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The prevalance of dementia in patients with type-2 diabetes mellitus

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Abstract

Background: Dementia is a growing public health concern, particularly among individuals with Type 2 diabetes mellitus (T2DM). This study aims to investigate the prevalence of dementia in T2DM patients and identify the associated risk factors, including age, glycemic control, diabetes complications, disease duration, hypertension and smoking.

Methods: A cross-sectional study was conducted involving 260 patients with T2DM. Data on dementia diagnosis, HbA1c and fasting blood glucose (FBS) levels, duration of diabetes, hypertension status, and smoking history were collected and analyzed. Statistical analyses were performed to determine the associations between these variables and the prevalence of dementia.

Results: The study found that 34.2% of individuals with T2DM had dementia. Age was identified as the most significant risk factor, with higher prevalence in older age groups. Elevated HbA1c and FBS levels showed a strong statistical association with dementia, corroborated by a 5-fold increased risk at HbA1c levels above 7%. Longer duration of diabetes was associated with higher dementia prevalence, reaching 86.7% in patients with over 20 years of diabetes. Hypertension, particularly prolonged and untreated, significantly increased the risk of dementia, with a 50.7% prevalence among hypertensive diabetics. Smoking history also emerged as a notable risk factor for dementia patients who are smokers.

Conclusion: The findings highlight a substantial prevalence of dementia among T2DM patients and underscore the importance of comprehensive management of diabetes and its complications. Effective glycemic control, early intervention for diabetic complications, hypertension management, and smoking cessation are critical strategies to mitigate the risk of cognitive decline in this population. Further research is needed to explore the underlying mechanisms and develop targeted prevention and treatment approaches.

Keywords: Type 2 Diabetes Mellitus(T2DM); Glycated Hemoglobin A(HbA1c); Cross Sectional Study; Diabetic Retinopathy; Cognitive Dysfunction; Dementia

1. Introduction

The magnitude of type 2 diabetes mellitus (T2DM) is increasing globally, with a rapid increase in prevalance is seen in low and middle-income countries. Currently, ~77 million people live with diabetes in India, which is expected to reach 134 million by 2045[1].

Uncontrolled serum glucose levels for extended duration are associated with retinopathy, nephropathy, and cardiovascular, cerebrovascular, and peripheral vascular diseases, leading to high morbidity and mortality rates in T2DM.

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Apart from these major morbidities, recently, mild cognitive impairment (MCI) in T2DM is gaining much attention as MCI can enhance the risk for developing dementia. The primary cognitive domains associated with T2DM are working memory, verbal fluency, immediate and delayed recall, visual perception, psychomotor speed, executive control, auditory, memory and processing speed, attention, etc.

Compared with persons who do not have diabetes, those with T2DM are 1.5 to 2.5 times more likely to develop all-cause dementia, including its two main subtypes, Alzheimer's disease (AD) and vascular dementia (VaD) [2].

Aims

The prevalence of dementia in patients with type 2 diabetes mellites.

Objectives

- To find out the prevalence of dementia among Type 2 DM Patients presenting to a tertiary care centre.
- To study the relationship between glycemic status (HbA1c) and presence of dementia.

2. Materials and methods

A Cross sectional study was done on 260 patients with Type-2 Diabetes Mellitus for a period of 18 months. Detailed history of the patients was collected. And then Patients will be subjected to Addenbrooke's Cognitive Examination. The cut off score for diagnosis of dementia is 82/100.

2.1. Statistical analysis

The data obtained was entered in a Microsoft Excel sheet, and statistical analysis was performed using statistical package for the social sciences (version 20). Descriptive analysis was performed using frequency and percentages.

3. Results

Table 1 Prevalence of dementia in type 2DM patients

Dementia	Number of patients	Percentage
Present	89	34.2
Absent	111	65.8
Total	260	100.0

Study observed that; Out of 260 sample type 2DM patients, 89 (34.2%) patients of patients had dementia and 111 (65.8%) of the patients not seen dementia.

3.1. The prevalence of dementia in type 2 diabetes mellitus patients was 34.2% in the present study

Table 2 Association between dementia and age

Age in years	Dementia		Total	X^2-test value, P-value & Significance
	Present	Absent		
	No (%)	No (%)	No (%)	
40—50	20 (24.1%)	63 (75.9%)	83 (31.9%)	$X^2 = 26.65$ P = 0.000, HS
51—60	31 (27.0%)	84 (73.0%)	115 (44.3%)	
61—65	38 (61.3%)	24 (38.7%)	62 (23.8%)	
Total	89 (34.2%)	171 (65.8%)	260 (100.0%)	
Mean ± SD	57.31 ± 6.67	53.46 ± 6.48	54.78 ± 6.80	----

NS= not significant, S=significant, HS=highly significant

The average ACE score was 81.75 with standard deviation 8.27. The minimum and maximum ACE score was 48 and 94 respectively.

There was statistically highly significant association between dementia and age of diabetes mellitus patients (P<0.001). Patients higher the age shows higher the dementia rate as compare to lower the age of patient.

Table 3 Association between dementia and latest HbA1c values

Latest HbA1c (%)	**Dementia**		**Total**	**X^2-test value, P-value & Significance**
	Present	**Absent**		
	No (%)	**No (%)**	**No (%)**	
≤ 7	20 (13.0%)	134 (87.0%)	154 (59.2%)	X^2 = 75.72 P = 0.000, HS
> 7	69 (65.1%)	37 (34.9%)	106 (40.8%)	
Total	89 (34.2%)	171 (65.8%)	260 (100.0%)	
Mean ± SD	8.08 ± 1.19	6.64 ± 1.01	7.12 ± 1.22	------

NS= not significant, S=significant, HS=highly significant

In the study out of 260 sample patients; 106 (40.8%) of patients were observed latest HbA1c was more than 7 %. The mean latest HbA1c was 7.12% with SD of 1.22

There was statistically highly significant association between dementia and latest HbA1c values (P<0.001). Dementia cases were significantly higher in patients with latest HbA1c more than 7 % compared with latest HbA1c ≤ 7% patients.

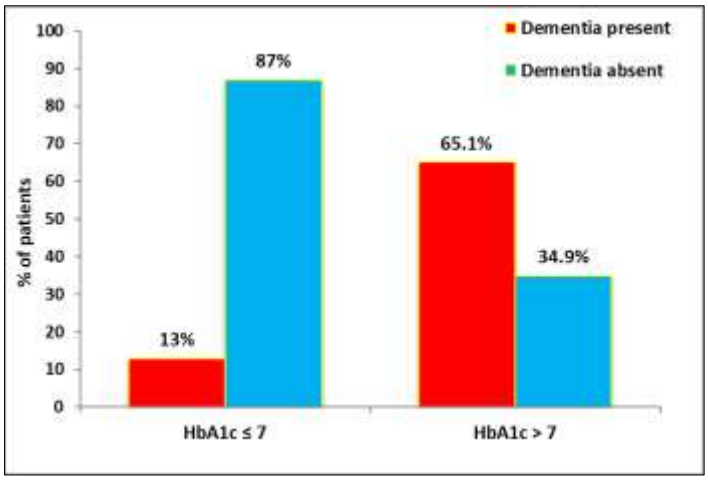

Figure 1 Multiple bar diagram presents association between dementia and latest HbA1c values

In the study out of 260 sample patients; 113 (43.5%) of patients were observed latest FBS was more than 130 mg/dl. The mean FBS was 138.76 mg/dl with SD of 24.19.

There was statistically highly significant association between dementia and latest FBS values (P<0.001). Dementia cases were significantly higher in patients with FBS more than 130 mg/dl compared with FBS ≤130 mg/dl patients.

Table 4 Association between dementia and latest FBS values

Latest FBS (mg/dl)	Dementia		Total	X^2-test value, P-value & Significance
	Present	Absent		
	No (%)	No (%)	No (%)	
≤ 130	22 (15.0%)	125 (85.0%)	147 (56.5%)	X^2 = 55.75 P = 0.000, HS
> 130	67 (59.3%)	46 (40.7%)	113 (43.5%)	
Total	89 (34.2%)	171 (65.8%)	260	
Mean ± SD	158.03 ± 25.29	128.74 ± 15.69	138.76 ± 24.19	------

NS= not significant, S=significant, HS=highly significant

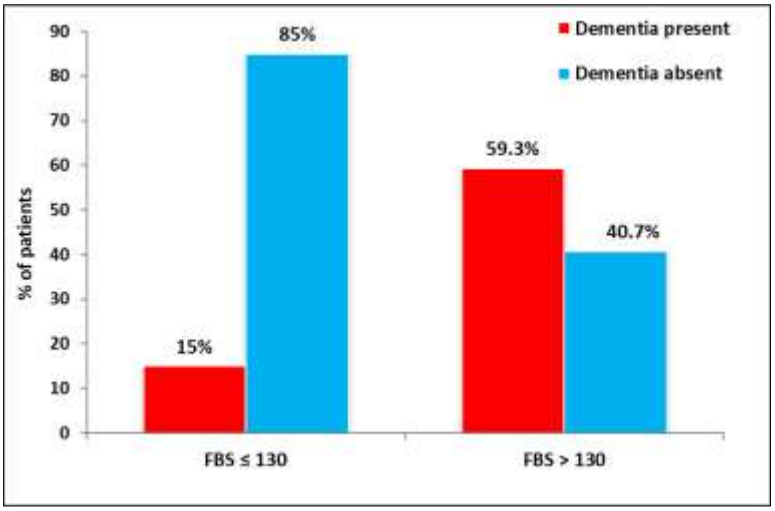

Figure 2 Multiple bar diagram presents association between dementia and latest FBS values

Table 5 Association between dementia and duration of diabetes mellitus

Duration of Diabetes mellitus	Dementia		Total	X^2-test value, P-value & Significance
	Present	Absent		
	No (%)	No (%)	No (%)	
3—10 years	25 (14.9%)	143 (85.1%)	168 (64.6%)	X^2 = 81.288 P = 0.000, HS
11—20 years	51 (66.2%)	26 (33.8%)	77 (29.6%)	
> 20 years	13 (86.7%)	2 (13.3%)	15 (5.8%)	
Total	89 (34.2%)	171 (65.8%)	260 (100.0%)	
Mean ± SD	14.0 ± 5.31	7.26 ± 3.56	9.57 ± 5.31	----

NS= not significant, S=significant, HS=highly significant

In the study out of 260 sample patients; 168 (64.6%) of patients were observed the duration of diabetes mellitus was 3—10 years, followed by 77 (29.6%) of patient's duration of diabetes mellitus was 11-20 years and > 20 years duration of DM patients were 15 (5.8%). The mean duration of diabetes mellitus was 9.57 with SD of 5.31

There was statistically highly significant association between dementia and duration of diabetes mellitus (P<0.001). Dementia cases were significantly higher in patients with duration of DM higher as compare to lower duration of DM.

Table 6 Association between dementia and hypertension

Hypertension	Dementia		Total	X^2-test value, P-value & Significance
	Present	Absent		
	No (%)	No (%)	No (%)	
Yes	67 (50.7%)	65 (49.3%)	132 (50.8%)	X^2 = 32.529 P = 0.000, HS
No	22 (17.2%)	106 (82.8%)	128 (49.2%)	
Total	89 (34.2%)	171 (65.8%)	260 (100.0%)	

NS= not significant, S=significant, HS=highly significant

Study observed that; 132 (50.8%) of hypertension cases were seen in the study, out of them the 67 (50.7%) cases were belongs to dementia patients

There was statistically highly significant association between dementia and hypertension (P<0.001). Above table reveals that the hypertension cases were significantly higher in the patients with dementia (50.7%) compared to the cases without dementia (17.2%).

Table 7 Association between dementia and smoking

Smoking	Dementia		Total	X^2-test value, P-value & Significance
	Present	Absent		
	No (%)	No (%)	No (%)	
Yes	21 (55.2%)	17 (44.8%)	38 (14.6%)	X^2 = 7.93 P = 0.018, S
No	68 (30.6%)	154 (69.4%)	222 (85.4%)	
Total	89 (34.2%)	171 (65.8%)	260 (100.0%)	

NS= not significant, S=significant, HS=highly significant

Study observed that; out of 260 sample patients; 38 (14.6%) of patients had the history of smoking.

There was statistically significant association between dementia and smoking (P<0.05). Above table reveals that the smoking cases were significantly higher in the patients with dementia (55.2%) compared to the nonsmokers in the cases dementia (30.6%).

4. Discussion

4.1. Prevalence of Dementia

According to our results 34.2% of individuals with Type 2 diabetes had dementia. A analogous study conducted in Brazil between 2004 and 2015 by Matoli NPDS et al [3] found that 29% of diabetics have dementia. Tipathi et al[4] discovered that diabetes mellitus was present in 33.3% of their dementia patients, indicating that diabetes is a risk factor for dementia. According to meta-analytic data by Gudala K et al [5] people with type 2 diabetes mellitus are 56% more likely to develop Alzheimer's dementia. According to a 2016 Indian study, 43% of those with type 2 diabetes over the age of 60 experienced cognitive decline [6]. Cholerton B et al.'s 2015 population-based study outlines the significance of glycemic management in preventing dementia in young persons.

The most important risk factor for dementia development is age, and our study discovered that dementia prevalence was higher in older age groups. According to Barbiellini Amidei C et al.'s cohort study published in JAMA, younger age at diabetes beginning was significantly associated with an elevated risk of dementia later in life, with a median follow-up of 31.7 years [7].

4.2. Dementia and HbA1c values and FBS values

We discovered a statistically significant connection between dementia and increased HbA1c and FBS levels. A case-control study[8] conducted in Germany in 2015 and published in the Journal of Alzheimer's Disease found a 5-fold increase in the risk of dementia at HbAlc levels above 7%. A study published in the journal "Alzheimer's disease and associated disorders" in January 2017[9] indicated that diabetes was connected with a 10% faster rate of memory impairment and that a 1-unit increase in HbA1c corresponded to a 0.05 SD decrease in memory score every decade.In a study published in the New England Journal of Medicine[10] in August 2013, researchers concluded that higher glucose levels may be a risk factor for dementia, even in persons without diabetes. Gupta et al. (2018) found a strong association between HbA1c readings and Cognitive Battery Test outcomes, concluding that HbA1c can operate as an essential biomarker in predicting dementia and cognitive impairment in uncontrolled diabetes.

4.3. Dementia and Duration of Diabetes

Our study found a statistically significant rise in dementia prevalence in patients with longer durations of diabetes mellitus. In our study, the prevalence of dementia was 86.7% in diabetics with duration for more than 20 years, and 66.2% in those who had diabetes for 11 to 20 years. This is consistent with the previously indicated causes, which include increasing age and the development of end-organ problems. A 2016 study conducted in the United States found that people with diabetes for a longer period of time and at a younger age had a greater incidence of cognitive decline.Cosway et al[11] discovered that the duration of diabetes is substantially associated with impaired functions, particularly verbal memory.

4.4. Dementia and Hypertension

In our study, the prevalence of dementia among people with hypertension and diabetes was 50.7%. There is a statistical link between the development of dementia and the presence of hypertension, particularly with prolonged duration of hypertension. In a 2009 study[12] there was a strong association between cognitive decline and a history of hypertension (systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥95 mm Hg), and the risk was the highest in patients with untreated hypertension.Hypertensive people are more likely to develop stroke-related dementia[13]. A 2020 study found that higher SBP (>180mmHg) was associated with a 1.6-fold increased risk of dementia.

4.5. Dementia and Smoking

The study found that 38 (14.8%) patients had a history of smoking.It indicated that smoking rates were much higher in dementia patients (55.2%) than in nonsmokers (30.6%).

In a meta-analytic analysis conducted in China in 2015, it was discovered that smoking increases the risk of dementia and that quitting smoking reduces that risk [14].

Limitations

- Sample size taken for the study is small compared to the prevalence of diabetes mellitus and dementia separately in the population.
- This is a cross sectional study and follow up data could not be obtained for comparison of the different variables.
- This is purely an observational study, hence beneficial effects of possible interventions on factors affecting dementia could not be ascertained.
- Quantification of dementia could not be done using Addenbrooke's Cognitive Examination.
- Since this is a tertiary institutional based study, the prevalence values obtained may not reflect the community prevalence.

5. Conclusion

In our study, the prevalence of Dementia in patients with Diabetes Mellitus in the age group 40-65 years, with duration of diabetes mellitus more than 3 years, is 34.2%.

The evidence underscores a strong link between T2DM and increased dementia prevalence.Highlighting the need for early detection, improved glycemic control, and lifestyle interventions may play a critical role in reducing the risk and burden of dementia in this vulnerable population.

Compliance with ethical standards

Acknowledgement

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The study was approved by the Institutional Ethical Committee

Statement of informed consent

Informed consent was obtained from all participants involved in the study, in accordance with ethical standards and guidelines for research.

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