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Dual task performance and executive function in physically under active and physically active elderly: A comparison

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ABSTRACT

Background

Effect of being physically active on motor and cognitive function is well known. Indirect effect of being physically active on dual tasking needs to be explored.

Aim & Objectives

To compare dual tasking and executive function in physically active and underactive elderly.

Method

124 Elderly were divided in to physically active and non-active using Rapid Assessment of Physical Activity (RAPA) scale and assessed for their Dual tasking skills using TUG-Cog, TUG-motor. Data was analyzed using unpaired t test.

Result

Physically active elderly performed significantly better than underactive elderly on Tug cog ,manual in both groups ($p<0.001$)

Conclusion

Physically active elderly have better dual tasking skills than their physically underactive counterparts.

Keywords: Dual tasking, Elderly, Physical activity

INTRODUCTION

Many activities of daily life involve simultaneous performance of multiple tasks which concurrently challenge motor and cognitive functions [1]. Aging leads to abnormal alterations that compromise the performance of motor skills, including impaired postural control, abnormal posture/ gait/ balance. This leads to a reduction in functional capacity thus causing difficulties in adapting to the environment, all of which can lead to a greater risk of falls [2-4].

The ability to perform multiple tasks which are common in daily living such as walking while engaged in a concurrent mental task (e.g. walking while talking, crossing road while carrying objects etc.) is impaired in elderly which is commonly correlated with fallsc[10]. Most of significant decrements in gait and/ or cognitive performance are

observed in older adults when cognitive tasks are performed while walking [1].

Positive effects of exercises on physical, cognitive and psychological well-being in elderly have been proved widely [3, 4].

It was hypothesized that, those doing physical exercises regularly will have good cognitive and physical capabilities and hence dual task performance. The effects of such indirect neuroprotectivity mechanism of exercise on brain function and dual task performance need to be studied in detail. Hence, this study was planned with the aim to assess dual task performance and executive function in physically active and physically under active elderly.

MATERIALS AND METHODOLOGY

Type of study

Cross sectional

Study population

Elderly

Setting

Community

Outcome measure

The dual task performance was assessed using TUG- COG and TUG- MAN and executive function was assessed by using Trail making test part A and B, TUG-COG r= -0.66 and ICC = 0.94 and TUG-MAN r= -0.72 and ICC= 0.99 [5] both have been found to have good validity and reliability [6, 7].

Inclusion criteria

Able to walk alone in neighborhood without any walking aid for at least once a day, Both genders,65 years and above, able to read, understand, interpret in English, Willing to participate in study., Geriatric Depression Scale score- 0- 9 score (suggesting no depression) [8], Mini Mental Scale Examination score- >27-30(suggesting no cognitive impairment) [9], Time up and go test timing- ≤ 10 secs score (suggesting no functional balance deficits) [10] They were further divided in to following two groups

- Physically active group- 30 mins of physical exercises 5 times per week85 (Common finding from previous studies as a criteria to decide elderly being physically active or underactive) and RAPA score above 6 [11]
- Physically underactive group- RAPA score below 6, physical exercise less than 30 mins or less than 5 times per week [11]

Exclusion criteria

Orthopaedic conditions like lower limb fracture, severe arthritis, deformities that can hinder walking abilities, Neurological conditions like, stroke, parkinsonism, sensory deficits, diabetic neuropathy, peripheral vascular disease that can affect walking abilities, Visual and vestibular processing insufficiency that can affect walking abilities.

SAMPLING TECHNIQUE

Convenience

Sample size

248

Parameters for sample size calculation

Zα =1.96(corresponding to type 1 error of 5% i.e 0.05),Zβ =1.282 (corresponding to power of 90%), σ = standard deviation ,d = mean Formula- n = 2(Zα+Zβ)2 ×(σ)2 /(d)2 , n = 124 ,Therefore , sample size -124 in each group

METHODOLOGY

After obtaining clearance from the institutional ethics committee and written consent of participants, they were screened according to inclusion and exclusion criteria. Basic screening was to done categorize them in to physically active(A) and underactive(B).They were assessed for Executive function using Trail making test A and B and Dual task performance using TUG-cognitive, TUG-manual Test. Adequate rest pauses were given as per participants comfort. Sequence of tests was decided by chit method. Scores of each test i.e TUG, TUG-COG, TUG- MAN were compared in both groups using SPSS 22.00

Table 1- Gender distribution in physically under active and physically active elderly

	Physically Underactive	%	Physically Underactive	%
Male	90	72%	90	72%
Female	35	28%	35	28%
Total	124	100%	124	100%

Table 2 –Comparison of age distribution in physically under active and physically active elderly

Age	Physically Under active	Physically active
Mean	71.282	71.5
SD	3.545	3.863
SEM	0.3171	0.907
Test	Man- Whitney U test	
p value	0.4536	
Inference	Not significant difference.	

Table 3 - Comparison of tug- cog tug-man (in secs) in physically under active and physically active elderly

	Physically Under active	Physically active	Physically Under active	Physically active
	TUG-COG		TUG-MAN	
Mean	12.1152	8.56	13.368	10.572
SD	1.233	1.157	0.862	1.238
SEM	0.1103	0.1034	0.0771	0.1107
Test	Man- Whitney U test		Man- Whitney U test	
p value	<0.0001		<0.0001	
Inference	Extremely significant.		Extremely significant.	

DISCUSSION

Gender, age, physical capacity can be important confounding factors for such type of studies. Both the groups were similar at baseline for these components hence, comparable on the basis of these confounding factors.

This study showed that, physically active elderly performed significantly better in tasks involving dual components and executive function as compared to their underactive counterparts. Although there is wide literature available on dual tasking, in our view, this is first study to compare dual tasking in physically active and underactive elderly.

Following can be the reasons for physically active elderly to be better in performance

Physical activity and its effects on physical performance

Various studies have demonstrated positive effect of physical activity on physical performance parameters like strength, endurance, ostogenesis, reaction time, balance etc. This can increase in relative effort associated with task speed or quality and hence increasing overall capacity leading to increase in Dual task efficiency [12, 13]. Steffen TM in their study follow up study also supports this hypothesis were they found the mobility decline to be reduced those being physically active irrespective of other comorbidities [10] There are various longitudinal studies which demonstrated that regular physical activity is useful in reducing mortality and enhancing mobility and promoting healthy aging [14, 16]. Many other studies demonstrated a dose response pattern for physical activity which they found to physical active lifestyle to reduce a risk of physical function [17, 18].

Exercises and its positive impact on cognitive functions

Many researches have proved positive effect of physical activity on cognitive functions thru different mechanisms and different doses and trainings [19-21]. It can be summarized as follows

Stimulation of neuroplasticity through angiogenesis

Blood supply to brain declines with aging. Physical activity enhances blood supply to brain and

thus functioning indirectly. Hippocampal angiogenesis due to sustained moderate-level physical activity leads to improvements in learning and memory function. A F-MRI study done to find association between brain connectivity and fitness showed that, brain connectivity was increased in those with higher levels of fitness than in those with lower fitness levels [22, 23].

Neurotrophins

Endogenous brain proteins which promote neuroplasticity i.e. neurotrophins play an important cognitive function [24]. They are secreted in response to physical activity. Following hormones play a key role

G-CSF (Granulocyte colony stimulating factor)

Increase in plasma levels of G- CSF have been found after short bursts of aerobic exercise and following sustained endurance exercise. This is found to increase cerebral grey matter volume which is important for increased cognitive reserve thus learning capacity and memory streamline [25, 26].

BDNF (Brain derived neurotrophic factor)

It is important for survival of neurons in the hippocampus, cortex, and cerebellum during brain development. Synaptophysin and synaptobrevin, substances which transport neurotrophins to neurotransmitter vesicles are increased by BDNF .It has seen to be increased in adults who engage in aerobic exercises [27-29].

IGF-1(Insulin like growth factor 1)

It has been found to promote neuronal growth in adults alter 6 months of moderate to high level of resistance activities [30].

Enhanced cardiovascular health leading to positive effects on CNS

It is positively associated with brain health and cognitive performance [31, 32]. Studies show association between hypertension and poor performance on attention, visuospatial abilities, perceptual and psychomotor abilities and memory in older adults [33]. Hypertension has been found to decrease blood flow, slower metabolism, especially in frontal and temporal lobes and white matter atrophy [34]. Thus, controlling hypertension might be one of the ways to reduce decline in cognitive performances. Regular Physical Activity is proved to be useful to decrease detrimental effects of hypertension on body [35]. Thus, it can be safely assumed that, those who maintain regular physical activities/ aerobic activities may benefit in reducing hypertension. This might provide a protective neuro cognitive effect thus sound brain functions. Studies also showed, hippocampal volume which is positively associated with spatial memory function is found to be improved in those having good aerobic capacity [36].

Many epidemiological and longitudinal systematic reviews studies have reported positive relation between physical activity and cognitive skills in healthy older adults [37-39].

General neuroprotective effects

Active lifestyle also prevents stress by decreasing cortisol levels which can also positively influence cognitive function [40]. Many longitudinal studies have also shown an association between higher level of physical activity and cognitive decline [41-43]. Current study also found similar results with respect to executive function which is one of the important components of cognitive function in those being physically active. Physically active elderly were very fast to complete the task as compared to physically under active elderly.

Automaticity and its effect on enhanced physical performance, cognitive performance

According to principle of automaticity, while doing dual tasking, if one task is automatic, or easy to perform, an individual can divert his attention on other task. Thus, performing optimal in both task components given dual task condition [44]. Regular Exercises like walking can help for the automation of gait skills and balance [45]. The physically active group might have had the added advantage of enhanced balance and automation of gait related skills they also had better executive function as compared to physically under active elderly. Thus may be they could concentrate on given cognitive or manual task and perform well on TUG COG and TUG MAN as compared to physically under active group. Thus we can say that, when the physical and cognitive functioning is improved, the dual task performance can be improved.

Keeping theories of dual task in mind, better cognitive and physical reserve might help to decrease interference. Task automaticity also might have given the added advantage to physically active elderly. Hence, physically active elderly participants

might have been able to concentrate better on both tasks as compared to their under active elderly counter parts. Hence, securing statistical significant better scores on TUG cognitive and TUG manual tests.

Although we could not come across any similar studies showing a direct association in positive effect of physical activity on dual task performance since, physical activity has shown to enhance physical and cognitive function efficiently, the positive effects on dual task performance can be linked to this change.

CLINICAL IMPLICATION

Society and policy makers should utilize this information for creating awareness and efficient policies to enhance physical activity in adults which in turn will help to prevent decrease in physical, cognitive functions and hence dual task functioning which in turn may help to decrease risk of falls, cost of care and enhancing quality of life.

LIMITATION AND FUTURE SCOPE

Current study included elderly with basic qualification of graduation, other cognitive functions (e.g. memory, reaction time) and physical functions (e.g. strength, flexibility) were not assessed. Other tasks assessing Dual task performance were not included (as functional balance was core area of interest).Only motor component of TUG was considered and performance for cognitive task was not studied hence, dual task interference cannot be commented. Future studies should focus on comparing dual task interference. Effect of different physical activity enhancement/ rehabilitation protocols can be compared in physically active and physically under active elderly. Another study can be done to identify factors influencing choice of lifestyle (physically active/ under active lifestyle) in individuals and its effect on dual task performance and executive function.

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