



“Effect of Decline in Different Cognitive Domains on Dual Task Performances Among Stable COPD Individuals”

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ABSTRACT:

Objectives: COPD patients suffer from different respiratory consequences but they also suffer from extra-respiratory consequences which impair their quality of life, one of which is cognitive decline so this study is aimed to contribute to change the perspective of recommendation of exercises to COPD subjects keeping the cognitive decline in mind which could lead to balance issues thus further leading to depression and anxiety

Methods: Total 50 patients were taken and were divided into two groups on the basis of MMSE score. Subjects in both the groups were asked to perform few tests and their data was noted. Those tests were Static Balance, Dynamic Balance and tests for Dual task training (Single motor, Cognitive Dual task training, Motor Dual task training).

The MMSE score of each subject was calculated domain-wise and the affected domains per subject were also noted down.

Results: The association of all the variables with particular domain was calculated using PEARSON'S CHI SQUARE TEST and significant and non-significant result came out domain-wise.

Conclusion:

- Cognitive domain 2 (Memory Recall) had a significant result on MMSE, other domains, Static balance, Dynamic balance and Cognitive Dual task.
- Cognitive domain 3 (Concentration) had a significant result on MMSE, other domains, Cognitive dual task and Motor dual task.
- Cognitive domain 5 (Language) had a significant result on MMSE and other domains.
- The domains having non-significant result on all the variables were Cognitive domain 1 (Orientation), Cognitive domain 4 (Working memory) and Cognitive domain 6 (Visuo-spatial).

Introduction:

According to WHO, Chronic Obstructive Pulmonary Disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. The more common terms “Chronic Bronchitis” and “Emphysema”

are no longer used but are now included within COPD diagnosis.

Chronic Obstructive Pulmonary Disease (COPD) is the condition of major consideration. It is a disease which is preventable and treatable but it has few extra-pulmonary effects which lead to disease severity.¹ Main cause is



tobacco smoking with the contributing factors of pollution and to some extent, the genetics.

There is airflow limitation which is not fully reversible. It is progressive and is associated with abnormal inflammatory response to noxious particles or gases. It is the most common cause of death worldwide and ranks 3rd in 2020 in global burden of disease.¹

There are 2 main consequences present after COPD which are pulmonary consequences and extra-pulmonary consequences. Common pulmonary symptoms of COPD include cough, mucus production, wheezing and shortness of breath on exertion.

GOLD criteria advise proper attention to respiratory treatment but also to the extra-respiratory consequences in COPD patients which include peripheral muscle dysfunction, systemic inflammation, nutrition depletion, and malnutrition.²

Recently more interesting extra-pulmonary dysfunctions have been proved through research which state that decline in cognition is present among COPD patients.³ Because of cognitive decline and extra-pulmonary dysfunctions, Balance issues have become the most important part in COPD patient's rehabilitation protocol.

Recent research has proved that impaired balance is one of the most important extra-respiratory causes which leads to loss of functional independence and falls.² and this also has an impairing effect on static and dynamic balance.^{4,5}

People with COPD have also shown significant cognitive decline which can be due to C-reactive protein⁶ or can be attributed to neuronal damage mediated through Hypoxia.⁷ Intact cognition enables a person to perform better during dual task activities so lot of researchers found that there is significant decline in motor performances due to dual task activities.

Considering the above, many studies have quoted that dual task training has greater effectiveness for improving dual task performance as compared to single task training among stable COPD individuals.^{8,9,10}

Still, we do not know the exact stage or percentage of COPD individuals who actually have cognitive decline. Also, cognition has been further classified into six domains including learning and memory, visuo-spatial and motor function, attention/concentration, language,

social cognition/emotions and executive functions.¹¹⁻¹³ The effect of decline in each domain on dual task performances is yet to be studied.

Considering the above issues, this study plans to find out the effect of decline in different cognitive domains on dual task performances in stable COPD subjects.

This study also aims to take a step further in increasing the knowledge of domain-wise decline in COPD subjects and will also help in finding out which domain is commonly affected and has the maximum impact on balance of the subjects.

This will further help in preparing a better exercise protocol for COPD subjects keeping all the above issues in consideration.

Objectives:

To determine:

- 1) Which type of cognitive domain is more involved in COPD patients
- 2) Percentage of COPD patients who have cognitive decline
- 3) Effect of decline of cognitive domain on patient's dual task performance.

Material and methods:

After the approval of our research proposal by Swami Rama Himalayan University, Dehradun, data collection was started. All participants agreed to participate in the study and signed the approved written consent form.

Both males and females under the age group of 40-70 years were included in the study and the data collection was done from chest ward and OPD of Swami Rama Himalayan University, Dehradun. Total data collection of 50 subjects was done based on inclusion and exclusion criteria via convenient sampling method.

Patients having age group of 40-70 years and both males and females who had no acute exacerbation since 3 weeks were included in the study.

Patients who had acute exacerbation from 1-3 weeks, neuromuscular condition, musculoskeletal condition, postural orthostatic hypotension, oxygen dependency, severe cognitive impairment on MMSE (score 0-17) were excluded from the study.



Outcome variables were MMSE scale (Mini Mental State Examination), Short Physical Performance Battery test (SPPB), Timed up and go test (TUG), Dual Task Training (Single Motor Task, Cognitive Dual Task Training, Motor Dual Task Training)

Procedure:

Subjects were selected based on inclusion and exclusion criteria. Informed consent was filled and ethical approval was taken.

MMSE score was taken for all the patients and according to it, patients were categorized into two groups- Group A (MMSE 17-24) and Group B (MMSE >24)

Same protocol was given to patients in both the groups.

After filling the consent form and dividing the subjects into groups according to MMSE Score, 3 tests were applied.

SPPB test for static balance was applied and score was given accordingly.

TUG test was applied for dynamic balance and the time taken to cover and come back (3-meter distance), was measured with stopwatch and noted.

SINGLE MOTOR TEST, COGNITIVE DUAL TASK TRAINING AND MOTOR DUAL TASK TRAINING (All these 3 tests come under Dual Task Training), were performed and the time taken to complete these tests was measured with stopwatch and noted. Two readings of each of these 3 tests were taken and the best out of the two was considered.

Results:

The result was calculated through SPSS software and Pearson's Chi Square test was used.

Among the 50 subjects, 32 were males and 18 were females

When correlation of all the variables was done with **COGNITIVE DOMAIN 2 (MEMORY RECALL)**, it was found out that 5 variables came out to be significant (**Figure 1**). These are as follows:

- MMSE (p-value $0.004 < 0.05$), which means that MMSE had an effect on Memory recall and it also affected patient's performance.
- Other domains (p-value $0.009 < 0.05$), which means that affection of other domains (Orientation, Concentration, working memory, Language, Visuo-spatial) were also affecting Memory Recall
- Static Balance (p-value $0.016 < 0.05$), which means that affection of Domain 2 (Memory Recall) also affected Static balance of the patient causing an effect on his/her performance.
- Dynamic Balance (p-value $0.003 < 0.05$), which means that affection of Domain 2 (Memory Recall) also affected Dynamic balance of the patient causing an effect on his/her performance.
- Cognitive Dual task 2 (p-value $0.002 < 0.05$), which means that affection of Domain 2 (Memory Recall) also affected Cognitive dual task performance of the patient

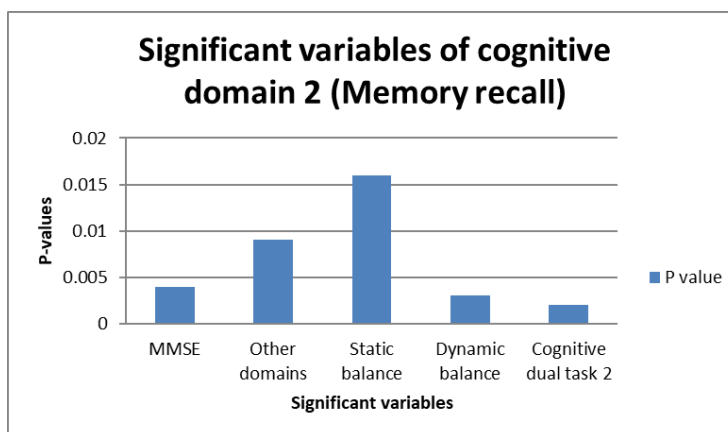


Figure 1: Significant variables of cognitive domain 2 (Memory recall)

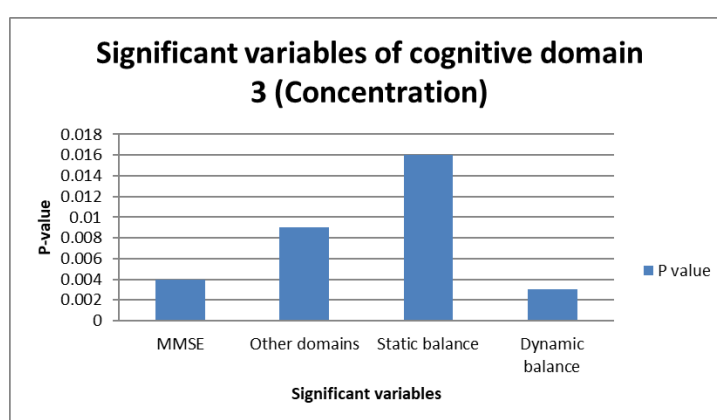


When correlation of all the variables was done with **COGNITIVE DOMAIN 3 (CONCENTRATION)**, it was found out that 4 variables came out to be significant (**Figure 2**). These are as follows:

- MMSE (p-value $0.000 < 0.05$), which means that MMSE had an effect on Domain 3 (Concentration) and it also affected patient's performance
- Other domains (p-value $0.000 < 0.05$), which means that affection of other domains (Orientation, Memory

Recall, working memory, Language, Visuo-spatial) were also affecting Concentration.

- Cognitive Dual task 2 (p-value $0.010 < 0.05$), which means that affection of Domain 3 (Concentration) also affected Cognitive dual task performance of the patient.
- Motor Dual task 1 (p-value $0.013 < 0.05$), which means that affection of Domain 3 (Concentration) also affected Motor dual task performance of the patient.

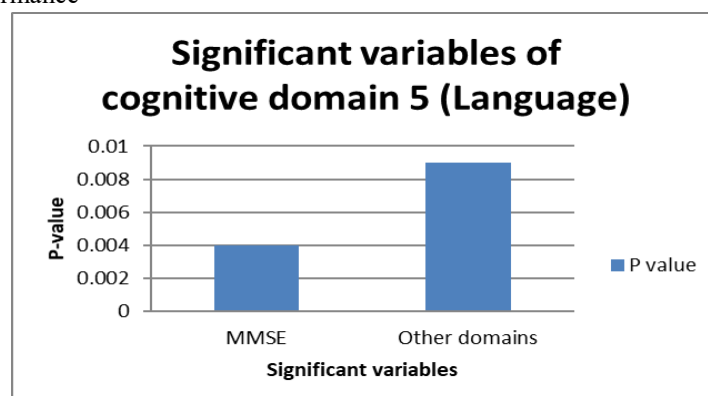


“Figure 2: Significant variables of cognitive domain 3 (Concentration)”

When correlation of all the variables was done with **COGNITIVE DOMAIN 5 (LANGUAGE)**, it was found out that 2 variables came out to be significant (**Figure 3**). These are as follows:

- MMSE (p-value $0.023 < 0.05$), which means that MMSE influenced Domain 5 (Language) and it also affected patient's performance

- Other domains (p-value $0.021 < 0.05$), which means that affection of other domains (Orientation, Memory Recall, Concentration, working memory, Visuo-spatial) were also affecting Language.



“Figure 3: Significant variables of cognitive domain 5 (Language)”

Only two domains had an impact on patient's dual task performances. Those two domains were:

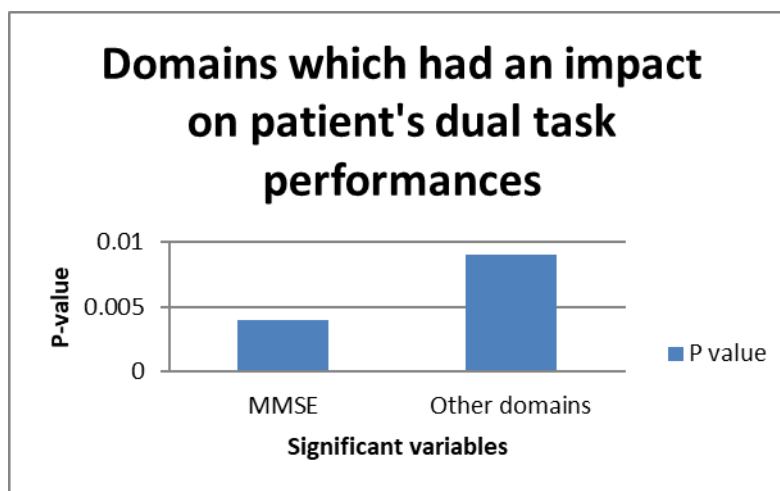
**Cognitive domain 2 (Memory Recall)**

result came out to be significant with P-value of 0.002.

Cognitive domain 3 (Concentration)

(Figure 4)

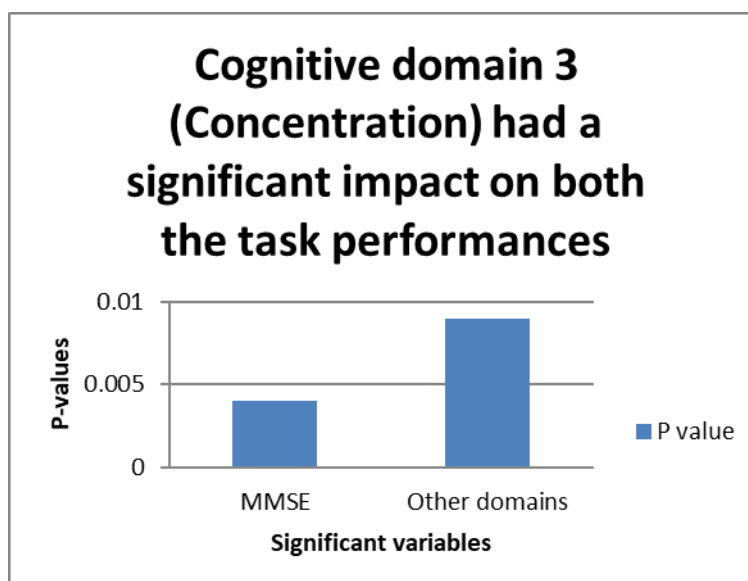
Cognitive domain 2 (Memory Recall) had an impact on cognitive dual task performance of the subjects and the



“Figure 4: Domains which had an impact on patient’s dual task performances”

Cognitive domain 3 (Concentration) had an impact on cognitive dual task performance and motor dual task performance of the subjects and the result came out to be

significant with P-value of 0.010 and 0.013 respectively.(Figure 5)



“Figure 5: Cognitive domain 3 (Concentration) had a significant impact on both the task performances”



Discussion:

The current research was performed to investigate the effect of mild and moderate cognitive impairment on static balance, dynamic balance and dual task training of COPD subjects. It is proved that COPD is associated with increased risk of impaired cognitive function¹⁴. But the studies have always discussed the level of cognitive impairments in COPD subjects. So, this study was done to find out which domain is more involved and has more effect on the patients.

The result of our study is based on the sample of 50 subjects (both males and females) of COPD divided into two groups according to MMSE score- Mild cognitive impairment and Moderate cognitive impairment. Both groups were given the same protocol and also their domain-wise affection was seen. Result of the study was statistically significant for Memory Recall (CD2), Concentration (CD3) and Language (CD5). For other domains, the result came out as non-significant.

Various controlled studies have discussed the importance of cognitive impairment in COPD^{15,16,17} when they compared them with healthy controls. Present study is supported by Villeneuve et al.¹⁸ who mentioned that level of education is the only variable in which significant differences are seen in COPD population with and without cognitive impairment.

Concentration in COPD individuals is one of the most widely studied for functions. In our study, for concentration, the result came out as significant for cognitive and motor dual task training leading to effect on their dual task performance. The effect of concentration was not seen on static and dynamic balance.

But for Orientation, we proved that the correlation of orientation was non-significant for all the variables which means affection of orientation was not causing any difficulty in their static and dynamic balance and also the dual task training.

Both domains are supported by Orth et al.¹⁹ who compared COPD individuals with healthy controls in terms of complex attentional and perceptual functions and further proved that in stimulated driving conditions, patients showed lower concentration and had a significantly higher number of accidents than healthy

controls.

Memory issues are common in COPD individuals. There are also number of studies that have failed to document any memory deficits in COPD patients. However, in our study we proved that Memory Recall was the only domain which had maximum effect on patient's performance. The result was significant for MMSE score which means it influenced overall MMSE score of the patient. Also, the result was significant for other domains and it had a significant effect on static balance, dynamic balance and dual task performance (cognitive part). The result was non-significant for motor dual task training.

But for Working Memory, the result came out as non-significant for all the variables which it was not causing effect on any of the variable further affecting patient's performance.

Both domains have been supported by majority of researchers which have documented deficits in verbal short-term and long-term memory^{20,21}. Visual memory²² and Spatial memory²¹. According to Villeneuve et al¹⁹, verbal memory and learning is the second most impaired cognitive domain in COPD individuals.

The presence of language dysfunctions alone in COPD patients is still controversial. In our study, we have investigated the effect of Language as a separate domain in Mild and moderately affected COPD individuals. And the result for the same came out as significant for two variables. It influenced their MMSE score and it had a significant effect on other domains.

This domain has been supported by significant number of studies that have documented serious language impairments assessed with verbal fluency tests in COPD patients²³⁻²⁵. Another recent review, conducted by Schou et al.²⁶ investigated the occurrence and severity of cognitive dysfunction in COPD patients, exploring the relationship between the severity of COPD and level of cognitive function

In our study, the result of Visuo-spatial domain came out as non-significant for all the variables which means it was not causing any effect on all the variables and thus there was no impact on their static and dynamic balance and also the dual task training.

This domain has been supported by many studies which



state that a decline in constructional abilities is very common among COPD patients²⁵. The term “executive functions” coined by Lezak refers to skills involved in formulating goals, planning their achievement, and effectively performing behaviours²⁷. The assessment of executive functions in COPD has shown that such patients tend to have slower processing speeds²⁸.

TUG test is an integrated assessment of physical function, which incorporates balance, gait speed and functional capacity²⁹. In our study, we asked all the subjects to perform this test as an assessment tool for dynamic balance and two readings for the same were taken.

TUG has been supported by a recent study which showed that patients with COPD took longer time to perform the TUG than the controls, and the prolonged TUG identified patients with COPD at risk of falls³⁰. Furthermore, in elderly, the TUG test has been found to be a responsive measure to a rehabilitation exercise program^{31,32}.

SPPB is usually related to functional and mobility factors³³⁻³⁵. In our study, we asked all the subjects to perform this test as an assessment tool for static balance in which we asked the subjects to stand in three positions- side to side stand, semi-tandem stance and tandem stance and we asked the subjects to maintain each position for 20 seconds which led to completion of all the positions in one minute.

SPPB has been supported by a recent article which says that SPPB is useful also for identifying frail elderly people in different socio-economic contexts³⁶. SPPB battery test takes no more than 5 minutes to carry out and could be applied in any clinical setting³⁷, even by non-specialized people also as it only requires limited knowledge to conduct the test. It has also been shown that use of this test is feasible in primary care units.

Conclusion:

The present study demonstrated that the balance performance was significantly correlated with different variables domain-wise but few domains also came out to be non-significant. This study proved that cognitive impairment affects balance ability and also puts the individuals with COPD at risk of falls. Thus, the findings confirm that there is a role of cognition in balance control and each domain plays a very important

role. Thus, cognitive function should be included as a part of routine assessment and according to the affected domains, individual exercise protocol should be made to improve that component further leading to low risk of falls.

Cognitive domain 2 (Memory recall), 3 (Concentration) and 5 (Language) proved that the result was significant for different variables for different domains. These domains had effect on the patient's balance and dual task performance and there is a need to focus on these domains while designing the exercise protocol.

Cognitive domain 1 (Orientation), 4 (Working memory) and 6 (Visuo-spatial) proved that the result was non-significant and they had no effect on any variable thus there is no need to focus on these domains while designing the exercise protocol.

The domains who were showing decline in the dual task performances of the subjects were Cognitive domain 2 (Memory Recall) and Cognitive domain 3 (Concentration). Rest, all the other domains had no effect on the dual task performances of the individuals

Percentage of COPD subjects who had Mild Cognitive decline (MMSE >24) were 56% and those who had Moderate Cognitive decline (MMSE 18-24) were 44%.

Clinical relevance:

- It is very important to check cognitive decline in COPD individuals as it can affect their whole lifestyle and can also lead to delayed recovery.
- All the static and dynamic balance tests that have been used for this study have caused improvements in patient's balance and have caused faster recovery and early hospital discharges and has also led to a better quality of life.
- Dual task training has mostly caused patient to do more works at a time and has led to improved cognition which is helpful in completing their daily chores.

Advantages:

One of the advantages of our study is that we can know which domain creates maximum impact on patient's performance (on Balance and Dual task training) and



decline in particular domain gives us a better understanding, thus will help further in making a better rehabilitation protocol and leading to improvement in patient's recovery and decrease in hospital stay and better quality of life.

Limitations:

One of the limitations of present study is that the score of patients who had limitation (in reading or writing) were affected thus further creating impact on dual task performance and balance of patients because we were not able to know the decline in particular domain clearly.

Future scope:

This study will take a step further in increasing the knowledge of domain-wise decline in COPD subjects and will also help in finding out which domain is commonly affected and has the maximum impact on balance of the subjects. This will further help in preparing a better exercise protocol for COPD subjects.

Conflict of interest:

There was no conflict of interest reported among all the authors of this clinical research.

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