The prevalence of Cognitive Impairment in Patients with Type II Diabetes and its Relationship with Quality of Life, Self-Management Profiles, and HbA1c

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Abstract

Objective: Diabetes mellitus (DM) is a common metabolic. One of the unknown complications of DM is cognitive disorders. Different types of cognitive impairment caused by DM may affect the quality of life, self-management of diabetes, and glycosylated hemoglobin. This study aimed to determine the prevalence of cognitive impairment and its relationship with glycosylated hemoglobin (HbA1c), diabetes self-management, and quality of life among diabetic patients.

Materials and Methods: This cross-sectional study was performed on 350 patients with type II diabetes (T2DM) admitted to Shiraz University of Medical Sciences clinics for 7 months. All the participants completed the brief psychological, demographic, quality of life, and self- management profile questionnaires. Then, HbA1c levels were examined. The data were analyzed using the SPSS statistical software, version 16.

Results: According to the results, 40.3% of the patients had normal cognition, while 44.9% and 14.9% had mild and moderate cognitive impairment, respectively. Moreover, a significant relationship was found between the cognitive impairment score and HbA1c level, some aspects of quality of life, and self-management profile.

Conclusion: DM was associated with changes in cognition. Besides, cognitive impairment was associated with some domains of quality of life and self-management profile; as the cognitive impairment score increased, quality of life and self-management profile increased, as well. Also, a decreasing trend was observed in HbA1c levels in moderate to normal cognitive impairment states.

Keywords: Cognitive impairment, Type II diabetes, Quality of life, Self-management profiles, Hemoglobin A_1c

Introduction

Diabetes mellitus (DM) is a common metabolic disorder (1). According to World Health Organization (WHO), the prevalence of diabetes is more than 8% in Iran (2). DM is the cause of end-stage renal disease in the U.S. and the most common cause of vision loss, neuropathy, cardiovascular disease, and stroke. The disease can also cause primary and secondary conflicts in Central Nervous System (CNS), high levels

of performance, and cognitive processes. The primary effects of DM on CNS can occur by insulin damaged performance, hyperglycemia, or both. The secondary effects are caused by excessive insulin treatment of DM, vascular disorders, or brain damage caused by hypoglycemia attacks (3). One of the unknown complications of DM is cognitive impairment (1). Cognitive impairment is known as a set of neurological disorders can interfere directly or indirectly with cognitive function and executive function of the nervous system, causing confusion in consciousness about oneself and the world around. It can also lead to specific behavioral abnormalities, such a way that patients' personal and social lives are strongly affected. Cognitive impairment resulting from DM includes reduced speed of information processing, attention, memory, learning, problem solving, intelligence, vision, and mental flexibility (4-6). Sandeep and Dash conducted a study in 2008 to investigate the relationship between cognitive dysfunction and diabetic states. The results showed that both DM and Alzheimer's disease were growing in the world and these diseases would have a significant impact on the quality of life (7). Cognitive impairment may be considered as one of the causes of decreased quality of life in these patients. Other studies have also indicated DM and its complications could have a negative impact on general health, sense of well-being, and quality of life (8-10). Cognitive impairment may also affect patients' self-management. Self-management of DM and maintenance of glycemic control are highly essential for short- and long-term complications (5,11).

DM self-management, as an operational definition, is a set of behaviors conducted by DM patients to achieve control on a daily basis (12,13). Maintaining HbA1c within the normal range is one of the diabetes treatment goals (13). Since cognitive impairment must be diagnosed and has impacts on clinical symptoms, treatment, and outcomes in many medical and surgical disorders, having knowledge in this area is quite essential. The findings of this study can be considered as a basis for broader surveys. These findings can also be used to improve service planning and enhance diabetic patients' knowledge and ability. The study aimed to evaluate the prevalence of cognitive impairment in patients with T2DM admitted to clinics affiliated to Shiraz University of Medical Sciences.

Materials and Methods

This cross-sectional study was conducted on 350 patients to evaluate the prevalence of cognitive impairment in patients with T2DM admitted to clinics affiliated to Shiraz University of Medical Sciences. The inclusion criteria of the study were having at least primary school education, suffering from T2DM, aging 25-60 years, at least one year after diagnosis of diabetes, having no other known major diseases such as Alzheimer's, depression, schizophrenia, multiple sclerosis, and anxiety, and being willing to participate in the study. At first, the participants completed a demographic information questionnaire including gender, age, education, occupation, duration of the disease, and type of medication. Then, cognitive disorders questionnaire with reliability of 0.81 was used as a mini mental status examination, a measure known for cognitive impairment screening and documentation of cognitive changes that occur over time. It also aimed to assess the potential effects of treatment on cognitive functions. The maximum score of the questionnaire was 30, with scores 21-27, 10-20, and <9 indicating mild, moderate, and severe cognitive impairment, respectively. In addition, a 34-item quality of life questionnaire with reliability of 0.84 was utilized to assess quality of life in eight areas, including limitations in social life (job, travel) due to physical health (six items), physical endurance (six items), public health (three items), satisfaction with treatment (four items), signs of trouble (three items), economic concerns (four items), mental health (five items), and food tolerance (three items). Finally, self-management profile questionnaire

with reliability of 56.9-68.2% consisted of eight questions and twelve domains divided into four sections; i.e., patient's behavior, ease of patient's behavior, confidence in one's ability to manage diabetes, and weight management. Then, HbA1c test was done. After all, the data were analyzed using the SPSS statistical software, version 16.

Results

This study was conducted on 350 patients aged 25 to 60 years with the mean age of 52.16±8.11 years. The patients' demographic information has been presented in Table 1. The features associated with DM in the study sample have also been summarized in Table 2. According to the results, most of the subjects were female (77.4%) with the mean age of 52.16±8.11 years, were married (83.7%), had primary school education (57.7%), and their mean current weight was 68.95±11.61 kg.

The results showed that 7 patients (2%) of the subjects had a history of diabetic coma. Diabetes complications in patients with type II diabetes are 12.9% kidney failure, 31.7% hypertension, 3.1% insulin shock, 4.6% recurrent infections, 20.3% of heart problems, eye problems 44.6%, 56.3 neuropathy% and 25.7% had stomach and intestinal problems.

The results showed that 59.8% of the patients had moderate and mild cognitive impairment, while other patients had no cognitive impairment. These results suggested that 44.9% of the patients with DM had mild cognitive impairment. (Table 3)

The relationship between cognitive impairment, gender and income status was assessed using chi-square test. Besides, Fisher's exact test was used to examine the association between cognitive impairment and other demographic variables. (Table 4)

The results showed that the third and seventh domains of quality of life were significantly associated with cognitive disorders; as the cognitive impairment score increased, quality of life increased, as well. (Table 5)

Table 1. Descriptive data of the study subjects (N=350)

Variable		Number or mean	% (±SD)
Gender (N)	Male	271	77.4%
	Female	79	22.6%
Age (MEAN)		52.16	8.11
Current weight		68.59	11.61
Marital Status	Single	22	6.3%
	Married	293	83.7%
	Divorced	6	1.7%
	Widowed	29	8.3%
Employment status	Employee	26	7.4%
	Self-employed	32	9.1%
	Unemployed	8	2.3%
	Homemaker	236	67.4%
	Retired	45	12.9%
	Unable to work	3	0.9%
Place of residence	Urban	337	96.3%
	Rural	13	3.7%
Education level	Primary school	202	57.7%
	Diploma	120	34.3%
	Bachelor	24	6.9%
	Higher	4	1.1%
Monthly income	Over one million tomans	49	14.1%
	Less than one million tomans	301	85.9%

Table 2. The patients' frequency of cognitive impairment (mild, moderate, severe)

	Range	Status	Number	Percent
Cognitive impairment	0-9	Severe	0	0
	10-20	Moderate	52	14.9%
	21-26	Mild	157	44.9%
	27-30	Normal	141	40.3%

Table 3. The relationship between the patients' demographic variables and cognitive impairment

Cognitive impairment / Demographic variables		Moderate N=52	Mild N=157	Normal N=141	*P*-value
Mean (age)		(6.98) 52.17	53.23(7.51)	50.96 (8.97)	0.054
Sex	Male	9(17.3)	38 (2.24)	32 (22.7)	0.610
N (%)	Female	43(82.7)	119 (75.8)	109 (77.3)	
Marital Status	Single	2(3.8)	7(4.5)	13(9.2)	0.411
N (%)	Married	45(86.5)	131(83.4)	117(83)	
	Divorced	1(1.9)	2 (1.3)	3 (2.1)	
	Widowed	4(7.7)	1(10.8)	8(5.7)	
Employment status	Employee	3(5.8)	19(12.1)	4(2.8)	0.015
	Self-employed	4(7.7)	15 (9.6)	13(9.2)	
	Unemployed	0(0)	6(3.8)	2(1.4)	
	Homemaker	40(76.9)	102 (65)	94(66.7)	
	Retired	4(7.7)	14(8.9)	27(19.1.)	
	Unable to work	1(1.9)	1(1.6)	1(1.7)	
Education level	Primary school	44(84.6)	98(62.3)	60(42.6)	<.001
	Diploma	8(15.4)	49 (31.2)	63 (44.7)	
	Bachelor	0 (0)	9(5.7)	15 (10.6)	
	Higher	0 (0)	1(.6)	3 (2.1)	
Monthly income	Below one million tomans	44(84.6)	138(87.9)	117(84.2)	0.606
	Over one million tomans	8 (15.4)	19 (12.1)	24 (15.8)	

In this study, HbA1c levels ranged from 4.6% to 16.2%, with the mean level of 16.8 ±1.95. The results indicated a decreasing trend in HbA1C levels from moderate to normal cognitive impairment states.

According to Table 6, some domains of self-management profile were significantly related to cognitive impairment.

Discussion

The results of this study showed no significant relationship between age and cognitive impairment. However, education level and employment status were significantly associated with cognitive impairment (P<0.05). Katarya et al. conducted a similar study in India in 2013 to assess the prevalence of cognitive impairment among 104 patients with type II diabetes.

The results of that study showed no significant relationship between cognitive impairment and age, sex, marital status, and place of residence (urban or rural) (P>0.05). The present study findings also indicated that occupation and education level were significantly related to cognitive impairment (P<0.05).

However, the findings of the study Katarya et al. performed in India in 2013 revealed no significant relationship between age, sex, marital status, and place of residence (urban or rural) and cognitive impairment (P>0.05). That study also demonstrated that MMSE scores of 67 patients were above 24, indicating normal cognitive function. Besides, MMSE scores of 24 patients were between 21 and 24 that implied mild cognitive impairment and those of 13 patients were below 21 that indicated severe cognitive impairment. In the current study, 57.35% of the patients gained above 24 scores which meant cognitive impairment. The high prevalence of cognitive impairment in our study may be attributed to many participants' low education levels (57.7%) compared to other studies. Katarya and colleagues also stated that low education levels contributed to the high prevalence of cognitive impairment in their study.

Table 4. The correlation between quality of life and cognitive impairment

MMSE score	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain6	Domain7	Domain8
Pearson's correlation	.040	-.021	.127	-.019	.024-	.014	.159	.058
Sig. (2-tailed)	.453.	.690	.017	.717	.654	.796	.003	.279
N	350	350	350	350	350	350	350	350

Table 5. The relationship between the patients' cognitive states and HbA1c levels

Cognitive impairment	Moderate	Mild	Normal	*P*-value
HbA1C	8.81±2.43	8.19±1.70	7.93±2.01	0.043

Table 6. The correlation between the self-management profile dimensions and cognitive impairment

MMSE Score	q2	q34_sum	q 567_sum	q8a	q8b	q8c	q8EFD_sum	q8g	q8H	q12sum
Correlation coefficient	.216	.110	.169	.311	.173	.211	.167	.101	.090	.112
Sig. (2-tailed)	.000	.040	.001	.000	.001	.000	.002	.059	.092	.035
N	350	350	350	350	350	350	350	350	350	350

The results of the present study showed a significant relationship between the third and seventh domains of quality of life and cognitive disorders. Accordingly, as the cognitive impairment score increased, quality of life increased, as well. The results also revealed a significant correlation between the level of cognitive impairment and the patients' behavioral aspects, including blood glucose monitor domain (the second item of the questionnaire), healthy food (items three and four), physical activity (items five, six, and seven), and patient's ease of behavior [blood sugar monitor structure (item 8a), receiving medication as directed (item 8b), healthy food (items 8d, 8e, and 8f), and facilitating weight management (item 8c)]. As the cognitive impairment score increased, the levels of these dimensions increased, as well.

The correlation between HbA1c level and cognitive status has been presented in Table 6.

Conclusion

Accordingly, the results of ANOVA showed a significant relationship between the patients' HbA1C and cognitive status (*P*=0.43). Based on the results of post hoc Bonferroni test, this difference was between the mean score and the normal range (*P*=0.038); the results showed a decreasing trend in HbA1C levels from average cognitive impairment to normal conditions. The mean level of HbA1C was 8.81±2.43 in moderate cognitive impairment, 8.19±1.70 in mild cognitive impairment, and 7.93±2.01 in normal conditions.

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