COGNITIVE IMPAIRMENT IN TYPE 2 DIABETES MELLITUS AND ITS DETERMINANTS: A CROSS-SECTIONAL STUDY AMONG DIABETIC PATIENTS OF TUMKUR, KARNATAKA

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Abstract:

BACKGROUND: One of the most challenging problems of the 21st century concerning health is diabetes mellitus. India is the second leading country with 65.1 million people suffering from diabetes in 2013, which is expected to go up by 109 million by 2035. Diabetic subjects have 1.5 times more chances to get cognitive declinesince it accelerates the process of brain aging due to hypoperfusion resulting in functional as well as cognition impairment. Cognitive decline may lead to bad diabetic control and poor adherence to treatment modalities, including diet plans.

AIMS &OBJECTIVES:To evaluate the presence of cognitive impairment in patients with T2DM; to assess the association of cognitive impairment with duration and severity of T2DM and to assess its association with other risk factors

METHODS: This cross-sectional study was conducted among 147 Type 2 Diabetic patients in the OPD & IPD of our institution. Data was collected using a pretested semistructured proforma. Cognitive function was assessed using GPCOG (General Practitioner Assessment of Cognition).

RESULT: Cognitive impairment was found to be present in 20.4 % of participants. Cognitive impairment increased with increase in age, duration of diabetes and this association was statistically significant.

CONCLUSION:In this cross-sectional study on cognitive functions diabetic patients we found higher prevalence of cognitive impairment. Gender, age and duration of diabetes have shown to be significantly associated with cognitive impairment.

KEYWORDS: Type 2 Diabetes Mellitus, Cognitive impairment, duration, severity, Glycaemic Control, GPCOG.

Introduction:

One of the most challenging problems of the 21st century concerning health is diabetes mellitus (DM).[1]It is a heterogeneous group of metabolic disorders with chronic hyperglycaemia and glucose intolerance[2]and also it has been considered as "a distinct kind of accelerated aging" since it surges an individual's liability to degenerative disease.[3]

According to recent analysis by International Diabetes Federation, about 382 million people have diabetes, which is projected to reach nearly 592 million in 2035. The majority of this 382 million people fall under the age group of 40 to 59 years. India is the second leading country with 65.1 million people suffering from diabetes in2013, which is expected to go up by 109 million by 2035.[1]Though it is generally seen in adults, there is an increase in adolescents and children too. Type2 DM has been viewed as a serious global health crisis.The people having type2 DM are often diagnosed only when complications have already established.[1]

The lethal effect of DM in renal, cardiac, retinal, and peripheral nervous system are well known and widely accepted.[4] The consistently high blood glucose levels is a significant cause for the complications of diabetes, particularly neurological manifestations. More recently, the question of impairment of cognition in type2 DMhas been the subject of much speculation.[5]

Cognitive functions denote "acquisition, processing, integration, storage plus recovery of information". It comprises attention, perceptions, memory, and executive function - higher order planning and decision-making.[6]

Cognitive dysfunction is a less known and less addressed complication of diabetes mellitus.[7]Diabetes is related with slow progressive end organ damage in brain. Diabetic subjects have 1.5 times more chances to get cognitive decline,since it accelerates the process of brain aging which is manifested by atrophy of the tissues due to hypoperfusion resulting in functional as well as cognition impairment. The risk effect is more when diabetes occurs in midlife than in later life.[8]Even the moderate consequence of type2 DM on cognition has significant public health issue.[9]

Though type2 DM is considered as a risk factor for cognitivedecline, it is not regularly assessed in routine clinical care. Cognitive decline may lead to bad diabetic control and poor adherence to treatment modalities, including diet plans.[10]

As treatment of type2 DM includes self-management behaviors along with the highly entangled parameters such as blood sugar monitoring, diet charting, medication, diabetes subjects with impairment of cognition have difficulty in managing their problem. They may have trouble in identifying acute problems like hypoglycemia.[11]

Effective performance of cognitive functions is essential for the basic survival and meaningful living and also for the development of competent and independent individuals.[3]

Hence, this study has been designed to evaluate the presence of cognitive impairment in patients with T2DM and also to assess its association with the disease duration and glycemic control.

Objectives of the study:

1. To Assess the presence of cognitive impairment in patients with T2DM

2. To Assess the association of cognitive impairment with duration and severity of T2DM
3. To assess the association of cognitive dysfunction with other risk factors.

Methods:

This cross-sectional study was conducted November 2017 – October 2019at a Medical College inTumakuru, Karnataka. Patients attending OPD and inpatients admitted in the medicine wards & ICU of a Medical College inTumakuru, were the study subjects. Sample size was calculated the standard formula for cross-sectional study with prevalence of 33%[12], confidence level of 95% and precision of 0.08%. Sample size obtained as 133. Taking into consideration 10% dropout rate, the overall estimated sample size was 147 subjects.

Inclusion criteria

- Patients with established diagnosis of type 2 diabetes mellitus aged 40 years and above of either sex

Exclusion criteria

- Established cases of Dementia, history of significant hearing and visual impairment, neurological disorders and family history of dementing illness

Methodology:

- After taking clearance from Institutional Ethical Committee, the study subjects fulfilling the inclusion criteria were recruited and the methodology explained. After taking written consent for the study, the pretested semi-structured proforma was administered to collect data on socio-demographic profile, medical history and clinical examination was done.
- Diabetes control was assessed from all the study subjects using HbA1C.
- Patients were assessed for cognitive impairment by using GPCOG (General Practitioner Assessment of Cognition).[13]
- Total score of 9
    - Score 9: Significant cognitive impairment.
    - Score 5-8: More information required. Proceed with step 2, informant section.
    - Score 0-4: Cognitive impairment.
- Data was entered in MS excel and data was analysed using EPI INFO version 7.2.2.6.
- Socio-demographic data was analysed using percentages and descriptive statistics. Association between various variables was analysed using chi-square test.

Results:

a. Socio-demographic profile:

Age of the study subjects was 57.01±11.1years. Majority were females, illiterate, with duration <5yrs, were on oral medications, with HbA1C of 6-8.9. Hypertension was the commonest comorbidity.Fasting blood sugar, post-prandial blood sugar, random blood sugar, HbA1C of study subjects were 155 [IQR: 115-212]mg/dl, 265 [IQR: 193-334]mg/dl, 249 [IQR: 167-302]mg/dl and 9.76±2.71 respectively.

b. Cognitive impairment among study subjects:

The study subjects were assessed for cognitive impairment by using GPCOG (General Practitioner Assessment of Cognition). Cognitive impairment was found to be present in 30 (20.4%) of the study subjects

c. Association of cognitive impairment with duration and severity of T2DM:

Cognitive impairment increased with duration of DM. This association was statistically significant. Cognitive impairment increased with increase in HbA1C except for HbA1C above 15. This association was not statistically significant(Table 1)

d. Association of cognitive dysfunction and other risk factors.

Cognitive impairment was more among males compared to females. Cognitive impairmentincreased with increase in age of the study subject. This association was statistically significant,Cognitive impairment was more in poorly educated & illiterates compared to well-educated. Cognitive impairment was more among subjects on insulin compared to those on oral medication. Cognitive impairment was more among subjects with comorbidities compared to those without comorbidities. Association between Cognitive impairment and sex, age & education of study subjects were statistically significant(Table 2).

Cognitive impairment was more among subjects with comorbidity like hypertension, neuropathy, nephropathy, retinopathy, hypothyroidism, H/O Hypoglycemia compared to those without comorbidities. But none of the associations were statistically significant (Table 3)

Discussion:

Diabetes is regarded as an epidemic disease with 382 milliondiabeticsthroughout the world.[1]It isa chronic disease which ends in long term complications. Cognitive dysfunction is also considered as an important chronic complication.Even though advancement is being made, cognitive dysfunction is still a neglected field in diabetes. A conserved cognitive status is vital for the awareness of the disease and itscompliance.[4]

In the present study we have observed that cognitive impairment is seen in 20.4% of the subjects.This is similar to various studies where cognitive impairment was observed in 19.5%, 13.5% of the studied patients conducted by Roy s et al[14], Gao et al[15] respectively.

In our study, we have observed that cognitive impairment increased with duration of DM. It shows that longer duration has an effect over cognitive function. In a study conducted by Divya Yogi-Morren et al., it was shown that subjects with long duration of DM performed poorly ontests on working memory, basic attention, and executive function[16].Renata C Alencaret al., investigated the connection of the duration of type2 DM with cognitive dysfunction and concluded that longer duration of DM is related with poor cognitive outcome.[10] Richard H Tuligenga et al., in his Whitehall II cohort study interpreted that accelerated cognitive decline in type 2 DM subjects is dependent on duration of thedisease.[17]SatyajeetRoy et al., established a negative correlation between cognition as well as diabetic duration and also observed a incremental pattern ofcognitive decline in those with more than 10 years duration.[14]Study done by

Rajeshkanna NR et al., showed a positive correlation of HbA1C level with duration of diabetes suggesting that cognitive dysfunction is more with higher level of HbA1c in the long run.[18]

In our study, we have observed that cognitive impairment increased with increase in HbA1C except for HbA1C above 15. This finding was similar to other studies where a negative correlation between the cognitive score and poor glycaemic control i.e., as the HbA1C levels increases, the cognitive impairment also enhances.[14,18,19]

In our study, we have observed that cognitive impairment was more among females compared to males. Similar to that, study done by Priyam Mukherjee et al., concluded that cognitive dysfunction is related with diabetes and no significant relationship of sex of patients with cognitive decline.[19]

In our study, we have observed that cognitive impairment increased with increase in age. S.C. Tiwari et al., in their study reported that type2 DM is a risk factor for impairment in cognitive functions irrespective of the cut-off age of either 60 years or 55years.[20]

In our study, Cognitive impairment was more among subjects on insulin compared to those on oral medication. In the studies conducted by Roy et.al., half (50%) of the patients in the cognitive impairment group were managed by diet, oral hypoglycemic drug(s), and insulin, followed by about one-third (31.2%) of the patients who were managed by diet and insulin.[14]

In our study, Cognitive impairment was more among subjects with comorbidities compared to those without comorbidities. The 2-fold increased risk of mild cognitive impairment (MCI) in subjects with diabetic retinopathy in a study.[21] Recurrent or chronic hypoglycemia caused by treatment with insulin may also contribute to permanent cognitive impairment.[22]

Conclusion:

The current study implies that cognitive dysfunction was significantly related to type2 DM and also there was a strong relation of the cognitive decline with diabetic duration and control.Factors that contribute to the severity of the disease include poor compliance to therapy, irregular routine follow up and health education.Glycemic control is a vital aspect in the management of type2 DM. Effective control needs proper diet, regular exercise, monitoring blood glucose by self and management of medications.

With type2 DM emerging as global pandemic, it is important that screening of diabetic complications should also include the assessment of cognitive status. Early recognition and management of the cognitive dysfunction will help in improving quality of life as well as independent living in type2 DM subjects.

Limitation: Cross-sectional nature of this study does not allow us to measure decline in cognitive function over time. A cohort study would have been a better study design.GPCOG is considered as a screening test. The influence of other risk factors like thyroid dysfunction, hormonal factors, vitamin D, B12, B2 and folic acid has not been quantitatively assessed.

Ethical clearance- Taken from Institutional ethical committee

Source of funding-Nil

Conflict of Interest- Nil

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Tables:

Table 1: Association of cognitive impairment with duration and severity of T2DM

Characteristics		**Impairment**	**No impairment**	**Chi/F**	**p value**
Duration	<5yrs	7 (9.1)	70 (90.9)	23.656	<0.001
	6-10yrs	8 (22.9)	27 (77.1)		
	11-15yrs	6 (28.6)	15 (71.4)		
	>15yrs	9 (64.3)	5 (35.7)		
HbA1C	<6	3 (37.5)	5 (62.5)	3.35	0.501
	6-8.9	9 (16.1)	47 (83.9)		
	9-11.9	10 (18.9)	43 (81.1)		
	12-14.9	7 (29.2)	17 (70.8)		
	15 & above	1 (16.7)	5 (83.3)		

Figures in the parentheses

Table 2: Association of cognitive dysfunction and other risk factors

Characteristics		**Impairment**	**No impairment**	**Chi/F**	**p value**
Sex	Male	80 (85.1)	14 (14.9)	4.881	0.027
	Female	37 (69.8)	16 (30.2)		
Age	40-49	1 (2.6)	38 (97.4)	26.43	<0.001
	50-59	7 (16.7)	35 (83.3)		
	60-69	12 (27.9)	31 (72.1)		
	70-79	5 (27.8)	13 (72.2)		
	80 & above	5 (100.0)	-		
Education	Graduate	-	32 (100.0)	27.41	<0.001
	Matriculation	2 (5.4)	35 (94.6)		
	Primary & secondary	8 (26.7)	22 (73.3)		
	Illiterate	20 (41.7)	28 (58.3)		
Type of treatment	Oral	15 (16.1)	78 (83.9)	5.38	0.06
	Insulin	9 (37.5)	15 (62.5)		
	Both	6 (20.0)	24 (80.0)		
Comorbidities	Yes	19 (21.3)	70 (78.7)	0.123	0.835
	No	11 (19.0)	47 (81.0)		

Figures in the parentheses

Table 3: Association of cognitive dysfunction and complications and other comorbidities

Comorbidities	**Impairment**	**No impairment**	**p value**
Hypertension	14 (22.6)	48 (77.4)	0.679
Neuropathy	4 (22.2)	14 (14 (77.8)	0.764
Nephropathy	2 (25.0)	6 (75.0)	0.666
Retinopathy	5 (29.4)	12 (70.6)	0.343
Hypothyroidism	1 (20.0)	4 (80.0)	1.00
H/O Hypoglycemia	4 (33.3)	8 (66.7)	0.266

Figures in the parentheses