ORIGINAL RESEARCH ARTICLE

Prevalence of Cognitive Impairment and Associated Factors in Diabetic Patients Attending a Rural Health Facility in Goa, India

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ABSTRACT

Introduction: Diabetes prevalence is rising globally, projected to reach 643 million by 2030, with India's rate surpassing the global average. Cognitive impairment (CI) is a common, yet underdiagnosed complication.

Materials and Methods: This cross-sectional study was conducted from January to April 2024 at the Rural Health and Training Center. A total of 200 diabetic patients were selected for the study by simple random sampling method. The objective was to estimate the prevalence of cognitive impairment and identify associated factors among the participants.

Results: The study revealed 78(39%) of participants had mild cognitive impairment, 15(7.5%) had mild dementia, and 107(53.5%) exhibited normal cognition. A majority (65.5%) were aged 50 years or older. Males 133(66.5%) outnumbered females 67(33.5%). Most patients (81%) had lived with diabetes for less than a decade. Significant associations were found between cognitive impairment and factors like age, age at diagnosis, and diabetes duration.

Conclusion: Nearly half of the participants showed cognitive impairment, predominantly among older individuals. Regular cognitive screening and tailored care are crucial for diabetic patients.

Keywords: Cognitive impairment, Diabetes, MoCA

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Introduction

Diabetes, a chronic condition characterized by insulin deficiency or resistance, affects millions worldwide. The global prevalence has risen from 108 million in 1980 to 537 million in 2021, with projections reaching 783 million by 2045.[1] India has the second-largest diabetic population, with 74.9 million cases in the 20–79 age group expected to rise to 124.9 million by 2045.[2]

Diabetes affects all body systems, including the brain, leading to cognitive impairment, a common yet often underdiagnosed complication.[3] A 1% increase in HbA1C doubles the risk of cerebrovascular accidents.[4] Cognitive impairment is, characterized by difficulties in memory, learning, concentration, and decision-making, is more prevalent in those with diabetes, who are twice as likely to develop cognitive impairment compared to their healthy counterparts.[5,6]

Dementia, often associated with cognitive impairment, has significant physical, psychological, and economic impacts on individuals and their caregivers. While dementia is more prevalent among older adults, it is not an inevitable consequence of aging. Globally, dementia affects approximately 50 million individuals, with a disproportionate 60% residing in developing countries.[7,8,9] The assessment of cognitive function plays a crucial role in managing diabetes, as cognitive impairment can significantly impact patients' daily functioning, autonomy, and overall quality of life. Despite its importance, cognitive dysfunction in diabetes remains understudied, particularly in rural Goa. This study aims to address this knowledge gap.

Methodology

Study setting: A hospital-based cross-sectional study was conducted at the Rural Health and Training Centre in Mandur, Goa, over a four-month period from January to April 2024, following prior approval from the Institutional Ethics Committee (IEC) with reference number GMCIEC/2023/355. Diabetic patients aged over 30 who attended the center were included in the study. However, individuals with diagnosed neurological conditions, speech or hearing disabilities that could affect their ability to respond to the questionnaire, and pregnant women were excluded. Informed consent was obtained from all participants after the study's purpose was clearly explained.

The sample size was calculated to be 184 based on a reported cognitive impairment prevalence of 22.8% from a study by Gupta et al., with a 95% confidence interval (CI) and a 0.05 margin of error. Data was collected for 200 participants. The NCD register at the health center was used to create a list of diabetic patients, from which participants were selected using simple random sampling by generating a random number table. This approach ensured that every patient had an equal chance of selection, reducing the likelihood of selection bias.

Data Collection: The study utilized a semi-structured questionnaire and the Montreal Cognitive Assessment (MoCA) tool.[10]

Data was collected through face-to-face interviews using a semi-structured questionnaire. The questionnaire gathered sociodemographic details and relevant factors, including the duration and type of diabetes treatment, as well as the HbA1c value, measured using the Abbott autoanalyzer machine with the enzymatic method.

The Montreal Cognitive Assessment (MoCA) is a widely used screening tool for evaluating cognitive impairment. It assesses seven cognitive domains: visuospatial/executive (5 points), naming (3 points), memory (5 points for delayed recall), attention (6 points), language (3 points), abstraction (2 points), and orientation (6 points), with a maximum possible score of 30. A score of 26 or higher was considered indicative of normal cognition. Scores ranging from 18 to 26 were classified as mild cognitive impairment, while scores between 11 and 16 were categorized as mild dementia. The questionnaire was administered in the local language.

Case definitions: Diabetes patients: A person was defined as having diabetes if the diagnosis had been made by a doctor or if the person was receiving treatment for diabetes.

Cognitive impairment was defined as a MoCA score below twenty-six. Normal cognition was defined as a MoCA score of twenty-six or higher.

Body Mass Index (BMI) was classified into the following categories: underweight (<18.5), normal (18.5 to 22.99), overweight (23 to 24.99), and obese (25 and above).[11]

Duration of diabetes: Duration of ≤5 years since the first diagnosis was considered short duration and >5 years was considered long duration. HbA1c:

Controlled HbA1c: was defined as value less than or equal to seven.

Uncontrolled HbA1c: was defined as value more than seven.[12]

Data Analysis: The results were presented as mean, standard deviation, and proportions. Data was entered into MS Excel, and analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., 2013). The Chi-square test was employed to analyze the data, with a p-value of <0.05 considered statistically significant.

Results

Sociodemographic Profile: The study included 200 patients with type 2 diabetes mellitus. As shown in

Table 1: Distribution of study participants according to sociodemographic characteristics (N= 200)

Type of variable	Participants (%)
Age group (in years)	
30-39	20(10)
40-49	49(24.5)
50-59	**84(42)**
60 and above	47(23.5)
Sex	
Male	**133(66.5)**
Female	67(33.5)
Education	
Illiterate	34(17)
Primary	31(15.5)
Middle	**44(22)**
Secondary	19(9.5)
Higher secondary	42(21)
Graduate and above	30 (15)
Occupation	
Unemployed	67(33.5)
Employed	**133(66.5)**
Marital Status	
Unmarried	19(9.5)
Married	**133(66.5)**
Divorced	15(7.5)
Widow/widower	33(16.5)
Socioeconomic status	
Class 1	42(21)
Class 2	**89(44.5)**
Class 3	38(19)
Class 4	25(12.5)
Class 5	6(3)

Table 2: Distribution of study participants according to clinical characteristics (N= 200)

Type of variable	Participants (%)
Age of onset of diabetes (in years)	
30-39	49(24.5)
40-49	**59(29.5)**
50-59	58(29)
60 and above	34(17)
Duration of diabetes	
6 months – 2 years	36(18)
2 – 5 years	49(24.5)
5 – 10 years	**77(38.5)**
>10 years	38(19)
Type of treatment	
OHAs	**115(57.5)**
Both insulin and OHAs	85(42.5)
Duration of treatment	
6 months – 2 years	50(25)
2 – 5 years	56(28)
5 – 10 years	**62(31)**
> 10 years	32(16)
Body Mass Index (BMI)	
Underweight	29(14.5)
Normal	**72(36)**
Overweight	62(31)
Obese	37(18.5)
HbA1c	
Controlled	74(37)
Uncontrolled	**126(63)**

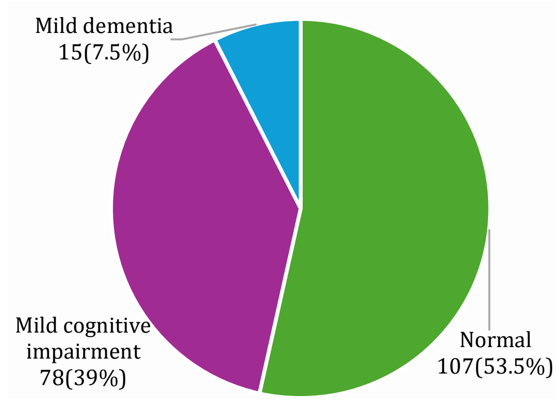

Figure 1: Prevalence of cognitive impairment

Table 1, most participants were above the age of 50. More than two-thirds of the study participants were males 133 (66.5%) which outnumbered the females 67(33.5%). A little less than one fourth of the participants 44(22%) had middle school education, while lowest proportion of individuals 19(9.5%) with secondary school education. Most of the study population were employed 133(66.5%). Majority of the study participants were married 133(66.5%). According to the modified BG Prasad classification (2023), most participants belonged to the Class II socioeconomic category, while Class V had the least representation.[13]

Clinical characteristics: Majority of the participants had confirmed diabetes for a period of more than 5 years, 115 (57.5%). A little more than half of the study participants 115 (57.5%) were on oral hypoglycaemic agents (OHAs). A little less than half of the participants 94 (47%) were on treatment for a period of more than 5 years. Nearly one-third of study participants were overweight, 62 (31%) while 37 (18.5%) participants had obesity. More than half, 126 (63%) participants had uncontrolled HbA1c, (HbA1c >7%).

As per Figure 1 Majority of study participants had normal cognition, 107 (53.5%), whereas 78 (39%) had mild cognitive impairment and 15 (7.5%) had mild dementia.

Table 3 shows the association between Cognitive impairment and various study factors associated with cognitive impairment. Participants with maximum mild cognitive impairment were in the age group of 50 years and above and there was significant association between age and mild cognitive impairment (p <0.001). Mild cognitive impairment as seen more among the literates than illiterates and there existed a significant association between educational status and Mild cognitive impairment (p 0.007).

Mild CI was found to be more among those with age at diagnosis of diabetes ≥50 years, duration of diabetes for ≥ 5 years as well as those receiving treatment for ≥5 years. These associations were found to be statistically significant (p <0.001).

Table 3: Association between Cognitive impairment and selected factors. (N = 200)

Variable	Cognitive Impairment (CI)		OR	*P* – value	95% CI
	Impaired cognition (n=93) (%)	Normal cognition (n=107) (%)			
Age (in years)					
≥50	84(64.1)	47(35.9)	11.91	**< 0.001***	5.427-26.15
<50	9(13)	60(87)	Ref		
Sex					
Male	57(42.9)	76(57.1)	0.64	0.146	0.357-1.165
Female	36(53.7)	31(46.3)	Ref		
Education					
Illiterate	23(67.6)	11(32.4)	2.86	**0.007***	1.312-6.266
Literate	70 (42.2)	96 (57.8)	Ref		
Occupation					
Unemployed	31(46.3)	36(53.7)	0.986	0.963	0.547-1.78
Employed	62(46.6)	71(53.4)	Ref		
Age at diagnosis of DM					
≥ 50 years	84(64.1)	47(35.9)	11.91	**<0.001***	5.427-26.15
< 50 years	9(13)	60(87)	Ref		
Duration of diabetes					
≥ 5 years	74(64.3)	41(35.7)	6.27	**<0.001***	3.32-11.9
< 5 years	19(22.4)	66(77.6)	Ref		
Type of Treatment					
Both insulin and OHAs	42(49.4)	43(50.6)	1.23	0.478	0.699-2.15
OHAs	51(44.3)	64(55.7)	Ref		
Duration of treatment					
≥ 5 years	68(72.3)	26(27.7)	8.47	**<0.001***	4.48-16.0
< 5 years	25(23.6)	81(76.4)	Ref		
HbA1c					
Uncontrolled	65(51.8)	61(48.4)	1.75	0.06	0.975-3.14
Controlled	28(37.8)	46(62.2)	Ref		
Body Mass Index (BMI)					
Malnourished	59(46.1)	69(53.9)	0.955	0.878	0.535-1.704
Normal	34(47.2)	38(52.8)	Ref		

OR: Odds ratio; CI: Confidence interval
*Denotes statistically significant association according to the Chi-square test of association

Table 4: Binary logistic regression model on the association of selected risk factors and Cognitive impairment (N= 200)

Variables in the model	Sig.	AOR	95.0% CI for AOR
Age above 50 years	0.0001	15.978	6.289-40.595
Illiterate	0.083	2.584	0.883-7.562
Duration of Diabetes ≥5 years	0.989	1.008	0.318-3.201
Duration of treatment ≥5 years	0.0001	11.369	3.443-37.545
Constant	0.0001	0.064	

AOR: Adjusted Odds ratio; CI: Confidence interval

Table 3 demonstrated a statistically significant association between cognitive impairment and several factors, including age above 50 years, educational qualification, age at diabetes diagnosis, and the duration of diabetes and treatment.

Participants aged above 50 had a substantially higher prevalence of cognitive impairment and were 11.9 times more likely to develop it. Those with lower educational qualifications faced a 2.98-fold increased risk. Furthermore, individuals diagnosed with diabetes after the age of 50 were 11.9 times more likely to experience cognitive impairment. The risk was also notably higher for those with a diabetes duration of more than five years (6.27 times) and a treatment duration exceeding five years (8.47 times).

Table 4 presents the binary logistic regression analysis, which identifies age group (AOR = 15.978) and treatment duration (AOR = 11.369) as significant and independent predictors of cognitive impairment among individuals with diabetes.

Discussion

The present study aimed to explore the factors associated with cognitive impairment among individuals with diabetes. The findings highlight significant relationships between age, duration of diabetes treatment, education level, and cognitive impairment.

In the present study the prevalence of Cognitive impairment in patients with diabetes was 46.5%. This finding is comparable to studies conducted in Gujarat, Karnataka which reported prevalence of 50%

and 50.5%, respectively. However, our prevalence was found to be higher than that of studies in Punjab (33.73%), West Bengal (42%) and Puducherry (30%).[14-18]

The study found that participants aged 50 years or older were significantly more likely to have cognitive impairment compared to those below 50 years, this is consistent with existing literature, where aging is a well-established risk factor for cognitive decline.[19] These findings emphasize the importance of early cognitive screening for patients with diabetes.

This study revealed a significant association between sociodemographic factors like age, education disease characteristics like age of onset of diabetes, duration of diabetes. Our findings are consistent with the findings of a few studies.[15,16,18]

Prevalence of cognitive impairment was found to increase with age and was comparable with similar studies in other parts of the country.[15,16]

Males outnumbered females in our study, however in other similar studies females were more in number than males.[15,16] This finding could be due to differences in study setting or sampling method.

With greater urbanization, residents have access to a wider range of job opportunities, contributing to increased income levels. These factors help explain the predominant representation of Class 2 individuals in our study.

In the present study, cognitive impairment was more prevalent among unemployed individuals, which can be attributed to the effects of long-term unemployment, including increased stress, reduced mental stimulation, and social isolation.

In our study most of the study participants with cognitive decline had diabetes for more than 5 years, which is consistent with study done by Godhasara et.al[14] This may be attributed to factors such as microvascular and macrovascular damage, chronic inflammation, and age-related changes.[19]

No significant association was found between BMI and cognitive impairment ($p = 0.878$). This finding is somewhat surprising given that obesity has been linked to metabolic dysregulation and neurodegeneration. One possible explanation is that other metabolic factors, such as lipid profile and insulin resistance, might play a more critical role in this population.

A key strength of this study is the identification of independent predictors of cognitive impairment in a diabetic population.

Limitations

Due to resource constraints, HbA1c testing could not be performed in the study. Instead, the most recent HbA1c value, preferably measured within the past three months, was used to assess diabetes control.

The findings of the study cannot be generalised, as it was conducted in a hospital setting, which may not be the same in diabetic patients in community or different healthcare settings.

Conclusion

Nearly half of the study population had cognitive impairment, predominantly it was seen among older individuals. The findings emphasize the importance of regular cognitive screening and tailored care for diabetic patients.

Recommendations

The study highlights the importance of recognizing cognitive impairment as a frequent complication of Diabetes Mellitus. Public health policies should emphasize incorporating routine screening of cognitive domain into the National Programme for Prevention and Control of Non-Communicable Diseases (NP-NCD). It is essential to ensure that primary care physicians are adequately trained and equipped to conduct cognitive screenings and provide complete care to enable early detection and timely intervention.

From a clinical perspective, integrating cognitive screening into diabetes care can improve disease management by identifying impairments that may affect a patient's ability to follow treatment regimens. Early detection facilitates the development of a mechanism, which can improve long-term health outcomes and enhance patients' quality of life.

On a national level, such measures could help to reduce the healthcare system's strain by reducing the complications associated with diabetes and cognitive decline. The findings also stress the need for further research, particularly longitudinal studies, to gain deeper insights on the progression of cognitive impairment in diabetic patients. Future research should assess the role of various other factors such as glycemic control, lifestyle modifications, and medication adherence on cognitive functioning. Evaluating the effectiveness of regular cognitive screening in diabetes care will form a base to formulate evidence-based policy decisions.

Author contribution: **VG** contributed to all aspects of the study, including conception, design, data collection, analysis and interpretation, as well as manuscript preparation. **AR** was involved in the study conception and data collection phases. **JC** played a role in the study conception, design, and manuscript preparation.

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