Section: Physiology

Original Research Article

COGNITIVE DYSFUNCTION IN TYPE 2 DIABETES MELLITUS: A CROSS-SECTIONAL ANALYSIS OF ASSOCIATED FACTORS

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ABSTRACT

Background: Diabetes mellitus is one of the common public health problems affecting approximately 11.4% of the adult population in India. Cognitive dysfunction, ranging from Mild Cognitive Impairment (MCI) to dementia, is one of the chronic complications of diabetes. **Aim & Objectives:** To assess the cognitive status in patients with Type 2 Diabetes Mellitus and to find its relationship with the duration of diabetes. **Materials and Methods:** The study consists of 50 Type 2 Diabetics in the age group of 40 to 60 years, recruited as cases from the Diabetology outpatient clinic in a tertiary care institute, Chennai, India and 50 age- and sex-matched healthy Non-diabetics as controls. Cognition was assessed using the Questionnaire of Mini-Mental State Examination (MMSE) and Mini-Cog. **Result:** In the study, diabetic patients showed a statistically significant ($p<0.05$) decline in MMSE and Mini-Cog scores compared to non-diabetic patients. A negative correlation was observed between MMSE and Mini-Cog scores and the duration of Diabetes Mellitus. **Conclusion:** From the above study, it is observed that in comparison with Non-Diabetics, Diabetics are more prone to cognitive impairment, which deteriorates with the duration of diabetes.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM), represents one of the most prevalent public health problems globally. The increasing incidence of T2DM is linked to factors such as lifestyle changes and ageing population. In India, DM affects more than 11.4% of the adult population.[1]

A critical complication of DM is cognitive dysfunction, which encompasses a wide range from mild cognitive impairment (MCI) to dementia. Cognitive decline in patients with T2DM frequently manifests as impairments in attention, psychomotor speed, executive function, and memory.[2]

The mechanisms linking T2DM and cognitive decline are complex and not yet understood completely. Despite the strong evidence linking T2DM and cognitive impairment, the cognitive status of T2DM patients is often not routinely assessed in clinical care. Undiagnosed cognitive impairment is problematic, as it is associated with poorer DM management and reduced health status. Patients with possible dementia or lower cognitive scores may require assistance to take their medications, indicating the importance of cognitive status for self-management ability and treatment compliance.

This study was undertaken to assess the cognitive status in patients with Type 2 Diabetes Mellitus and contribute to the growing body of knowledge regarding the interaction between T2DM and cognitive function.

MATERIALS AND METHODS

Study Design

This comparative cross-sectional study was conducted over a period of six months at a tertiary care institute in Chennai, India. Ethical approval was obtained from the Institutional Ethics Committee before the commencement of the study.

Study Population

50 Participants included patients with Type 2 Diabetes Mellitus (T2DM) attending the outpatient department, as well as 50 age- and gender-matched healthy controls from the general population.

Inclusion Criteria

- Patients aged 40 to 60 years
- Both male and female participants

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- Diagnosed with Type 2 Diabetes Mellitus (T2DM)

Exclusion Criteria

Participants were excluded if they had any of the following:

- Type 1 Diabetes Mellitus
- Poor glycaemic control
- History of psychiatric illness or current psychiatric drug use
- History of head trauma, epilepsy, or stroke
- Chronic hypertension
- Alcoholism
- Thyroid disorders
- History of hypoglycaemia

Data Collection

Detailed history taking and physical examination was done for all participants. Cognitive status was assessed using the Mini-Mental State Examination (MMSE) and the Mini-Cog test**.**

The Mini Mental State Examination (MMSE).[3] is a tool used to completely and systematically assess mental status of an individual. It consists of 11 questions that test five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The maximum score that can be attained by an individual is 30. If an individual attains a score less than 24, it is an indicative of cognitive impairment.

Mini cog test, developed to discriminate dementia persons with non dementia persons.[4]. It consists of a combination of three item recall and clock drawing . For three item recall, one point for each word correctly recalled. Score will be 0 – 3 points. For clock drawing, 2 points for drawing a normal clock and 0 point for wrong clock drawing. Finally add points scored in three item recall and clock drawing. A total score less than 3 indicates cognitive impairment.[5]

Statistical Analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 21.0**.** Comparisons between groups were performed using the unpaired t-test**.** The correlation between duration of diabetes and cognitive scores was assessed using Pearson's correlation coefficient**.** A *p* value of <0.05 was considered statistically significant.

RESULTS

This study assessed cognitive function in patients with Type 2 Diabetes Mellitus (T2DM) aged 40–60 years and compared them with age- and sex-matched non-diabetic controls. Around 54% of the selected T2DM patients were suffering from the disease for 5 – 10 years.

Table 1: Duration of diabetes

Duration	% of T2DM patients
1 – 5 years	36
5 – 10 years	54
11- 15 years	8
16 – 20 years	2

In both cognitive assessments (MMSE & MINICOG), The T2DM patients exhibited statistically significant lower mean scores compared to controls. [Table 2]

Table 2: Comparison of MMSE and Mini Cog scores among Diabetics and Non Diabetics

Test	Group	Mean ± SD	p-value
MMSE	Non-diabetics	25.42 ± 3.01	0.001*
	Diabetics	23.82 ± 2.04	
Mini-Cog	Non-diabetics	3.42 ± 0.99	<0.0001**
	Diabetics	2.14 ± 1.29	

p value <0.05 was considered significant.
*p value <0.01 was considered as highly significant.
**p value <0.001 was considered extremely significant.

When compared the duration of diabetes with MMSE and Mini cog scores, A statistically significant negative correlation was observed between duration of diabetes and cognitive scores. As the duration increases, more the cognition impairment. [Table 3]

Table 3: Correlation of cognition with duration of diabetics

	r value	p value
MMSE	- 0.62444	0.001*
Mini Cog	- 0.67667	0.0001**

value <0.05 was considered significant.
*p value <0.01 was considered as highly significant.
**p value <0.001 was considered extremely significant.

MMSE identified cognition impairment in 48.5% of diabetics while MINI COG identified in 60% of diabetics (Fig.1). MINI cog was able to identify cognition impairment in more diabetics patients when compared to MMSE.

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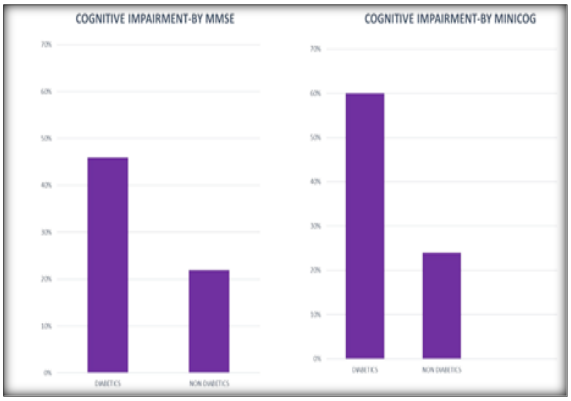

Figure 1: Percentage of diabetic patients and controls found to be having cognition impairment by MMSE and MINI COG

DISCUSSION

Our cross-sectional study demonstrated that patients with Type 2 Diabetes Mellitus (T2DM) aged 40–60 years are significantly more prone to cognitive impairment than non-diabetic controls, and also the duration of the disease correlates with the poor cognition scores. These findings align with previous studies that have consistently linked T2DM with cognitive decline.

Diabetes mellitus is a key component of metabolic syndrome, with approximately 11.4% of the Indian adult population affected by T2DM.[1] Cognitive dysfunction is a recognized chronic complication of diabetes, reported in both type 1 and type 2 diabetes.[6] It can range from mild cognitive impairment (MCI) to dementia, with one South Indian study reporting a prevalence of 48.6% among middle-aged T2DM patients.[7] Xu et al. found that both prediabetes and T2DM accelerate cognitive decline, increasing the risk of progression from MCI to dementia.[8] Similarly, Crane et al., in a prospective cohort study, observed that higher glucose levels were associated with increased dementia risk in both diabetic and non-diabetic populations, suggesting a direct neurotoxic effect of hyperglycemia independent of diabetes status.[9]

Several mechanisms have been proposed to explain T2DM related cognitive impairment. Sebastian et al. highlighted the role of central insulin resistance, which disrupts brain insulin signaling and contributes to impaired cognitive performance.[10] Other studies, such as those by Kodl et al. and Jellinger et al., identified multiple contributing factors including genetic predisposition, aging, ApoE genotype, recurrent episodes of hypo- and hyperglycemia, and cardiovascular risk factors such as hypertension and obesity. Furthermore, chronic hyperglycemia, hyperinsulinemia, and insulin resistance exacerbate neurodegeneration through oxidative stress, mitochondrial dysfunction, neuroinflammation, and amyloid cascade alterations.[11,12] Roberts et al,[13] also emphasized that earlier onset, longer duration, and greater severity of diabetes are strongly associated with MCI, corroborating the findings of our study.

With respect to assessment tools, our results showed that the Mini-Cog test identified more cases of cognitive impairment compared to the MMSE. This finding is consistent with reports that the Mini-Cog has greater sensitivity in detecting early cognitive deficits.[14-16] Given its simplicity and effectiveness, the Mini-Cog may serve as a practical tool for early screening in clinical practice.

Considering the high prevalence of T2DM and its strong association with cognitive decline, cognitive assessment should be integrated into routine diabetes care. Early detection of even mild impairment allows for timely interventions that may help preserve brain function and improve quality of life.

The limitations of our study include its relatively small sample size, short duration, and the absence of detailed neuroimaging or biomarker assessments.

CONCLUSION

Our study demonstrates that patients with T2DM exhibit significantly higher rates of cognitive impairment compared to non-diabetic individuals, with disease duration emerging as an important predictor. Incorporating cognitive screening, especially using sensitive tools such as the Mini-Cog into routine diabetes management could facilitate early identification of at-risk individuals and timely interventions to preserve cognitive health. Regular cognitive assessment should therefore be considered a key component of comprehensive diabetes care.

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