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IMPACT OF BRAIN EXERCISE AND WALKING AMONG TYPE II DIABETES PATIENT WITH IMPAIRED COGNITION OF TAMIL NADU- A RANDOMIZED CONTROL STUDY

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ABSTRACT

Aim: To Monitor the Impact of Brain Exercise and Walking Among Type II Diabetes Mellitus (TIIDM) Patient with Impaired Cognition.

Method: In this proposed Randomized control study, 135 TIIDM patients were enrolled using subjective Sampling with an age group of above 30 years of either genders. TIIDM with impaired cognition patient were assessed using the Montreal cognitive assessment (MoCA) scoring and further grouped into control arm (N=68) who follows usual care and Intervention arm (N=67) who follows usual care along with brain exercise and walking. Statistical analysis was performed by using SPSS Version 21.

Result: MoCA score perceived at the time of baseline measurement were found to be 17.74+_ 4.99 in control arm and 17.44+_5.47 in intervention arm. In the 4th week, the development was observed in intervention group and at 8th week the MoCA score between control and intervention group showed high significant P-valve was perceived (P=0.001).

Conclusion: Walking and brain exercise help to prevent further decline in cognitive function as well as plays a major role in the prevention and control of insulin resistance and diabetic-related health complication.

Keywords: TIIDM, Impaired Cognition, Brain Exercise, Walking

INTRODUCTION

According to the world health organization, Diabetes mellitus (DM) is a persistent disease caused by inherited or acquired lack in production of insulin by the pancreas, or by the ineffectiveness of the insulin generated (2019). They have appraisals that diabetes was the seventh foremost cause of death (2016). Nearly 1.6 million deaths were directly caused by diabetes **[1]**. Pathogenesis of diabetes is either genes or Environmental factor (e.g. Virus, microbiome, physical activity, dietary factors) will produce inflammation, autoimmunity or even metabolic stress. Thereby create a Cell Destruction or Cell Dysfunction and cause hyperglycaemia. Further complications include Microvascular complication (e.g. Retinopathy, Nephropathy, and Neuropathy) & Macro vascular complication (e.g. coronary artery disease, puerperal Arterial Disease, and stroke) **[2]**. During the life course, mild cognitive diminution may also develop as an outcome of long-term exposure to diabetes **[3]**. Diabetes mellitus directly affects the neurotransmitter and hippocamps, which is been a key role in new memories, learning, and emotions resulted in cognitive impairment **[4]**. The white matter purpose such as processing speed, attention, and visuospatial processing are particularly affected by diabetes **[5]**. Atrophy in subcortical and periventricular areas was associated with reduced execution on a memory task **[6]**. Even the age of onset of diabetes, the glycemic control level and the duration of diabetes affect the severity of cognitive deficiency. A mild cognitive inefficiency, a disorder that involves a decrease in cognition, does not usually significantly interfere with daily independent function but is a risk factor for dementia **[7]**. Two major cohort studies fortified that the diabetes population had an increased chance of cognitive impairment than the non-diabetes **[8]**. One of the studies achieved that older who had both mild life hour working and later life social engagement was related to lowest risk of mild cognitive impairment. If this risk participation becomes more firmly established, this could drive interventions at earlier stages than today to prevent cognitive decline in people at high risk of diabetes **[9]**. Cognitive decline can be improved by a cognitive training program by concentrating on Major cognitive domains. It is done either by playing traditional games, physical exercises, Brain exercises etc. some of the study results showed a positive outcome based on the cognitive training program **[10]**. Study showed a significant P-value based on the study population chosen **[11]**. As many studies resulted that Diabetes induces

cognition decline and the study was aimed to assess the cognitive changes among diabetes in Tamil Nadu.

MATERIALS & METHODS

Study Design

Randomized control Study

Control Arm = 68

Intervention Arm =67

Study Site

This study was conducted in the general medicine department from Employee state insurance hospital (ESI) at Ayanavaram, Chennai, Tamil Nadu.

Sample Size

161 participants were enrolled from general medicine department based on prevalence rate.

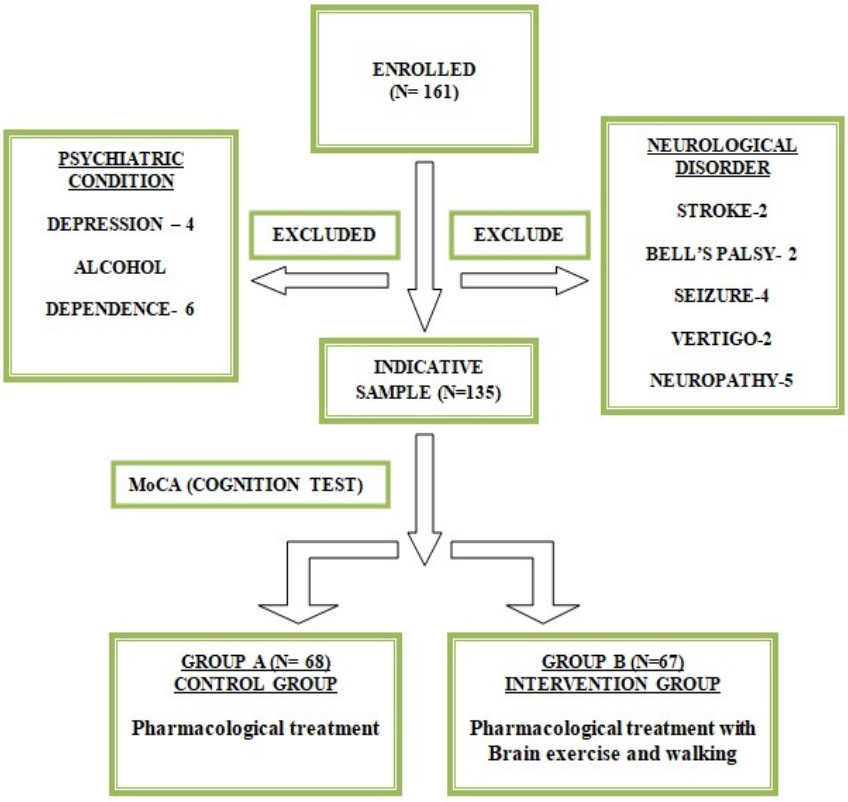
$$\frac{SS}{1+\frac{(ss-1)}{Pop.}} = \frac{384.1}{1+\frac{(384.1-1)}{275}} = \frac{384.1}{2.39}$$

New sample = 160.71

Where, SS – Sample Size & Pop. - Population

Inclusion & Exclusion Criteria

Participants were assessed and enrolled according to a diagnostic technique of the American Diabetes Association by health professionals of general medicine department. Age above 30 years of both genders was included in the study, whereas pregnant and lactating women, Geriatric population aged above 80 years, Patient with Neurological disorder; physically & psychologically unstable patients were excluded. The protocol of this research was explained to the participants.



Study Tool:

The Montreal cognitive assessment (MoCA) version 7.1 original version (Tamil or English) is used only after the fulfilment of the permitting process. MoCA is a screening instrument to measure mild cognitive dysfunction. It helps to assess cognitive domains like visuospatial/executive skills, naming, memory, attention, language, Abstraction, Delayed recall and orientation. The total possible score is 30 were, a score of 26 and above is considered as the normal range, less than that is vice versa.

Training Tools:

The cognitive training activity was carried out by training the executive domains like attention, memory, attention etc. Each participant provided with a chart sheet contains list of activities to be done per day. It was attached with their hospital note which was collected back at the end of the session. Participants asked to mark the activities done on that particular day. The activities to be done were, meditation (pranayama), walking for 30min, matching pairs using play cards (memory game), memorize the words and repeat, frame a word using a letter, simple mathematical calculation, Sudoku 2x2, 3x2, 3x3. Procedures and importance of the training activity were explained.

Research Ethics:

This study was approved by the Institutional ethics committee from Vels institute of science, technology and advanced studies (VISTAS), Pallavarm, Chennai. (VISTAS-SPS/IEC/V/2018/07). Before the study process, the health professional acquainted themselves to the study participants and got done with informed consent (Tamil or English).

Preparation & Investigation Phase:

The general medicine Doctors and Psychiatrist helps in enrolling the patient according the inclusion and exclusion criteria of this study. The researcher coordinated with nurses and primary health care volunteers under the general medicine department and explained about the data collection procedures.

The study population was included only from ESI hospital, Ayanavaram, Chennai. The population related details like gender, age, social habits were collected by interviewing. Socio-economic status, education, marital status were categorised based on revised kuppuswamyscale 2019 as per capita per month income in rupee. Glucose level and duration of DM were noted from the respective participants hospital note.

In this study MoCA appears to be a better screening tool than Standard mini mental state examination for measuring mild cognitive impairment in the diabetic population **[7]**.

The primary healthcare volunteers used the study tool in type II diabetic patients.161 patients enrolled, 26 excluded based on exclusion criteria, out of 135 patients found to have impaired cognitive function, as their MoCA score ≤ 25. 35. The impaired cognitive function was further divided into two groups Control armN=68 and Intervention arm N=67.

Participants in the control arm received only usual care. Whereas Intervention arm underwent brain exercises activities and walking for 30min on daily basis. Participants asked to mark the completed task as soon as possible in the given chart sheet. As the baseline is recorded Using MoCA scoring, same scoring method was followed on 4^{th} and 8^{th} week from the baseline calculation. Changes over time were statistically analysed.

Statistical Analysis:

All statistical analysis was carried out using IBM-SPSS 21.0. Descriptive summary statistics will be presented either as mean (SD) or median (minimum, maximum). Mean difference of each group was calculated by paired t-test. 95% confidence interval will be maintained to minimize type I (α) and type II (β) error and hence p – value of at least less than 0.05 will be considered statistically significant.

RESULT

The present study is involved with 135 impaired cognition participants of TIIDM. Where it was assigned into two groups N=68 in Control arm and N=67 in Intervention arm. Out of which 50.37% was Control arm, whereas 49.62% was impaired group. Based on the gender 52.94% Vs 58.20% was female. Female Participants were more than male 47.05% Vs 41.79%. According to the study result female are more prone to cognitive decline compares with male. Most of the 55.88% Vs46.26% participants were between the age group of 50-69 years. Moderate age group were affected by type II diabetes. Among intervention arm 23.88% were from middle school. Based on the economic status majority participants is from lower middle class. Marital status 61.76% Vs 58.20% were from married group. Social habits of intervention group 26.47% of smokers and 25.37% are alcoholic. As glucose level plays a major role in cognition 55.88% Vs 62.68% found to be >135 mg/dl. Duration of DM 38.23 Vs 32.83% ranges between 6-9 years, whereas 44.11 Vs47.76% ranges >10 years **(Table 1)**.

Table 2 describe the effect of treatment over time based on MoCA scoring method, at the base line mean control arm 17.74±4.99, intervention arm observed to have 17.44±5.47.after 4^{th} weeks from the base line control arm 17.9±4.58 and intervention arm is found to have 20.82±4.675. After 8^{th} weeks from the base line control arm were 17.49±3.74, whereas

intervention arm B' 23.82±1.67. Therefore overall effect of treatment showed the high significant p value was observed p=0.001.

Table 1: General characteristic of impaired cognition in Control Arm & Intervention Arm

IMPAIRED COGNITION		
GENDER	**CONTROL ARM**	**INTERVENTION ARM**
Male	**32(47.05%)**	**28(41.79%)**
Female	**36(52.94%)**	**39(58.20%)**
AGE		
30-49	**26(38.25%)**	**28(41.79%)**
50-69	**38(55.88%)**	**31(46.26%)**
70-80	**04(05.88%)**	**08(11.94%)**
EDUCATION		
Primary School	**15(22.05%)**	**15(22.38%)**
Middle School	**12(17.64%)**	**16(23.88%)**
High School	**14(20.58%)**	**03(19.40%)**
Diploma	**15(22.05%)**	**12(17.91%)**
Graduate	**12(17.64%)**	**11(16.41%)**
ECONOMIC STATUS		
Upper middle	**20(29.41%)**	**18(26.86%)**
Lower middle	**29(45.58%)**	**26(38.80%)**
Upper Lower	**19(27.94%)**	**21(31.34%)**
MARITAL STATUS		
Single	**10(14.70%)**	**08(11.76%)**
Married	**46(61.76%)**	**39(58.20%)**
Divorced	**08(11.76%)**	**06(08.95%)**
Widows	**08(11.96%)**	**14(20.89%)**
SMOKING		
Non-smokers	**38(55.88%)**	**38(56.71%)**
Smokers	**18(20.47%)**	**21(31.34%)**
Ex-smokers	**12(17.64%)**	**08(11.74%)**
ALCOHOLIC		
Non- alcoholic	**40(59.70%)**	**41(61.19%)**
Alcoholic	**15(22.05%)**	**17(25.37%)**
Ex-alcoholic	**13(19.11%)**	**09(13.43%)**
GLUCOSE LEVEL		
<135mg/dl	**30(44.11%)**	**25(37.31%)**
>135mg/dl	**38(55.88%)**	**42(62.68%)**
DURATION OF DM		
2-5 years	**12(13.23%)**	**13(19.40%)**
6-9years	**26(38.23%)**	**22(32.83%)**
>10years	**30(44.11%)**	**32(47.76%)**

Table 2: Effect of Training in MoCA over time

TIME PERIOD	CONTROL ARM (MEAN ±SD)	INTERVENTION ARM (MEAN ±SD)	P VALUE
BASELINE	**17.74 ± 4.99**	**17.44 ± 5.47**	**0.86**
At 4th WEEK	**17.9 ±4.58**	**20.82 ± 4.675**	**0.05***
At 8thWEEK	**17.49 ±3.74**	**23.82 ± 1.67**	**0.001****

***Significant; **Highly Significant**

DISCUSSION

The purpose of the present study is to assess the cognitive function among impaired cognition of TIIDM populations and to determine the effects of training between control arm who received usual care and the intervention arm who received usual care along with with brain exercise and walking for 30 min/ day. The research contains 135 active participants out of 50.37% from control arm Vs 49.62% is from the intervention arm. As the female tend to work at home they are more available. Current study possesses more female 52.94% Vs 48.20% which is lesser than 76.6% V 53.3% of the study population. 55.88% Vs 46.26% of the participants ranges between the age group of 50-60 years old. Based on marital status married population were about 61.76% Vs 58.20%. The Socio-Economic status was categorized based on revised **[12]** which are also plays an important role in cognition function **[12]**.

The participants were enrolled by a health professional from general medicine and psychiatrist. The MoCA scoring may found to be difficulty in the 1st stage later it becomes easy for both health care volunteers and participants. MoCA scoring is used to measure the changes over time from the baseline between two groups as same as **[13]**. In the case of pre-diabetic and newly diagnosed diabetes were associated with mild cognitive decrement. Even though the blood glucose level is a normal range, it is slightly associated to create a negative effect on cognition. Another study resulted that hypercortisolemia appears to exacerbate cognitive dysfunction in type II DM in the presence of poor glycaemia **[11]**. Glucose level ranges <125mg/dl is 43.11% this study ranges 44.11% Vs 37.31% in <135mg/dl. A meta-analysis study compares the Intensive Glycaemic control and cognitive decline which resulted that treatments do not reduce the cognitive decline instead leads to the hypoglycaemic condition.

Further treatment is greater consideration of neurological consequences of the hypoglycaemic event in the long term should be investigated **[12]**. The report from Telangana, India showed that the subjects having >5years of Diabetic duration resulted in increased cognitive Dysfunction which is related to attention and short term memory **[13]**. The study involves 38.23% Vs 32.83% ranges between 6-9 years **[14]** whereas, 44.11% Vs 47.76% has >10 years of DM duration. The study tool was used on both the control and intervention group. As the control group underwent usual care there are no significant changes observed whereas, the intervention group showed a significant difference from the baseline score

17.44±5.47 on 4th and 8th week. Therefore high significant P-valve was perceived (P=0.001). The study posits that continues cognitive training can stimulate the cerebral function and slow down the degeneration duration among diabetes patient with mild cognitive impairment **[15]**. The intervention group had an average score of about 19.5 with the range of 17-23 before exercise which was slightly similar to the MoCA average score at pre-test of 20.8 with the range of 18-24 **[11]**.

A quasi-experimental study developed a cognitive stimulation program on perceived memory self-efficacy among 23 older adults with Mild Cognitive Impairment. The intervention program was for 8 sessions, 2 sessions per week resulted that cognitive stimulation program was effective **[16]**. A cross-sectional study describes the importance of regular cognitive function monitoring especially for diabetes patients **[17]**. In this study, cognition training helped the participants to improve their cognitive function and depression or stress thereby asked them to have a regular check-up of their cognition level.

CONCLUSION

This study was performed to assess the cognitive function among type II Diabetes mellitus. It shows that majority of the TIIDM patients remain to have impaired neurocognition during the course of their life and results of the present study suggest that every diabetic subject should be examined for cognition so that future imperative sequels of TIIDM, especially neurodegeneration and vascular dementia may be tackled effectively and the study reveals that exercise plays a major role in the prevention and control of insulin resistance, pre-diabetes, Gestational DM, type 2 diabetes, and diabetes-related health complications. Both aerobic and resistance training improve insulin action, at least acutely, and can assist with the management of glucose levels. Walking and brain exercise helps to prevent the further decline in cognitive function among Diabetes mellitus. The inclusion of an exercise program or other means of increasing overall Physical activity is critical for optimal health in individuals with type II diabetes.

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