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Cognitive impairment among type 2 diabetes mellitus patients at Jimma University Specialized Hospital, Southwest Ethiopia

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Cognitive impairment is the major health problem particularly in elderly with type 2 diabetes mellitus. The aim of this study was to determine the magnitude of cognitive impairment and associated factors among type 2 diabetics in Jimma University Specialized Hospital, 2016. Comparative cross sectional study was employed among 105 type 2 diabetes mellitus patients and 105 matched healthy individuals at Jimma University Specialized Hospital using consecutive sampling technique. Mini-mental state examination scale was used to measure cognitive function. Frequency, independent t-test, and logistic regression were carried to present data. Variables with p≤0.05 were considered as significant association between dependent and outcome variables. Prevalence of cognitive impairment among type 2 diabetes mellitus was higher than healthy individuals (53.3%). Age, occupations, fasting blood glucose level, and type of treatment options for diabetics were the predictors of cognitive impairment among type 2 diabetes mellitus patients. The prevalence of cognitive impairment among type 2 diabetes mellitus patients was significantly higher than non-diabetes study participants. This study was intended to offer information on cognitive impairment and associated factors among type 2 diabetes mellitus patients to concerned bodies in designing diagnosis and management strategies particularly focusing on counseling in preventing risk factors.

Key words: Cognitive impairment, type 2 diabetes mellitus, mini-mental state examination, Ethiopia.

INTRODUCTION

Diabetes mellitus (DM) is a chronic endocrine disorder due to disturbance of insulin hormone. Type 2 diabetes mellitus (T2DM) accounts for 90 to 95% of all varieties of DM worldwide. The rise of blood glucose level beyond the physiologic limits would result in complications to different body parts including central nervous system, which is the center of cognition (American Diabetes Association, 2013).

Cognition refers to information processing and application of knowledge which encompasses focused

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attention, executive function, recall, processing language and making decisions (Anderson et al., 2001; Tomar, 2012). T2DM leads to disturbances of brain metabolites (Rajani et al., 2015) and neurotransmitters which are vital for cognition. Memory function appears to be affected in patients with T2DM (Van Harten et al., 2007). Two large cohort studies confirmed that being a diabetic would increase the probabilities of developing cognitive impairment by 1.3 times as compared to non-diabetic populations (Okereke et al., 2008; Tiwari et al., 2012). Predictors of cognitive impairment as evidenced from the study in Pakistan (Musleh et al., 2014) and in India (Sengupta et al., 2014) were age, sex, educational level, area of residence, marital status, unemployment, poverty and chronic illness like hypertension and DM. A study in Korea showed a higher prevalence of cognitive impairment among elderly T2DM patients and predictors were age, educational background and systolic blood pressure (Lee et al., 2014; Mavrodaris et al., 2013). An observational study in 2011 at Tikur Anbesa Referral Hospital, Ethiopia, showed 45% prevalence of cognitive impairment (29.6% mild and 15.4% moderate) among T2DM patients (Tefera et al., 2013).

The largest proportion of the population in Jimma zone which is found in the southwestern part of Ethiopia, chew a plant with its main ingredient, nicotine (neurostimulant), called khat (35.8%), smokes cigarette (11.2%) and consumes alcohol (43.4%) (Lee et al., 2014). Thus, with the aforementioned background and due to many other risk factors, it was expected that cognitive impairment among T2DM patient in the current study area would be high. In addition, the current study would fill the knowledge gap in the area; to the authors' best knowledge, no study had been done in Jimma town that shows the association between cognitive impairment and diabetes.

Lastly, findings from this study may help local, regional and federal policy makers and health professional give attention to integrative health approach to minimize the burden of health problems associated with T2DM. So, the purpose of this study was to determine the impact of diabetes mellitus on human cognition and associated factors that increase the risk of cognitive impairment among T2DM patients in comparison to healthy controls.

MATERIALS AND METHODS

Study setting, design, and population

Institution based comparative cross-sectional study design was employed at Jimma University Specialized Hospital (JUSH) diabetic clinic, Jimma town, located at 352 km Southwest of Addis Ababa, Ethiopia. Data collection was carried out from March 25 to April 25, 2016. All T2DM patients aged 30 years and above attending JUSH Diabetic clinic, having the duration of 1 year and above from diagnosis and all relatively healthy individuals who came to JUSH diabetic clinic and matched for age, sex, and educational level were included. Individuals with gross hand tremor, blindness, deafness, hyperlipidemia, traumatic brain injury and family history of dementia were excluded.

The sample size was determined using two population proportion formula with the assumption of P_1 = 45% (Tefera et al., 2013) and P_2=26% (Vertesi et al., 2001), and confidence level of 95% with power of 80%.

$$n=\frac{(r+1)(Z\alpha/2+Z\beta)2\ P(1-P)}{r(p1-p2)2}=100$$

Where, n = sample size, p1 = proportion of T2DM with cognitive impairment, p2 = proportion of non-diabetes people with cognitive impairment, Zβ = standard normal variate for power, Zα = standard normal variate for level of significance, $p1-p_2$ = effect size, P = pooled proportion, that is, average proportion (p1+p2)/2, r = ratio of number of participants of cases to controls (1 in this case). For each group, the sample size (n) was 100. After adding a non-response rate of 5%, the total sample size for each group was 105. Consecutive sampling technique was used to select both T2DM patients and healthy control individuals. During the data collection period, there was a total of 1853 DM patients registered for follow-up at JUSH diabetic clinic.

Data collection procedure

Data were collected using pretested interviewer-administered questionnaire which consisted of sociodemographic characteristics, substance use, physical measurements of height and weight, medical history and adapted standardized mini mental state examination (MMSE) for cognition assessment (Tefera et al., 2013). A MMSE evaluates orientation (10 points), registration (3 points), attention and calculation (5 points), recall (3 points), language and praxis (9 points; naming, repetition, 3-stage command, reading, writing and copying) (Vertesi et al., 2001). Diabetes-related questions were filled by reviewing the patients' medical chart as well as testing for fasting blood sugar (FBG) format at the Medical Laboratory Department where patients often get to obtain the baseline FBG status during their routine checkup. International Diabetic Federation cut off points for body mass index (BMI) and blood pressure (BP) and the American Diabetic Association cut off points for fasting blood glucose were used to obtain the baseline BMI, BP and FBG.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board of Jimma University, College of Health Sciences and Letter of Cooperation was obtained from Jimma University and JUSH. Written informed consent was taken from the study participants to start data collection. Any identifiable issues were eliminated to ascertain confidentiality.

Statistical analysis

Data were checked for its completeness then entered to Epi data version 3.1 and exported to SPSS version 20.0 for windows. Descriptive statistics, independent t-test, and logistic regression model were done. Variables having a $p \leq 0.05$ in the independent t-test were considered as statistically significant and p-value < 0.25 in the binary logistic regression was considered as a candidate for multiple logistic regression. From multiple logistic regression, exposure variables with a p-value < 0.05 with 95% confidence interval were declared as predictors for cognitive impairment.

RESULTS

Socio-demographic and economic characteristics of the study participants

A total of 210 study participants with an equal proportion of T2DM patients and healthy controls were involved. Male to female ratio was 1.06 and majority of respondents 57 (27.1%) were in the age range of 30 to 45 years. Non-diabetes study subjects had a higher income than T2DM patients. Moreover, the mean body mass index was significantly higher among T2DM patients than non-diabetes study subjects as predict (Table 1).

Substance use profiles of study participants

As shown in Table 2, 55 (52.4%), 33 (31.4%), and ten (9.5%) of the T2DM patients had a lifetime of khat chewing, alcohol drinking, and cigarette smoking, respectively compared to 41, 43.8 and 5.7% among healthy subjects. However, from each category, the current proportion of khat chewing, alcohol drinking, cigarette smoking was 34 (61.8), 11 (33.3%), and 2 (20%), respectively compared to 53.5, 39.1, and 33.3% among the healthy subjects (Table 2).

Cognitive impairment among T2DM patients and healthy controls

The joint education adjusted MMSE score of the study participants using the independent t-test, was 24.55 and significantly ($p<0.001$) lower MMSE was observed among T2DM patients compared to the non-diabetic study participants. The burden of cognitive impairment among T2DM patients was significantly higher than for non-diabetes study participants (53.3% versus 31.4%) (Table 3). Table 3 compares the severity of cognitive impairment among T2DM patients with healthy individuals; mild 31 (29.5%) versus 26 (24.8%), moderate 23 (21.9%) versus 7 (6.7%), and severe 2 (1.9%) versus 0 (0%) (Figure 1).

Clinical archives of T2DM patients

The mean duration of diabetes and FBG level were 6.9 years (SD±5.5) and 164.02 mg/dl (SD±68.54), respectively. The most (11, 68.8%) affected people were with 7 to 8 years of disease duration. Seventy-two (68.6%) had hyperglycemia (≥ 126 mg/dl) at the time of data collection; whereas 21 (20%) T2DM patients had history of hypoglycemia (<126 mg/dl) and 43 (41.0%) individuals had comorbid hypertension. Sixty-six (62.9%) T2DM patients rely on oral hypoglycemic agents, whereas 25 (23.8%) used both insulin and oral hypoglycemic agents (Table 4).

Predictors of cognitive impairment among T2DM patients

In the multiple logistic regression analysis, participants' age and occupation, FBG level and treatment options were significantly associated with cognitive impairment. T2DM patients aged ≥62 years and being a farmer by occupation were higher odds for cognitive impairment by 7.5 times [AOR= 7.54, 95% CI (1.38, 41.38)] compared to those age ≤45 years and by 7.38 times [AOR=7.38, CI (1.26-43.15)] compared to employees T2DM patients (Table 4). Moreover, cognitive impairment among T2DM patients who had FBG level greater than or equals to 126 mg/dl is 4.4 times [AOR=4.43, 95% CI (1.14, 17.18)] as likely as cognitive impairment among T2DM patients with FBG level below 126 mg/dl. Furthermore, the odds of cognitive impairment among T2DM patients who used only oral hypoglycemic agents as a treatment option are 5.4 times [AOR=5.39, 95% CI (1.37, 41.18)] the odds of cognitive impairment among T2DM patients who used insulin (Table 5). Substance use related variables were tested for crude association with cognitive impairment in binary logistic regression. Nonetheless, there was no substance related variable with $p<0.25$. Hence, nothing was entered into multiple logistic regression analysis.

DISCUSSION

Cognitive impairment is the neurophysiologic disturbance caused due to neuronal damage and functional defect among neurotransmitters (Umegaki et al., 2013; Ojo and Brooke, 2015). In this study, T2DM was shown to be a risk factor for cognitive impairment. The burden of cognitive impairment among T2DM patients was 53.3% compared to 31.4% among non-diabetic patients, an almost 20% increase among the T2DM patients. This is a severe public health problem that needs attention of researchers, physicians, and policymakers. It was nearly similar to the findings of the study conducted in Tikur Anbesa referral Hospital, Ethiopia (Tefera et al., 2013) and Nigeria (Chukwuemeka et al., 2015) but higher than studies from Saudi Arabia and Republic of China (Eman et al., 2015; Li et al., 2016). Socio-demographic, economic, recruitment criteria's and related factors might be the cause of such epidemiological difference of cognitive impairment among T2DM patients. Individuals with T2DM had been seen to develop the risk of Alzheimer's diseases in the work of Leibson et al. (1997). In addition, a 9 years cohort study showed that T2DM patients would develop Alzheimer's disorders with 65% probabilities than non-diabetic populations (Arvanitakis et al., 2004). In addition, a very long 11 years cohort study reaffirms the incidence of Alzheimer diseases increases by 4.8% among T2DM patients (Huang et al., 2014). These findings supports that diabetes is a risk factor for neurological disorders including cognitive impairment. Persistent hyperglycemia would lead to vascular

Table 1. Proportion of diabetes and non-diabetes study subjects at Jimma University Specialized Hospital, Jimma, Ethiopia.

Variable		Study groups (n=210)		
		Total (n=210) [Frequency (%)]	**T2DM group (n=105) [Frequency (%)]**	**Non-diabetes group (n=105) [Frequency (%)]**
Age (years)	Mean±SD	53.53±11.576	53.36±11.674	53.70±11.53
	30-45	57 (27.1)	29 (27.6)	28 (26.7)
	46-55	55 (26.2)	29 (27.6)	26 (24.8)
	56-61	49 (23.3)	22 (21.0)	27 (25.7)
	≥62	49 (23.3)	25 (23.8)	24 (22.9)
Sex	Male	108 (51.4)	54 (51.4)	54 (51.4)
	Female	102 (48.6)	51 (48.6)	51 (48.6)
Religion	Orthodox	85 (40.5)	39 (37.1)	46 (43.8)
	Muslim	95 (45.2)	55 (52.4)	40 (38.1)
	Protestant	22 (15.5)	7 (6.7)	15 (14.3)
	Catholic	8 (3.8)	4 (3.8)	4 (3.8)
Ethnicity	Oromo	116 (55.2)	67 (63.8)	49 (46.7)
	Amhara	50 (23.8)	21 (20.0)	29 (27.6)
	Tigre	16 (7.6)	5 (4.8)	11 (10.5)
	Guraghe	21 (10.0)	8 (7.6)	13 (12.4)
	Other**	7 (3.3)	4 (3.8)	3 (2.9)
Education level	≤Grade 8	126 (60.0)	63 (60)	63 (60)
	Grade 9-12	56 (26.7)	28 (26.7)	28 (26.7)
	College and above	28 (13.3)	14 (13.3)	14 (13.3)
Marital status	Single	6 (2.9)	3 (2.9)	3 (2.9)
	Married	139 (66.2)	84 (80.0)	55 (52.4)
	Divorced	35 (14.3)	8 (7.6)	27 (19.0)
	Widowed	30 (16.7)	10 (9.5)	20 (25.7)
Occupation	Employed	76 (36.2)	33 (31.4)	43 (41.0)
	Merchant	31 (14.8)	10 (9.5)	21 (20.0)
	Farmer	36 (17.1)	26 (24.8)	10 (9.5)
	Housewife	56 (26.7)	31 (29.5)	25 (23.8)
	Daily laborer	4 (1.9)	2 (1.9)	2 (1.9)
	Other	7 (3.3)	3 (2.9)	4 (3.8)
Income (EB)	Mean±SD	1446.67	1213.01±1093.3	1680.33±1287.52*
	≤500	57 (27.1)	32 (30.5)	25 (23.8)
	501-1000	63 (30.0)	37 (35.2)	26 (24.8)
	1001-2000	46 (21.9)	21 (20.0)	25 (23.8)
	≥2001	44 (21.0)	15 (14.3)	29 (27.6)
Residence	Urban	156 (74.3)	74 (70.5)	82(78.1)
	Rural	54 (25.7)	31 (29.5)	23(21.9)
BMI (Kg/m^2)	Mean ±SD	23.473±3.47	24.2±4.2*	22.8±2.43
	<18.5	7 (3.3)	5 (4.8)	2 (1.9)
	18.5-24.9	142 (67.6)	61 (58.1)	81 (77.1)
	25-29.9	48(22.9)	27 (25.7)	21(20.0)
	≥30	13(6.2)	12 (11.4)	1(1.0)

Significant mean, **Adere, Dawuro, Kulo, Keffa. SD, Standard deviation; BMI, body mass index; EB, Ethiopian Birr = 23; USD = 23 EB.

Table 2. Substance use profiles of study participants at Jimma University Specialized Hospital, Jimma, Ethiopia.

Variable	Study groups		
	Total (n=210) [Frequency (%)]	T2DM group (n=105) [Frequency (%)]	Non-diabetes group (n=105) [Frequency (50%)]
Life time khat chewing history			
Yes	98 (53.3)	55 (52.4)	43 (41.0)
No	112 (46.7)	50 (47.6)	62 (59.0)
Current khat chewing			
Yes	57 (58.2)	34 (61.8)	23 (53.5)
No	41 (41.8)	21 (38.2)	20 (46.5)
Life time alcohol drink			
Yes	79 (37.6)	33 (31.4)	46 (43.8)
No	131 (62.4)	72 (68.6)	59 (56.2)
Current alcohol drink			
Yes	29 (36.7)	11 (33.3)	18 (39.1)
No	50 (63.3)	22 (66.7)	28 (60.9)
Life time cigarette smoking			
Yes	16 (7.6)	10 (9.5)	6 (5.7)
No	194 (92.4)	95 (90.5)	99 (94.3)
Current cigarette smoking			
Yes	4 (25.0)	2 (20.0)	2 (33.3)
No	12 (75.0)	8 (80.0)	4 (66.7)

Table 3. Comparison of cognitive status among study groups at Jimma University Specialized Hospital, Jimma, Ethiopia.

Variable		Study groups (n=210)			t/χ^2	p-value
		Total (n=210) Frequency (%)	T2DM group (n=105) Frequency (%)	Non-diabetes group (n=105) Frequency (%)		
Cognitive impairment	Yes	89 (42.4)	56 (53.3)	33 (31.4)	9.438	0.002**
	No	121 (57.6)	49 (46.7)	72 (68.6)		
MMSE score	Mean±SD	24.55±4.9	23.41±5.60	25.70±3.783	-3.466^t	<0.001**

**Significant; χ^2, Chi-square; t, independent t-test; SD, standard deviation.

dysfunction, oxidative stress and inflammation in tissues of the brain and this could aggravate incidence of cognitive impairment. In the current study, age and occupation were predictive factors of cognitive impairment among socio-demographic and economic variables. It is a general fact that, as age advances cognitive capabilities of individuals also drops dramatically (Sengupta et al., 2014; Lee et al., 2014; Hamed et al., 2013), because neuronal functions become poor in processing and integrations of information. Occupation is one of the key determinants that has been seen associated with many health problems. In the same manner, in our findings, governmental and non-governmental employees of T2DM patients showed a lower incidence of cognitive impairment than other types of occupations (farmers) of the patients. This could be because they received better payment from the employers that would able to cover their living expenses and moreover, seem they are free from work stress and stable than others. Researches are not consistent in the

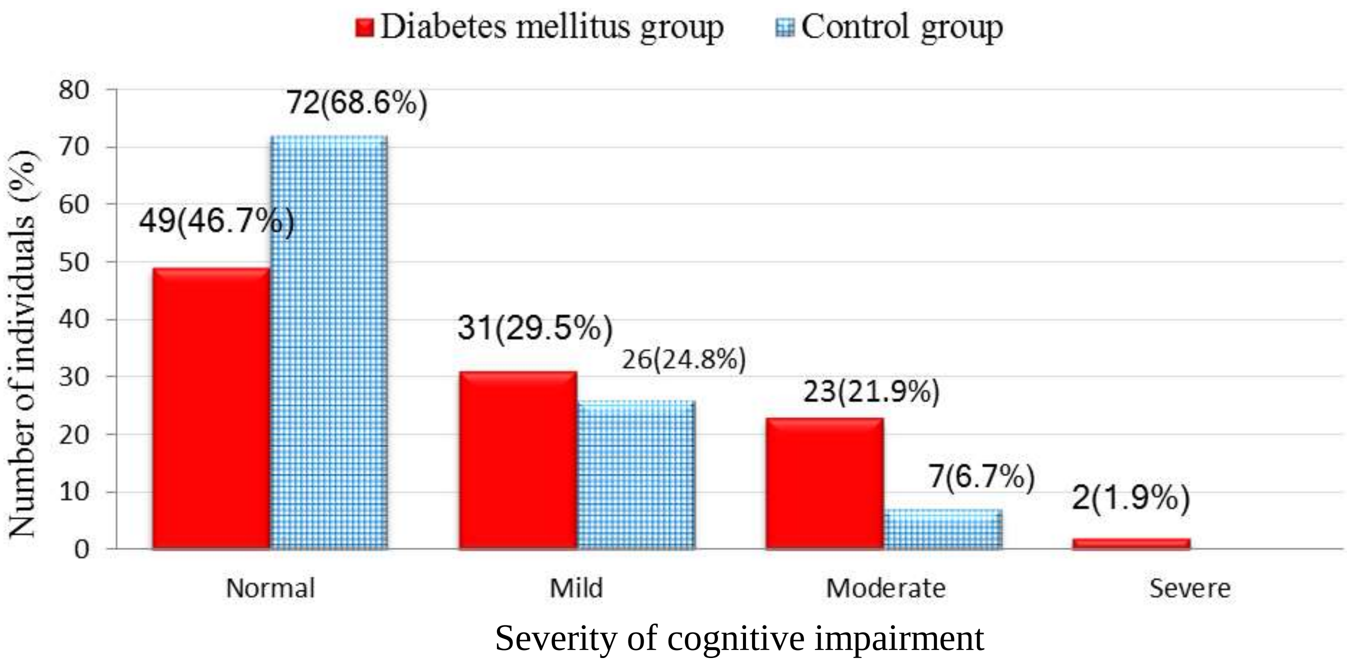

Figure 1. Levels of cognitive status among type 2 diabetes mellitus and healthy controls at Jimma University Specialized Hospital, Jimma, Ethiopia.

Table 4. Sociodemographic covariates and cognitive impairment in binary and multiple logistic regression analysis among Diabetes Mellitus patients at Jimma University Specialized Hospital, Jimma, Ethiopia March to April 2016.

Variable		**DM group (n=105)**			
		Cognitive impairment			
		Yes [Frequency (%)]	**No [Frequency (%)]**	**COR (95% CI)**	**AOR (95% CI)**
Age (year)	30-45	11 (37.9)	18 (62.1)	1	1
	46-55	14 (48.3)	15 (51.7)	1.53 (0.54-4.35)	1.59 (0.39-6.54)
	56-61	13 (59.1)	9 (40.9)	2.36 (0.76-7.34)	4.6 (0.89-23.81)
	≥62	18 (72.0)	7 (28.0)	4.208 (1.33-13.30)	7.54 (1.38-41.38) [**]
Sex [N]	Male	26 (48.1)	28 (51.9)	1	-
	Female	30 (58.8)	21 (41.2)	1.54 (0. 71- 3.33)	
Educational level	Grade 8 and lower	47 (74.6)	16 (25.4)	7.34 (2.02-26.70)	2.51 (0.39-16.23)
	Grade 9 - 12	5 (17.9)	23 (82.1)	0.543 (0.12-2.46)	0.27 (0.04-1.71)
	College and above	4 (28.6)	10 (71.4)	1	1
Marital Status [N]	Single	0 (0.0)	3 (100)	0.0	-
	Married	46 (54.8)	38 (45.2)	1	
	Divorced	4 (50.0)	4 (50)	0.83 (0.19-3.53)	
	Widowed	6 (60.0)	4 (40.0)	1.24 (0.33-4.71)	
Occupation	Employed	9 (27.30)	24 (72.7)	1	1
	Merchant	4 (40.0)	6 (60)	1.78 (0.41-7.80)	1.01 (0.16-6.32)
	Farmer	22 (84.6)	4 (15.4)	14.67 (3.95-54.48)	7.38 (1.26-43.15) [**]
	Housewife	20 (64.5)	11 (35.5)	4.85 (1.68-14.03)	2.72 (0.54-13.77)
	Daily laborer	0 (0.0)	2 (100)	0.0 (-)	0.0 (-)
	Other	1 (33.3)	2 (66.7)	1.33 (0.11-16.57)	0.70 (0.03-19.9)

Table 4. Contd.

Monthly income	≤500	21 (65.6)	11 (34.4)	5.25 (1.35-20.40)	2.28 (0.09-57.91)
	501 - 1000	23 (62.2)	14 (37.8)	4.518 (1.20-16.97)	2.99 (0.14-66.10)
	1001 - 2000	8 (38.1)	13 (61.9)	1.69 (0.40-7.17)	2.61 (0.15-46.29)
	≥2001	4 (26.7)	11 (73.3)	1	1
Residence	Urban	32 (43.2)	42 (56.8)	1	1
	Rural	24 (77.4)	7 (22.6)	4.50 (1.72-11.75)	0.79 (0.14-4.45)
BMI (kg/m^2) [N]	<18.5	2 (40.0)	3 (60.0)	0.49 (0.08-3.18)	-
	18.5-24.9	35 (57.4)	26 (42.6)	1	
	25-29.9	14 (51.9)	13 (48.1)	0.80 (0.32-1.99)	
	≥30	5 (41.7)	7 (58.3)	0.53 (0.15-1.86)	

N, Variable not candidate for multiple logistic regression. **Significant at p<0.05.

Table 5. Clinical variables and cognitive impairment in binary and multiple logistic regressions among Type 2 Diabetes Mellitus patients at Jimma University Specialized Hospital, Jimma, Ethiopia.

Variable		Total Frequency (%)	DM group (n=105)			
			Cognitive impairment			
			Yes [Frequency (%)]	No [Frequency (%)]	COR (95 % CI)	AOR (95 % CI)
FBG (mg/dl)	Mean±SD			164.02±68.54		
	<126	33 (31.4)	17 (51.5)	16 (48.5)	1	1
	≥126	72 (68.6)	39 (54.2)	33 (45.8)	0.8 (0.49-2.54)	4.43 (1.14-17.18)**
Disease duration (year)	Mean ±SD			6.883±5.5474		
	1-3	28 (26.7)	13 (46.4)	15 (53.6)	1	1
	4-6	36 (34.3)	18 (50.0)	18 (50.0)	1.15 (0.43-3.10)	0.99 (0.24-4.19)
	7-8	16 (15.2)	11 (68.8)	5 (31.2)	2.54 (0.697-9.24)	1.56 (0.17-14.33)
	≥9	25 (23.8)	14 (56.0)	11 (44.0)	1.47 (0.497-4.34)	2.71 (0.44-16.62)
Hypoglycemia episodes	Yes	21 (20)	13 (61.9)	8 (38.1)	1.55 (0.58-4.13)	3.02 (0.78-11.72)
	No	84 (80)	43 (51.2)	41 (48.8)	1	1
Comorbid HTN	Yes	43 (41)	22 (51.2)	21 (48.8)	0.86 (0.396-1.88)	1.05 (0.33-3.35)
	No	62 (59)	34 (54.8)	28 (45.2)	1	1
Treatment options	Insulin only	14 (13.3)	6 (42.9)	8 (57.1)	1	1
	OHA only	66 (62.9)	39 (59.1)	27 (40.9)	1.93 (0.60-6.19)	5.388 (1.37-41.18)**
	Both	25 (23.8)	11 (44.0)	14 (56.0)	1.048 (0.28-3.92)	2.55 (0.60-26.40)
Study group	DM group	105	56 (53.3)	49 (46.7)	2.49 (1.42,4.38)	p = 0.001
	Control group	105	33 (31.4)	72 (68.6)	1	

1, Reference; **Significant at p<0.05; OHA, Oral hypoglycemic agents; COR, crude odds ratio; AOR, adjusted odds ratio.

relationships of drug therapy and cognitive functions among T2DM patients. For example, a cohort study on elderly females T2DM patients treated with oral hypoglycemic agents for 2 years showed no significant difference in their cognitive function as compared to non-diabetes populations (Logroscino et al., 2004). On the other hand, patient treatment for 6 months by rosiglitazone, a thiazolidinedione, or glyburide, a sulfonylurea combined with metformin showed improved FBG level and working memory (Ryan et al., 2006). Another study also found that oral hypoglycemic agents and multiple drug therapy were more effective at improving cognitive function than monotherapy (Wu et al., 2003). However, the current finding shows that using oral hypoglycemic agents as treatment options cause cognitive impairment by 5.1 times than using insulin or combined options among T2DM patients. It is difficult to investigate the disagreement of the studies in this regard but it could be an important scenario for the researcher to search and find a solution in the area. Furthermore, the results of this study disclosed that any of the substances used were not associated with cognitive impairment. However, an experimental and cross-sectional study on human showed that khat chewing and alcohol drinking were associated with memory deficits and impair cognitive flexibility (Kimani and Nyongesa, 2008; Wabel, 2011; Colzato et al., 2011; Hoffman and al' Absi, 2013).

Limitations of the study

Interpretation of this study results has the following limitations; first, the sample size was limited and the nature of the design was cross sectional. Thus, 100% certainty could not be inferred for the associations of T2DM and cognitive function. Second, the blood glycated hemoglobin, insulin, inflammatory markers and other were not measured due to lack of fund. Thirdly, brain scan was performed to see injury in the brain that might interfere with cognation as well.

Conclusion

In this study, the independent predictors of cognitive impairment among T2DM patients were age, occupation, FBG, and type of treatment options. Despite the higher proportion of substance use, no substance use related variables were significantly associated with cognitive impairment among T2DM patients. This study was carried out with the intension that it will offer information on cognitive impairment and associated factors among type 2 diabetes mellitus patients to concerned bodies in designing diagnosis and management strategies particularly focusing on counseling in preventing risk factors.

COMFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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