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Significance Of Neurobic Exercse On Executive Function And Quality Of Life Among Middle Aged Individuals With Type Ii Diabetes Mellitus

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ABSTRACT

BACKGROUND OF THE STUDY:*Type II Diabetes Mellitus is a chronic metabolic disorder characterized by high blood sugar levels, insulin resistance, and relative insulin deficiency. It primarily results from obesity and physical inactivity [(1)]. Recent studies have shown that individuals with Type II DM often experience mild cognitive impairment (MCI). Prolonged diabetes, particularly with elevated HbA1c levels, is associated with poorer cognitive performance [(5)]. If untreated, MCI in middle-aged individuals (45-70 years) could progress to dementia in older age [(4)]. Type II DM, cognitive dysfunction often manifests as mental slowing, attention deficits, and reduced executive function. These impairments are associated with declines in memory, processing speed, and complex motor functioning [(10)]. Neurobic exercise involves engaging the five senses (sight, hearing, taste, smell, touch) to stimulate brain activity. Neurobic exercises are particularly beneficial for enhancing executive functions such as task planning, problem-solving, and judgment. These exercises have been shown to improve cognitive performance in individuals with Type II diabetes by enhancing attention and motor control [(11)].*

OBJECTIVES OF THE STUDY:*The objective of the study is to find out the effect of Neurobic exercise to improve the executive function and quality of life among middle aged individuals with type 2 Diabetes Mellitus.*

METHODOLOGY:*A total of 30 middle-aged participants (36–55 years) with T2DM were randomly assigned to an experimental group (n=15) and a control group (n=15). The intervention lasted 24 weeks, with 48 sessions of 60 minutes each. Executive function and quality of life were assessed using the Montreal Cognitive Assessment (MoCA) and Quality of Life in Diabetes (QOLID) tools, respectively.*

RESULTS:*Statistical analysis using paired and unpaired 't'-tests revealed significant improvements in both executive function and quality of life in the experimental group compared to the control group. The MoCA scores improved to 6.8 in the experimental group versus 5.6 in the control group, while QOLID scores were 22 and 17.8, respectively.*

CONCLUSION:*This study concluded that Neurobic exercise is effective in improving Executive functionand Quality of life among middle aged individuals with type II Diabetes Mellitus.*

KEY WORDS: *Quality of life, Montreal cognitive assessment, Type II diabetes mellitus, Neurobic exercise*

INTRODUCTION

Type II diabetes mellitus (DM) is a long-term metabolic disorder that is characterized by high blood sugar, insulin resistance and relative lack of insulin. It is primarily occurring as a result of obesity and lack of exercise [(1)]. Type II diabetes makes up about 90% of cases of diabetes with the other 10% is primarily due to type 1 diabetes [(2)]. Duration of type II DM more than 5 years and an increasing HbA1c were found to be associated with a lower cognitive performance [(5)]. Mild to moderate cognitive impairment were found to be present among middle aged population (45-70yrs) with Type II DM which could possibly results in dementia in older adults if untreated.

COGNITION AND ITS SIGNIFICANCE:

Cognition is defined as "the mental action or process of acquiring knowledge and understanding through thought, experience and the senses" [(7)]. Cognitive dysfunction involves mental and motor slowing, impaired attention and reduced executive function. Reduction in executive function may also

lower the quality of life, significantly [5].

Furthermore, Type II DM has also been associated with decreases in psychomotor speed, frontal lobe\executive functions, verbal memory, processing speed, complex motor functioning, working memory, immediate recall, delayed recall, verbal fluency, visual retention and attention [10].

There are two types of Mild cognitive impairment (MCI). They are:

- **Amnestic MCI:** Memory impairment, often a precursor to Alzheimer's.
- **Non-amnestic MCI:** Impairments in executive functions, affecting quality of life.

MECHANISMSRELATED TO COGNITIVE DECLINE IN DIABETES MELLITUS:

Diabetes causes progressive brain damage, particularly affecting the frontal lobe (executive functions), including a number of complex behaviors such as problem solving, planning, organization, insight, reasoning and attention are also noted in individuals with diabetes [10]. High insulin levels may also increase beta-amyloid production, linked to Alzheimer's [9].

QUALITY OF LIFE AND COGNITIGVE IMPAIRMENT AMONG TYPE II DIABETES:

QOL is defined by WHO as an individual's perception of their life in the context of cultural values and personal goals. Cognitive decline affects QOL through impairments in attention, memory, and abstract thinking. It is controversial whether QOL is already disturbed in more initial phases of cognitive decline like MCI – Mild Cognitive Impairment [11]. Early detection of cognitive issues in diabetes is crucial for timely interventions. The cognition and quality of life measurement tools were used by QOLID questionnaire and MOCA.

NEUROBIC EXERCISE AND EXECUTIVE FUNCTION:

Neurobic exercises stimulate brain activity through sensory engagement (sight, hearing, taste, smell, touch), enhancing neural connections and promoting neurotrophin production for nerve growth. These exercises improve executive functions, including attention, problem-solving, and judgment. Multi-task walking training has shown benefits in improving executive functions and motor control in individuals with Type II DM.

OBJECTIVES OF THE STUDY

- To find out the effect of Neurobic exercise to improve the Executive function among middle aged individuals with type 2 Diabetes Mellitus.
- To find out the effect of Neurobic exercise on Quality of life among middle aged individuals with type 2 Diabetes Mellitus.

METHODLOGY

STUDY DESIGN : Experimental study
STUDY POPULATION : Middle aged people with type 2 DM fulfilling selection criteria.
SAMPLING METHOD: Randomised sampling
SAMPLE SIZE : 30 Samples

STUDY SETTING : MGMCRI- Neuro OPD
OUTCOME MEASURES : Executive function, Quality of life
OUTCOME TOOLS : MOCA - Montreal Cognitive Assessment
QOLID - Quality of Life Instrument for Indian Diabetes
TREATMENT DURATION: 24 Weeks (48 sessions) 60 minutes
STUDY DURATION : 12 months
VARIABLES:
INDEPENDENT VARIABLE: Neurobic exercise & Aerobic Walking
DEPENDENT VARIABLE : A. Executive function
B. Quality of life

SELECTION CRITERIA

INCLUSION CRITERIA

- Age group: 50-60
- Both male & female
- Duration of diabetes more than 5 yrs.
- Mini mental state examination (MMSE) score of 18-23 are included.

EXCLUSION CRITERIA:

- Gestational diabetes patients or Type 1 diabetes.
- Inability to communicate due to physical and mental disability
- Diabetes specific complications such as chronic neuropathy, Diabetic foot etc.,
- No history of psychiatric disorder or neurological condition
- No depressive symptoms
- Current smoker or alcoholic

Materials used: Paper, Pen, Stopwatch, Questionnaire Crayons Data Collection Sheet Various Objects for identification. (eg: Key)

PROCEDURE

EXPERIMENTAL GROUP - NEUROBIC EXERCISES:

(NEUROBIC TRAINING TO IMPROVE EXECUTIVE FUNCTION)

Neurobic exercises are brain tasks designed to keep the brain active and improve the executive functions of the brain. By writing letters, words, and sentence and drawing diagrams with the non-dominant hand of the participant stimulates their brain and provides the brain with a challenge which in turn helps to improve executive function.

The developed Neurobic training program consisted of six exercises with stimuli of the different physical senses. The six Neurobic exercises whereas follows:

1. DRAW AND COMPLETE THE TASK ON PAPER:

The patient is positioned in a comfortable position and was instructed to draw and complete the incomplete diagram shown by the therapist. A set of 64 tasks with a gradual increase in complexity was provided to the patient throughout the treatment sessions as per the individual's ability to complete the given task.

2. IDENTIFICATION OF OBJECT :

The patient is seated in a comfortable position with eyes closed and the individual is asked to touch and feel the items kept in a box. 10 minutes later the participant was advised to remember and write the names of the items on the paper using his/her non-dominant hand.

3. WRITING EXERCISE:

The writing exercise was provided to the subject by the therapist by various methods,

A) Writing the answers to the simple questions asked by the therapist using dominant or non-dominant hand as per the instructions provided by the therapist.

B) Making a rough sketch of a given or instructed alphabet using dominant or non-dominant hand as per the instructions provided by the therapist.

Writing a number on a paper using dominant or non-dominant hand as per the instructions provided by the therapist

4. LETTER / WORD GUESSING USING GRAPHESTHESIA SENSATION:

The patient is seated in a chair with eyes closed, the therapist stands behind or at the side of the patient. The therapist writes a letter/ word by using his finger on the back or on the palmar aspect of the forearm of the participant and instructed the patient to write the answer on paper using the dominant or non-dominant hand as per the instructions of the therapist.

5. READING EXERCISE: The participant was instructed to read a newspaper or book in upside down position as per instructions of the therapist.

6.ARITHMETIC EXERCISE:

Various arithmetic exercises were provided to the individual by various methods such as,

A). Adding the numbers from 0 to 100 in ascending order (Start reciting one by one; progression will be done by counting by two by two and so on)

b). Subtracting the numbers from 100 to 0 in descending order (Start reciting one by one; progression will be done by counting by two by two and so on)

CONTROL GROUP – AEROBIC EXERCISE (WALKING)

Based on the Position Statement of the American Diabetes Association (2016), the standard Aerobic exercise training was advised for the controls with the following recommendations:

a) **Type of exercise:** Prolonged, rhythmic activities using large muscle groups (e.g., walking, cycling, jogging and swimming as per the patient's interest).

b) **Intensity:** Moderate to vigorous (subjectively experienced as "moderate" to "very hard").

c) **Duration:** At least 150 min/week at moderate to vigorous intensity for most adults with diabetes.
d) **Frequency:** 3–7 days/week, with no more than 2 consecutive days without exercise.

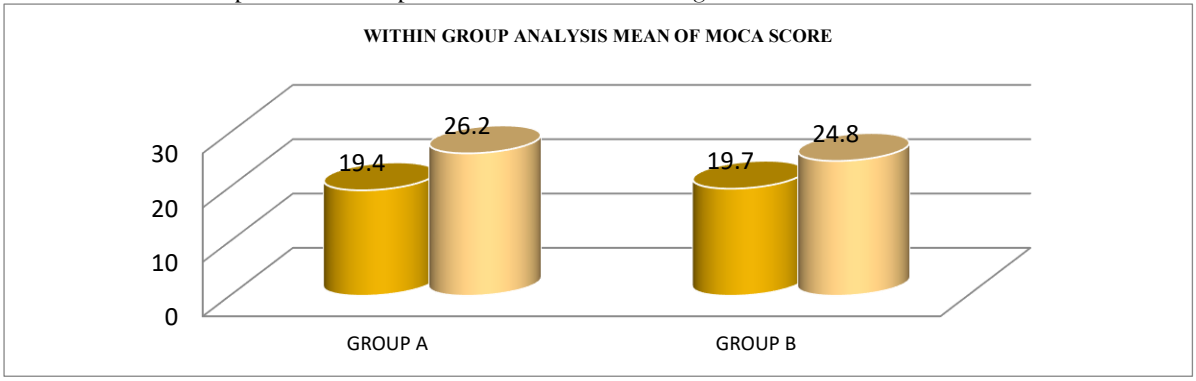
STATISTICAL ANALYSIS

The pre-test and post-test interventional differences within the two groups and between the two groups were analysed using paired "t" test and unpaired "t" test for outcome measures. Statistical significance was set at $p<0.05$ was considered as a significance difference.

WITHIN THE GROUP ANALYSIS OF MOCA IN GROUP A AND GROUP B: PAIRED t TEST

GROUPS	Pre Test	Post Test	T-Value	P-Value	Significance
GROUP A	19.4	26.2	19.17	.0001	<0.05
GROUP B	19.7	24.8	16.04	.0001	<0.05

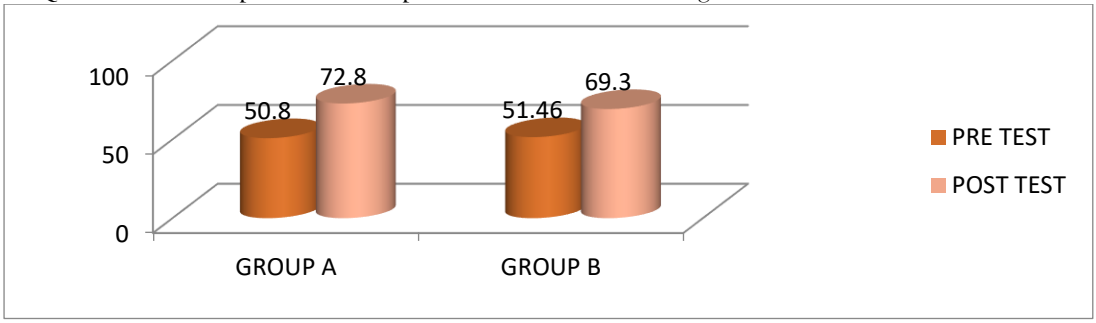
The t-Value of MOCA for Group A is 19.17and Group B is 16.04 with 14 degree of freedom. The p-Value of MOCA for Group A and Group B is <0.05 considered significant.



WITHIN THE GROUP ANALYSIS OF QOLID IN GROUP A AND GROUP B:

GROUP	Pre-Test	Post-test	T-Value	P-Value	Significance
GROUP A	50.8	72.8	23.12	<0.0001	<0.05
GROUP B	51.46	69.3	16.51	<0.0001	<0.05

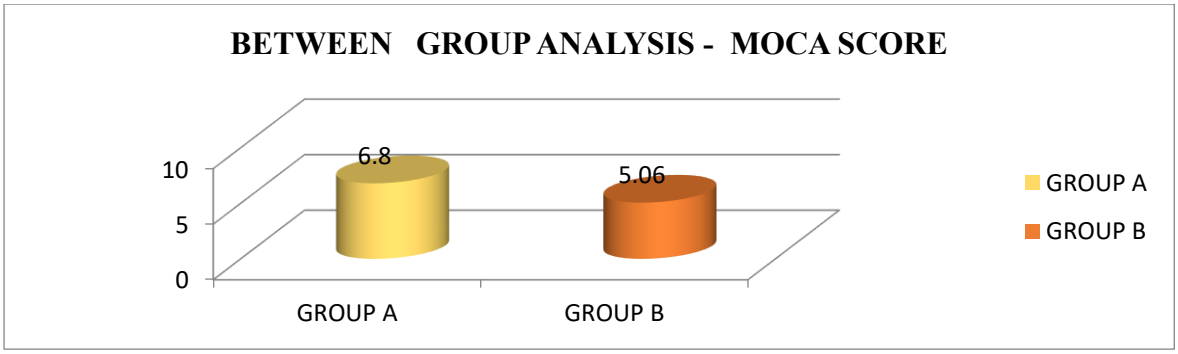
The t-Value of QOLID for Group A is23.12andGroup B is 16.51with 14 degree of freedom. The p-Value of QOLID for Group A and Group B is <0.05 considered significant.



BETWEEN GROUP ANALYSIS OF MOCA IN GROUP A AND B

GROUP	MEAN	SD	t-VALUE	p-VALUE	SIGNIFICANCE
GROUP A	6.8	1.32	3.650	0.0005	<0.05
GROUP B	5.06	1.18			

The 't'value of MOCA between the group is 3.650 and the p value is 0.0005.The result is significant at <0.05 level neglect the null hypothesis.

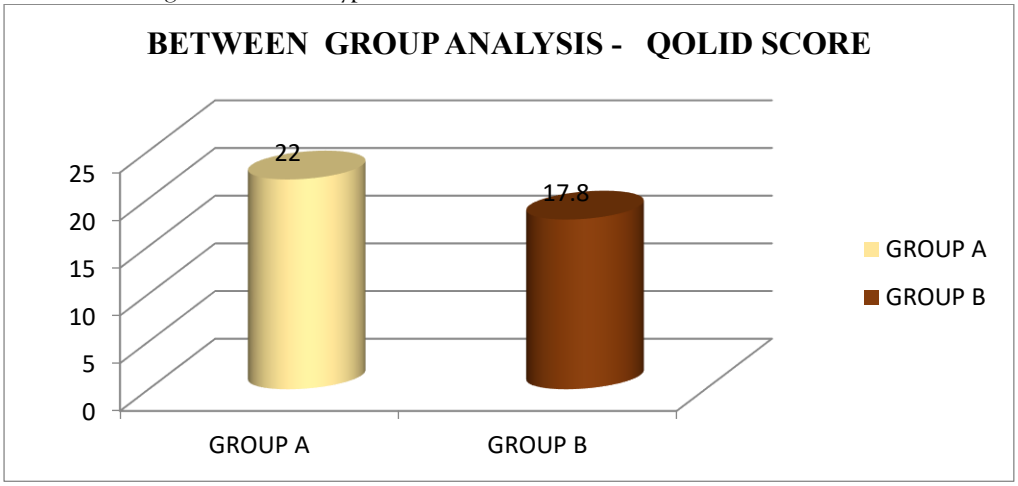


Graphical representation of Between group analysis of mean value of MOCA which shows significant improvement

BETWEEN GROUP ANALYSIS OF QOLID IN GROUP A AND B

GROUP	MEAN	SD	t-VALUE	p-VALUE	SIGNIFICANCE
GROUP A	22	0.05	2.869	0.0077	<0.05
GROUP B	17.8	1.46			

The 't'value of QOLID between the group is 2.869 and the p value is 0. 0077.The result is significant at <0.05 level neglect the null hypothesis.



Graphical representation of Between group analysis of mean value ofQOLID which shows significant improvement

RESULTS

The mean and standard deviation of pre and post values of Neurobic exercise and aerobic walking.

Within the group analysis of MOCA:

In this experimental study the mean and SD for MOCA, pre and post values of GROUP A is 19.4 ,26.2 and the t value is 19.17 and GROUP B is 19.7, 24.8 and t value is 16.04. The statistical analysis is done with paired "t" test within the group shows significant (p<.0001).

Within the group analysis of QOLID

The mean and SD for QOLID, pre and post values of GROUP A is 50.8,72.8 and the t value is 23.12. GROUP B is 51.46,69.3 and the t value is 16.51. The statistical analysis is done with paired "t" test within the group shows significant (p<.0001).

Within the group analysis, it has been shown that the pre and post values of Neurobic exercise shows significant.

Between group analysis of MOCA and QOLID

The mean and SD for MOCA in GROUP A is 6.8, 1.32and GROUP B is 5.06, 1.18 and the t value is 3. 6-50.The mean and SD for QOLID in GROUP A is 22, 0.05 and GROUP B is 17.8,1.46 and the t value is 2.869.The statistical analysis was done using unpaired 't' test between the groups and show statistical significance of p<0.05.

Between the group analysis of mean of the post values show that the experimental group is significant than control group.

DISCUSSION

This experimental study demonstrated that Neurobic exercises significantly enhance executive function and quality of life (QOL) in middle-aged individuals with Type II Diabetes Mellitus (DM) when compared to traditional aerobic walking[14,26]. These findings support the rejection of the null hypothesis and indicate the superior efficacy of Neurobic interventions in promoting cognitive and functional well-being in this population.

The cognitive improvements observed can be attributed to the multisensory stimulation involved in Neurobic activities, which engage various neural pathways and promote the release of neurotrophins. These neurochemicals support neuroplasticity by fostering neural growth and connectivity, particularly in areas like the frontal cortex and hippocampus—regions essential for memory consolidation and executive functioning. Enhanced activation in these areas is linked to better attention control and task-switching capabilities, which are often compromised in individuals with diabetes-related cognitive decline[16]. Moreover, the study suggests that while aerobic exercise improves QOL through physical and cardiovascular benefits, Neurobic exercises directly influence cognitive domains such as working memory, delayed recall, and executive function—critical components of overall life satisfaction and daily functioning[30]. This direct impact on cognitive health translates into better self-management, social interaction, and productivity, thus elevating QOL more holistically.

CONCLUSION: This study concluded that Neurobic exercise is effective in improving Executive function and Quality of life among middle aged individuals with type II Diabetes Mellitus.

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