# Association between risk factors and cognitive impairment among type 2 diabetes mellitus patients

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**ABSTRACT**

**Background:** Diabetes mellitus type 2 is considered as one of the leading causes of illness and mortality through over the globe. Diabetic retinopathy, neuropathy, and nephropathy are all effectively screened on a regular basis. Recent research have shown that cognitive deterioration can occur in patients with diabetes and that it can go unnoticed for a long time, implying that routine screening is necessary.

**Methodology:** An observational cross sectional study was conducted among 158 patients with complaint of T2DM aged between 60-79 years of age were found with cognitive impairment on the basis of MMSE score in a tertiary care center. Detailed history along with laboratory and biochemical data were taken from patients after taking written informed consent and approval of Institutional Ethical committee through the pre-structured questionnaire.

**Results:** Mild cognitive impairment was noted in 88 (55.69%) type 2 diabetes mellitus patients and Normal cognitive function in 70 (44.30%). Those with MCI had higher HbA1c (6.57 ± 1.27 vs. 6.13 ± 1.22), higher FBS (148.34 ± 18.61 vs. 145.25 ± 16.31), PPBS (173.91 ± 42.64 vs. 167.47 ± 38.15) and TNF-α (79.32 ± 8.74 vs. 72.98 ± 6.76), which were statistically significant. The cognitive domains of executive function, naming, attention, language, and memory showed a statistically significant difference between those with Mild cognitive impairment and Normal cognitive function. There were no differences in the mean age, duration of disease, and education level between the groups.

**Conclusion:** The significant prevalence of Mild cognitive impairment in type 2 diabetes patients emphasizes the value of routine screening of cognitive functions. Further research into the link between cognitive impairment and poor blood glucose control is needed to see if improving blood glucose control can assist in enhancing cognitive functions.

## Introduction

The major risk factors for Type 2 diabetes mellitus (T2DM), which is characterized by relative insulin deficiency and insulin resistance, and sedentary lifestyle and obesity [1]. The prevalence of T2DM is increasing in developing and developed countries because of changes in socioeconomic factors and increased practice of unhealthy lifestyle habits [2]. T2DM is associated with cognitive impairment, and exhibiting worse cognitive ability and more abnormalities on brain imaging than individuals without diabetes [3,4]. The prevalence is particularly higher for mild cognitive impairment (MCI) in T2DM patients older than 65 years [5]. Multiple long-term epidemiological studies have implicated T2DM as a risk factor for cognitive impairment and dementia in the elderly [6,7].

The causes underlying T2DM patients' cognitive impairment and brain anatomical abnormalities are still unknown. Several risk factors for Mild cognitive impairment in T2DM patients have been identified, including vascular risk factors, macrovascular diseases, microvascular complications, poor glycaemic control, increased insulin level, increased oxidative stress,

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accumulation of amyloid-beta peptide and tau hyperphosphorylation, and decreased nerve growth factor[3, 7, 8]. However, the significance of such impairment is generally over looked in favour of other T2DM consequences; there are no specific tools for avoiding or correcting cognitive deficiencies in diabetic patients [9]. Given that early-stage therapies for cognitive impairment are somewhat effective, it's crucial to understand the features of MCI in T2DM patients and to discover the most efficient diagnostic indicators for Mild cognitive impairment in these patients [10].

The aim of current study was to determine the characteristics of cognitive impairment in T2DM patients in this age range, as well as to identify potential risk factors and biomarkers based on the demographic and clinical parameters of the patients. This knowledge could aid efforts for detecting MCI in T2DM patients early on.

## Methodology

The present study was conducted among 158 patients with complaint of T2DM aged between 60-79 years of age were found with cognitive impairment on the basis of MMSE score in Rajeev Gandhi Centre for Diabetes & Endocrinology and Department of Physiology on patients of Type 2 Diabetes Mellitus attending Diabetes clinic in Jawaharlal Nehru Medical college hospital, Aligarh Muslim University after approval from Institutional ethical committee. Detailed history along with laboratory and biochemical data were taken from patients after taking written informed consent through the pre-structured questionnaire.

Only T2DM patients aged 60-79 years were included on the basis of diagnosis of diabetes from revised American Diabetic Association Criteria i.e. fasting plasma glucose >126 mg/dl (>6.1 mmol/1) and 2 hours postprandial plasma glucose >200 mg/dl (>11.1 mmol/1) along with those given written informed consent were included in the study. Any systemic condition other than T2DM related to neuropathy (malnutrition, alcoholic neuropathy, renal failure), known case of chronic depression, psychiatric illness, neuropathies associated with exogenous toxic agents, metals or drugs, pregnant women with HRT were excluded from the study.

## Results

158 participants having type 2 DM were

included in this study. Eighty eight (55.70%) type 2 diabetes mellitus patients had Mild cognitive impairment (MMSE score ≤ 23) and 70 (44.30%) type 2 diabetes mellitus patients had normal cognitive function (MMSE score ≥ 24). The HbA1c, FBS, PPBS and TNF-α levels were significantly higher in patients with Mild cognitive impairment (TABLE 1). There were no significant differences in mean age and the duration of diabetes between the groups. HbA1c, FBS, PPBS and TNF-α levels showed a negative correlation with the MMSE scores. Of the domains tested, orientation, registration, attention &calculation, recall and Language showed a statistically significant difference between those with Normal cognitive function and Mild cognitive impairment.

**TABLE 1: Distribution of Demographic Profile of study subjects.**

| Variables | Categories | Frequency | Percent (%) |
|---|---|---|---|
| Age Groups | 60-67 years | 85 | 53.8 |
| | 68-79 years | 73 | 46.2 |
| Body Mass Index | <18.5 | 36 | 22.8 |
| | 18.5-24.9 | 48 | 30.4 |
| | >25 | 74 | 46.8 |
| MMSE Score | 18-23 | 88 | 55.7 |
| | 24-30 | 70 | 44.3 |

Only 2.6% of those with abnormal results in the Mild cognitive impairment group could name all five terms used for memory tests correctly, whereas 25% of those with normal scores could. Only 10.5% of those with Mild cognitive impairment were able to repeat both of the administered questions, but 53.1% of those with Normal cognitive function were able to do so. The difference in orientation ratings between the groups was just marginally significant. The difference in abstraction scores between the two groups was not statistically significant.

## Discussion and Conclusion

The current study examined the prevalence of Mild cognitive impairment in type 2 diabetes patients in North India. Mild cognitive impairment was shown to be prevalent in 54.3%

of the people in our study. This is higher than earlier Indian research, which showed a range of 19.5% to 48.0%. Earlier studies using the MMSE, trail making tests, modified MMSE, and other neuropsychological tests such as the digit span test, digit symbol substitution test, and others were found to be less sensitive in detecting Mild cognitive impairment when compared to the current study using the MMSE score test for cognitive functions evaluation.

Patients with cognitive impairment had significantly higher FBS, PPBS, HbA1c, and TNF-, all of which were negatively associated to MMSE scores in our study. Cognitive impairment was detected in 11.6% of patients with good glycemic management (HbA1c under 7%) and 30.2% of patients with HbA1c 7% or higher in a prior study by Roy Subjects with glucose levels >125 mg/dl had a 1.73 times increased chance of developing neurocognitive impairment, according to Khullar the ACCORD MIND experiment, which included 2977 type 2 diabetes patients, discovered a statistically significant age-adjusted link between HbA1c level and four cognitive test scores. The HbA1c level has been shown to be inversely related to both the clock in a box and the clock drawing test. As a result, our findings are consistent with previous research suggesting that poor glycemic management in type 2 diabetes is linked to cognitive deterioration.

While there is a considerable body of evidence relating abnormal blood glucose levels to cognitive impairment, it is unclear whether bettering glycemic control leads to improved cognition. Enhanced HbA1c was linked to improved cognition in nonamnestic areas in the diabetes control and complications study in type 1 diabetes. Improving HbA1c levels in an aged population over a 5-year period was linked to a slower rate of global cognitive deterioration, according to Luchsinger.

In previous research, being a woman and having diabetes for a longer period of time were found to be independent risk factors. Our research found no evidence of a gender difference or a link between diabetes duration and gender.

Executive function, name, attention, language, and memory indicated a statistically significant difference between those with Normal cognitive function and those with mild cognitive impairment in the current study. Attention, language, orientation, visual perception, visual movement organisation, and logical questioning were all found to improve with effective cognitive training in individuals with mild cognitive impairment in a prior study. The relevance of early identification of mild cognitive impairment was highlighted in a study on the outcome of a cognitive training programme in adults with mild cognitive impairment.

We used the Oxford Medical Education version of MMSE score which is relatively easy and quick to perform. The level of education among subjects in both groups was similar.

In conclusion, our research reveals a high prevalence of undiagnosed mild cognitive impairment in type 2 diabetes patients who visit an outpatient clinic. All glycaemic control indicators and MMSE scores, which represent cognitive function, had a strong negative connection. These findings support the use of a sensitive measure like the MMSE in routine screening of type 2 diabetes mellitus patients to detect mild cognitive impairment. In the future, studies on the effects of better glycaemic control on cognitive function will be needed to better appreciate the implications of our findings in the long-term management of these patients.

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