tasks [17]. However, many cognitive-motor dual-task studies show that, there is no universal explanation that can predict the pattern in the elderly in a particular situation [18]. Considering the principle of task specificity, it was hypothesized that while doing dual-tasking an individual should concentrate on the component of the task for which his capacity is limited by compromising the other task performance. The current study was proposed to check the above-stated hypothesis. The main objective of this study was to analyze the task prioritization patterns in the elderly with cognition or motor capacity affection. Exploring this area will help to develop strategies which can be used in the prevention of falls or fear of fall (FOF) in the future.

Aim

To study influence of physical and cognitive capacity on task prioritization while performing dual task in elderly.

Objectives

To assess elderly of different Group for Dual Task cost and to compare these group for physical capacity and cognitive capacity also to find interference pattern in these groups.

MATERIALS AND METHODS

Institutional ethics committee clearance was taken. A pilot study was performed to decide the sample size. There was maximum variation in the cognitive domain of BACN group and the sample size was calculated 164 i.e 41 in each group (α= 0.1, β= 0.2) using formula N = {Zα2×sd2}/d2.Elderly with no depression (GDS 0-9) and able to walk 30 meters without walking aid was asked to sign written informed consent to participate in the study. Those having a neurological condition, pain (VAS >4), peripheral vascular disease, vestibular processing insufficiency, and on pharmaceutical agents like antidepressants, etc which affect cognition or alertness were excluded. Participants were divided into 4 groups based on their Montreal Cognitive Assessment (MoCA) and TUG (Time Up and Go) scores. Participants with MoCA score more than or equal to 26 were considered affected cognition, TUG test score of more than 14 secs was considered with balance affected. These are Group were as follows 1- balance affected and cognition normal (BACN), Group 2 -balance normal and cognition affected (BN CA), Group 3- balance normal and cognition normal (BN CN), Group 4- balance affected and cognition affected (BA CA).

Gait speed during the n-back test (individual walks on the 30 meters walkway for 30 seconds. After every 3 seconds a number was given and he/she had to answer the preceding number) and TUG- Cognitive test (Individuals get up from the chair, walk 3 meters as quickly and safely as possible, cross a line marked on the floor, turn around, walk back, and sit down. Along with that they are supposed to subtract a random number by 3. Time is taken to complete the test noted in seconds.) were used as gait-related dual-tasks. The sequence of the tests was decided by the chit method, prior practice was given for the task with an adequate rest period in between as per the subject's preference. Dual-task cost was calculated using formula DTC= [Dual-task performance-single task performance)/single motor performance] X 100 and dual-task interference was found using a conceptual model of the interference pattern [15].

Dual-task Interference interpretation table

	Cognitive performance based on DTC			
		No change	improved	Worsened
Motor performance based on DTC	No change	No interference	Cognitive facilitation	Cognitive interference
	Improved	Motor facilitation	Mutual facilitation	Motor priority trade-off
	worsened	Motor interference	Cognitive priority trade-off	Mutual interference

RESULTS

Table 1: - Demographic data and screening scores

	Age (mean± SD) In years	TUG- MOTOR (mean±SD) in secs	MoCA scores (mode)
GROUP 1 (BACN)	71 ± 8.23	16.3±3.092	26
GROUP 2 (BNCA)	68 ± 6.13	10.6±2.46	24
GROUP 3 (BN CN)	66 ± 4.59	9.32±1.92	26
GROUP 4 (BA CA)	70 ± 6.59	15.6±3.94	24

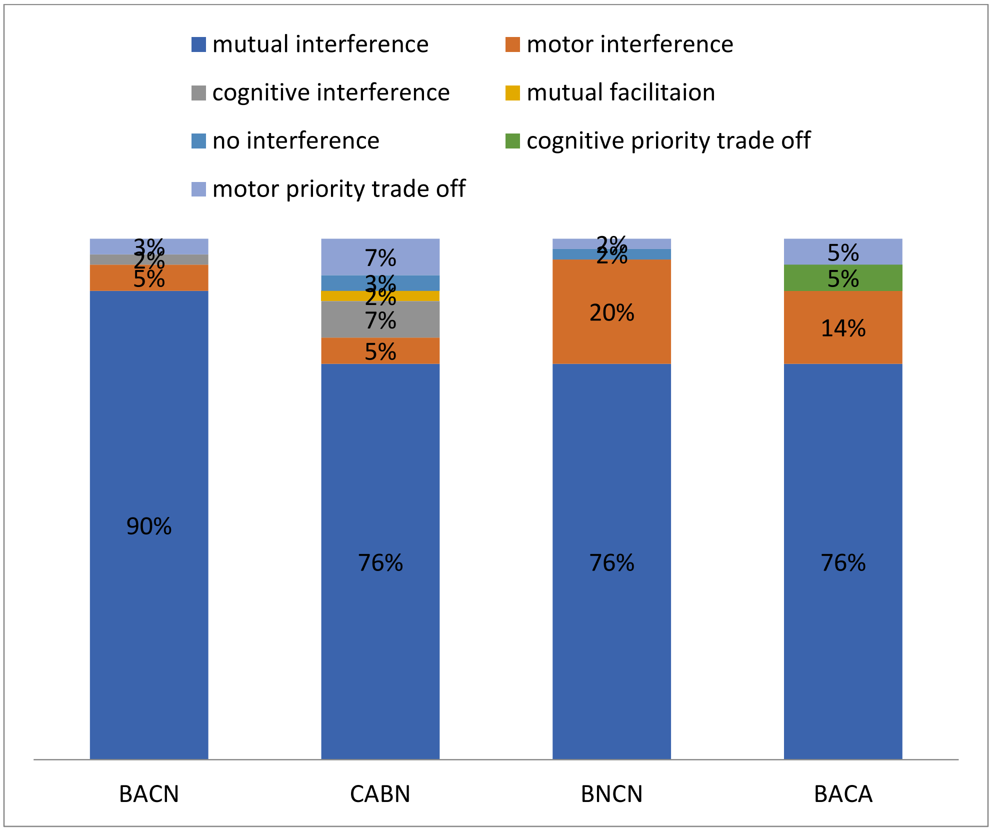
Montreal Cognitive Assessment (MoCA)

TUG (Time Up and Go); BACN (balance affected and cognition normal); BNCA(balance normal and cognition affected); BNCN(balance normal and cognition normal); BACA(balance affected and cognition affected).

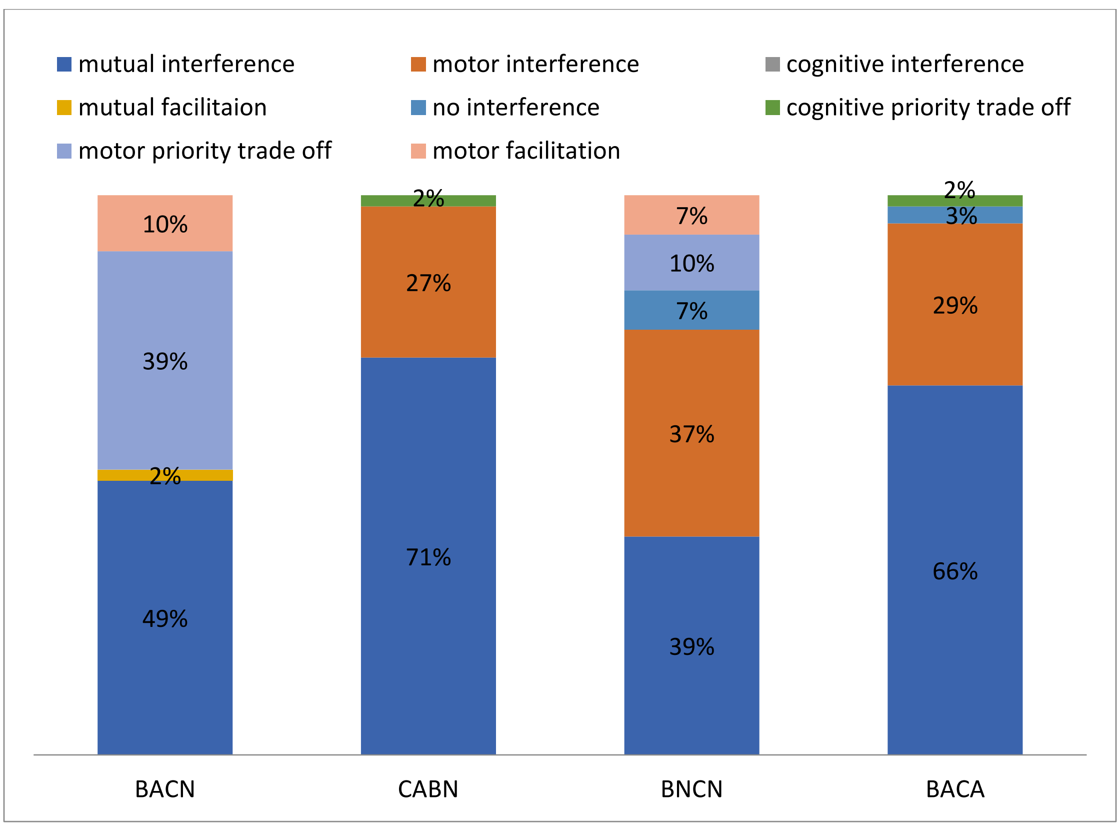
Table 2: - Comparison of baseline scores in all groups (using unpaired t test)

Groups	Age(p value)	Physical capacity (TUG- Motor) p value	Cognitive capacity (MoCA scores, p value)
BACN VS BNCA	>0.05	<0.001*	<0.001*
BACN VS BOTH NORMAL	<0.05	<0.001*	>0.05#
BACN VS BOTH AFFECTED	>0.05	>0.05#	<0.001*
BNCA VS BOTH NORMAL	>0.05	>0.05#	<0.001*
BNCA VS BOTH AFFECTED	>0.05	<0.001*	>0.05#
BOTH NORMAL VS BOTH AFFECTED	>0.05	<0.001*	<0.001*

*- Significant difference, # -Not significant difference



Graph 1-Interference pattern of each group for N-back test



Graph 2: - Interference pattern for each group for TUG- Cog task

DISCUSSION

Participants of this study demonstrated mutual interference pattern irrespective of their cognitive or motor capacity affection. None of the previous studies have documented such findings. The following can be the probable reasons for such unique results

It is well known that; motor and cognitive functions are adversely affected by the physiological degenerative processes. Therefore, it is highly possible that with aging, the capacity of the body to do dual-task decreases [19]. As per the anatomic distribution, executive functions and working memory both are part of the frontal lobe function [20]. Thus, the anatomical decrease in brain mass, especially in the frontal lobe, contributes to a reduction of cognitive processing capacity during aging. It in turn may limit the extent to which neural plasticity can compensate for age-related decrements of locomotion [20]. Hence with limited neuronal resources, one or both components of the task may get compromised [21]. Studies have been suggested that, dual-task performance varies according to the level of physical capacity [22]. Hence the group was compared for these capacities.

Although it was decided to have distinctly different groups as per cognitive/motor capacity, the maximum number of participants was near the cut off criteria for MoCA or TUG scores i.e one or two scores above or below the cut off criteria. This means although they were statistically different for their capacities, their capacities might have been clinically similar i.e those who have affected the balance score may have a normal balance or vice versa and the same with cognitive capacity. Thus, the ceiling effect might have led to the observed result. Leading them to follow the same prioritization pattern.

The choice of the second task used to evaluate the effects of dual-tasks on walking also can affect dual-task performance [12]. For e.g. tasks that require mathematical skills (such as serial 3 subtractions) might create only minimal loading of attention if the subject is highly skilled with calculations, whereas subjects who are not comfortable or who have less calculative skills might be severely affected by the performance of such a task. Thus, influencing the performance and hence the mixed interference pattern. Although all participants were graduate and were gave a prior practice, their comfort to perform the task was not considered.

The type of task also influences dual-task performance [23]. Level of Task complexity has been suggested as one of the factors affecting dual-task performances [24]. The task with low task complexity appears to be easier to accomplish, as compared to other tasks that require higher-level Executive function which appears to be significantly more difficult [25]. Challenging motor tasks requires more cognitive effort leading to increase interference in the motor domain. In the current study, the tasks given to the participants might have been of different level of challenge for each participant.

According to the cross-domain competition model [26] both tasks, performance has declined due to competition between cognitive and motor resources. Hence mutual interference pattern might have been noted. Thus, it can be inferred that all these factors collectively may be responsible for bringing about mutual interference pattern, irrespective of the capacities, prioritization pattern, or the tasks that have been given.

The study had some limitations although the groups were statistically similar on age at baseline, the influence of gender, and environmental distraction on the performance of individuals while dual-tasking was not considered. The participants being closer to cut off scores in their cognitive and motor capacity also may suggest them being similar in their capacities for motor and cognitive tasks future studies can be done to overcome these factors in distinctly different groups e.g. in a disease-specific population or those who have clear complains of cognitive or motor loss. The influence of other factors such as task complexity, environment, individual preference can also be analyzed.

Considering above finding of the study, it is suggested that, both cognitive and motor capacity should be enhanced to improve the dual-task performance and to reduce the FOF and improve Qol (Quality Of Life). Explicit instructions should be given on which task to be concentrated to ensure optimal performance.

CONCLUSION

Physical and cognitive capacity does not influence task prioritization in the elderly while doing dual-task. Influence of other factors such as task complexity, environment, individual preference also is considered to determine this pattern.

ABBREVIATIONS

BA CN-balance affected cognition normal
BN CN –balance normal cognition normal
BA CA- balance affected cognition affected
CA BN-cognition affected balance normal
FOF - Fear of falling
GDS-geriatric depression scale
Moca –Montreal cognitive assessment
TUG –time up and go.

Role of authors

1. ATIYA SHAIKH: RESEARCH IDEA, LITERATURE SEARCH, STATISTICS.
2. KOMAL PATEL: LITERATURE SEARCH, DATA COLLECTION.
3. NIMESH GUPTA: ARTICLE WRITING.

REFERENCE

[1]. Mane A, Patil P, Sanjana T, Sriniwas T. Prevalence and correlates of fear of falling among elderly population in urban area of Karnataka, India. J Midlife Health. 5(3), 2014, 150.

[2]. Van Helden S, Wyers CE, Dagnelie PC, Van Dongen MC, Willems G, Brink PRG, et al. Risk of falling in patients with a recent fracture. BMC Musculoskelet Disord. 8, 2007.

[3]. Kumar A, Verma A, Yadav M, Srivastava AK. Review research paper fall: The accidental injury in Geriatric population. Journal of Indian Academy of Forensic Medicine. 2011.

[4]. Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? J Am Med Assoc. 297(1), 2007, 77–86.

[5]. Baker SP, Harvey AH. Fall injuries in the elderly. Vol. 1, Clinics in Geriatric Medicine. 1985, 501–12.

[6]. Kumar S, Medicine P, George K. Relationship Between Fear of Falling, Balance Impairment and Functional Mobility in Community Dwelling Elderly. Falls Balanc Elder. 19(2), 2008, 48–52.

[7]. Mann R, Birks Y, Hall J, Torgerson D, Watt I. Exploring the relationship between fear of falling and neuroticism: A cross-sectional study in community-dwelling women over 70. Age Ageing. 35(2), 2006, 143–7.

[8]. Kannus P, Palvanen M, Niemi S, Parkkari J. Alarming rise in the number and incidence of fall-induced cervical spine injuries among older adults. Journals Gerontol - Ser A Biol Sci Med Sci. 62(2), 2007, 180–3.

[9]. Lajoie Y, Teasdale N, Bard C, Fleury M. Upright Standing and Gait: Are There Changes in Attentional Requirements Related to Normal Aging? Exp Aging Res. 22(2), 1996, 185–98.

[10]. Neider MB, Gaspar JG, McCarley JS, Crowell JA, Kaczmarski H, Kramer AF. Walking and Talking: Dual-Task Effects on Street Crossing Behavior in Older Adults. Psychol Aging. 26(2), 2011, 260–8.

[11]. Woollacott M, Shumway-Cook A. Attention and the control of posture and gait: A review of an emerging area of research. Gait and Posture. 16, 2002, 1–14.

[12]. Yogev-Seligmann G, Hausdorff JM, Giladi N. The role of executive function and attention in gait. Movement Disorders. 23, 2008, 329–42.

[13]. Downton J. Wenn alte Menschen stürzen. Ursachen und Risiko. Pflege und Prävention. Ernst Reinhardt, München Basel. 1995

[14]. Lundin-Olsson L, Nyberg L, Gustafson Y. "Stops walking when talking" as a predictor of falls in elderly people. Lancet. 349(9052), 1997, 617.

[15]. Plummer P, Eskes G. Measuring treatment effects on dual-task performance: A framework for research and clinical practice. Front Hum Neurosci. 28(9), 2015.

[16]. Yogev-Seligmann G, Hausdorff JM, Giladi N. Do we always prioritize balance when walking? Towards an integrated model of task prioritization. Movement Disorders. 27, 2012, 765–70.

[17]. Yogev-Seligmann G, Rotem-Galili Y, Mirelman A, Dickstein R, Giladi N, Hausdorff JM, et al. How does explicit prioritization alter walking during dual-task performance? Effects of age and sex on gait speed and variability. Phys Ther. 90(2), 2010, 177–86.

[18]. Schaefer S. The ecological approach to cognitiveâ€"motor dual-tasking: findings on the effects of expertise and age. Front Psychol. 14, 2014, 5.

[19]. Liebherr M, Schubert P, Schiebener J, Kersten S, Haas CT. Dual-tasking and aging—About multiple perspectives and possible implementations in interventions for the elderly. Cogent Psychol. 3(1), 2016, 1–14.

Available from: http://dx.doi.org/10.1080/23311908.2016.1261440
[20]. Jonides J, Marshuetz C, Smith EE, Reuter-Lorenz PA, Koeppe RA, Hartley A. Age differences in behavior and PET activation reveal differences in interference resolution in verbal working memory. J Cogn Neurosci. 12(1), 2000, 188–96.
[21]. Abernethy B. Dual-task methodology and motor skills research: Some applications and methodological constraints. J Hum Mov Stud. 14(3), 1988, 101–32.
[22]. Hausdorff JM, Schweiger A, Herman T, Yogev-Seligmann G, Giladi N. Dual-task decrements in gait: Contributing factors among healthy older adults. Journals Gerontol - Ser A Biol Sci Med Sci. 63(12), 2008, 1335–43.
[23]. Simoni D, Rubbieri G, Baccini M, Rinaldi L, Becheri D, Forconi T, et al. Different motor tasks impact differently on cognitive performance of older persons during dual task tests. Clin Biomech. 28(6), 2013, 692–6.
[24]. Koenraadt KLM, Roelofsen EGJ, Duysens J, Keijsers NLW. Cortical control of normal gait and precision stepping: An fNIRS study. Neuroimage. 85, 2014, 415–22.
[25]. Walshe EA, Patterson MR, Commins S, Roche RAP. Dual-task and electrophysiological markers of executive cognitive processing in older adult gait and fall-risk. Front Hum Neurosci. 17(9), 2015, 1–13.
[26]. Lacour M, Bernard-Demanze L, Dumitrescu M. Posture control, aging, and attention resources: Models and posture-analysis methods. Neurophysiologie Clinique. 38, 2008, 411–21.

How to cite this article: Atiya Shaikh, Komal Patel, Nimesh Gupta. Influence of physical and cognitive capacity on task prioritization during the gait-related dual-task performance in elderly: A comparison. Int J of Allied Med Sci and Clin Res 2020; 8(2): 368-374.
Source of Support: Nil. **Conflict of Interest:** None declared.