Does social support affect development of cognitive dysfunction in individuals with diabetes mellitus?

Feride T. Yilmaz, RN, PhD, Selma Sabancıogullari, RN, PhD, Kadriye Aldemir, RN, MSc, Azime K. Kumsar, MSc, PhD.

ABSTRACT

الأهداف: لتحديد الوظائف المعرفية والدعم الاجتماعي (SS) بين الأفراد مع داء السكري (DM)، وآثار SS على تطورالخلل المعرفي (CD).

الطريقة: أجريت هذه الدراسة المستعرضة في 121 مريضاً بداء السكري في عيادة الغدد الصماء من جامعة جمهوريت الخدمات الصحية التطبيق ومستشفى البحوث وسيواس، تركيا بين أبريل ويونيو 2014م. جمعت البيانات باستخدام «نموذج تقييم المريض»، « اختبار الحالة العقلية المصغر الموحد (SMMSE)" و "المقياس المتعدد الأبعاد للدعم الاجتماعي المدرك (MSPSS)".

النتائج: كانت النتيجة المتحصل عليها من قبل مرضى DM من SMMSE 21.74 ± 5.66، ووجد لدى 65.3% منهم ضعف ادراكي. واعتبر المتوسط الكلى للمشاركين من MSPSS معتدل (66.61±14.42). كان هناك علاقة إيجابية ذات دلالة إحصائية بين الوظيفة المعرفية وSS (r=0.273، p=0.002). لوحظ أن لدى الأفراد مع CD مستويات منخفضة من SS، وأن الدعم الغير كاف من أزواجهم وأسرهم يؤثر على تطورهم CD (p=0.008).

الخاتمة: تم التوصل في هذه الدراسة إلى أنه يوجد اختلال في الوظائف المعرفية لدى الأفراد مع DM، وتتحسن حالتهم ويتطور إدراكهم كلما زاد الدعم الاجتماعي. لذلك بإمكان المهنيين الصحيين تحسين الوظائف الادراكية لدى الأفراد مع DM عن طريق تسهيل استخدام مصادر SS.

Objectives: To determine cognitive functions and perceived social support (SS) among individuals with diabetes mellitus (DM), and the effects of SS on the development of cognitive dysfunction (CD).

Methods: This cross-sectional study was conducted in 121 patients with DM presenting at the Endocrinology Clinic of Cumhuriyet University Health Services Application and Research Hospital, Sivas, Turkey between April and June 2014. Data were collected utilizing the "Patient Assessment Form", "Standardized Mini Mental State Examination (SMMSE)", and "Multidimensional Scale of Perceived Social Support (MSPSS)".

Results: The mean score obtained for DM patients from the SMMSE was 21.55±5.7, with 65.3% found to have cognitive impairment. The total mean score of the participants for MSPSS was considered moderate (66.61±14.42). There was a significant positive correlation between cognitive function and SS (r=0.273, p=0.002). It was determined that individuals with CD had low levels of perceived SS, and that insufficient support from families and significant others contributed to the development of CD (p=0.008).

Conclusion: In this study, it was determined that the cognitive function of individuals with DM was impaired and would improve as the perception of SS increased, and that perceived SS would affect the development of CD. Therefore, health professionals can contribute to the improvement of cognitive function of individuals with DM by facilitating the use of SS sources.

Saudi Med J 2015; Vol. 36 (12): 1425-1431
doi: 10.15537/smj.2015.12.12845

From the Departments of Internal Diseases Nursing (Yilmaz, Aldemir), Psychiatric Nursing (Sabancıogullari), School of Susehri Health High, Cumhuriyet University, Sivas, the Department of Internal Diseases Nursing (Kumsar), Faculty of Health Science, Biruni University, Istanbul, Turkey.

Received 5th July 2015. Accepted 11th October 2015.

Address correspondence and reprint request to: Dr. Feride T. Yilmaz, Department of Internal Diseases Nursing, School of Susehri Health High, Cumhuriyet University, Sivas, Turkey. E-mail: feride_taskin@hotmail.com

The prevalence of diabetes mellitus (DM), a major public health problem affecting people's quality of life - physically, mentally, socially, and economically,[1] is on the rise in Turkey and the whole world. While 8.4% of the adult population suffers from DM worldwide, this rate is approximately 15% in Turkey.[2] Diabetes mellitus leads to damage in a variety of tissues and organs over time. In the literature, DM is reported to impair cognitive functions due to damages it causes to the central nervous system.[3] Cognitive function can be impaired in individuals with DM due to abnormalities

in insulin secretion and glucose metabolism.[4,5] Good cognitive function in diabetic individuals is important, since it facilitates metabolic control and treatment management.[6] Therefore, early detection of cognitive impairment, and the implementation of effective treatment and coping methods will help people with DM to fulfill their professional and social activities, and thus, will facilitate management of the disease.[7] One of the factors that affect diabetic individuals' compliance with the treatment of DM and health outcomes is the perceived social support (SS). To manage the disease, an individual with DM needs the support of family and other individuals in the social environment, which he/she is in.[8] The literature states that adequate SS will help a person to change his/her negative health behaviors, to increase his/her effectiveness, and to gain more control over his/her emotional state.[9] The presence of SS in diabetic individuals affects their healthy eating habits' compliance with treatment,[8,10] and self-care processes specific to DM.[11,12] In addition, the presence of perceived SS may be particularly useful in coping with difficulties likely to occur due to treatment.[13] Cognitive dysfunction (CD) is a complication considered in the background in individuals with DM.[7] Social support facilitates adaptation to treatment, and thus, reduces the likelihood of the development of complications.[8,10] In the literature, there are studies investigating the effect of diabetic individuals' perception of SS on metabolic parameters[10,14] and other complications of DM.[15] This study was conducted to determine the cognitive function and perceived SS among individuals with DM, and the effect of SS on the development of CD. This study may help determine whether SS provided for individuals with DM has an effect on cognitive functions such as attention, registration, and recall. A higher perceived SS is thought to positively contribute to the regulation of blood glucose levels, and thus, to prevent the deterioration of cognitive function caused by DM.

Methods. This cross-sectional study comprised 172 patients treated for DM in the Endocrinology Clinic of Cumhuriyet University Health Services Application and Research Hospital, Sivas, Turkey between April and June 2014. A total of 121 patients diagnosed with DM for at least 6 months, literate, able to communicate, did not have a diagnosis of any psychiatric illness, and willing to complete the questionnaires were included in the study sample. The remaining 51 diabetic patients had major depression disorder, were taking psychoactive or depression medication (anticholinergics, narcotics, antidepressants, benzodiazepines or tranquilizers), unable to communicate verbally, and/or refused to participate in the study and were excluded.

Data collection tools. Data were collected utilizing the Patient Assessment Form, Standardized Mini Mental State Examination (SMMSE), and Multidimensional Scale of Perceived Social Support (MSPSS).

Patient assessment form. Socio-demographic and disease-related characteristics were evaluated with this form. The form prepared by the researchers included items on age, gender, marital status, educational status, occupation, type of DM, duration of the disease, and presence of other chronic diseases. The results of biochemical analysis of the patient, fasting (preprandial) blood glucose (FBG), and hemoglobin A1c (HbA1c) values were recorded. Two diabetes specialists, and 3 academicians were interviewed regarding the convenience of the questionnaire.

The SMMSE. The participants' cognitive functions were evaluated using the SMMSE. The Turkish validity and reliability study of the test was conducted by Güngen et al.[16] The maximum possible score to be obtained from the 11-item test, which has 5 domains (orientation, registration/memory, attention, recall, and language) was 30 points. According to the inter-rater reliability study of the test, r was 0.99, and the kappa value was 0.92.[16] In order to evaluate CD in individuals with DM, the scores obtained from the test were divided into 2 categories as in Tekin et al's[17] study; while the scores between 25 and 30 points indicated the absence of CD, the scores between 0 and 24 indicated the presence of CD. In this study, the Cronbach's alpha value of the test was 0.84.

The MSPSS. The MSPSS scale was adapted in Turkish by Eker et al[18] in 1995 consisting of 12 short items, which subjectively evaluate the adequacy of SS from 3 different sources. The 7-point Likert-type scale includes 3 subscales: each of which consists of 4 items: family, friends, and significant others. Each sub-scale's score is calculated by summing up the scores of 4 items in the sub-scale. The minimum of 12, and maximum of 84 possible scores could be obtained from the entire scale. The scale does not have a cut-off score. Higher scores indicate that the perceived support is high, whereas lower scores indicate either the support is not

Disclosure. Authors have no conflict of interest, and the work was not supported or funded by any drug company.

perceived, or the person does not receive any support. While the Cronbach's alpha reliability coefficient of the original scale was 0.85, it was 0.77 in our study.

Data collection. Data were collected using face-to-face interviews with DM patients, and carried out by the same person. Interviews were conducted in a separate interview room, such that the participants could answer questions comfortably.

Statistical analysis. Data were analyzed using the Statistical Package for Social Sciences version 14 (SPSS Inc., Chicago, IL, USA). Socio-demographic characteristics of the individuals with DM, and features of the disease were evaluated as means and percentages. To calculate the mean scores for the scales used to determine the participants' cognitive functions and perceptions of SS, means and standard deviation were used. To compare the cognitive function levels of individuals with the independent variables, student t test, Mann-Whitney U-test, one-way ANOVA, or Kruskal-Wallis test was used, considering whether the data distribution was normal or not. The relationship between SS and cognitive function was assessed using Pearson's correlation and linear regression analysis. Uni-directional ANOVA was used to compare the mean scores of SS according to whether there are CD in individuals, or not.

The study was approved by the Non-interventional Clinical Research Ethics Committee of the university. In addition, written permission was obtained from the institution where the study was conducted. Verbal and written informed consent was obtained from all study participants.

Results. The mean age of the participants was 57.2 ± 13.32 years. Most were female, married, primary school graduates, and housewives. A total of 14.9% of the participants were smokers, 7.4% used alcohol, 42.1% were obese, 34.7% had DM for more than 11 years, and 90.1% had type 2 DM. The participants' mean FBG level was 175.65 ± 80.91 mg/dL, mean HbA1c level was 10.78 ± 2.74, and 62% had one or more chronic diseases. Among these chronic diseases, the most common was hypertension (52.1%). According to the study sample, 36.4% of the participants took both oral antidiabetics and insulin, 78.5% took their medicine regularly, 43% paid attention to their diet, 20.7% exercised regularly, and 71.1% had no family history of Alzheimer's disease, or dementia. The mean subscale scores the participants obtained from the SMMSE and MSPSS are shown in **Table 1**. When the SMMSE total score was evaluated in the research (21.55 ± 5.72), CD was detected. According to the evaluation of the subscale scores of the SMMSE, 65.3% of the participants were found to have CD. Evaluation of the cognitive functions of the participants revealed that the most affected subscale of the SMMSE was attention (1.79 ± 1.94), while the least affected was orientation (8.87 ± 1.82). When the participants' perceived SS systems were evaluated, the highest and lowest scores were obtained from the family (24.04 ± 5.04) and friend subscales (19.17 ± 6.62). The comparison of the demographic and disease characteristics of the participants in terms of the mean scores for the SMMSE is shown in **Table 2**. From the study sample, those who were 56-75 years of age, female, literate but not graduated from any school, and/or housewives, had another chronic illness, or did not exercise regularly had low mean SMMSE scores. The relationship between the SMMSE and MSPSS is provided in **Table 3**. There is a significant positive relationship between the mean total scores obtained from the 2 scales (r=0.27; $p<0.01$, **Table 3**). A significant positive correlation (r ranging from 0.184-0.273) was determined between family support and orientation and language subscales ($p<0.05$), and between support from significant others and orientation, attention, recall and language subscales ($p<0.01$). This finding suggests that individuals with DM may have better cognitive function as their perceived SS increases. The results of the t test on the significance of regression coefficients, indicate that the MSPSS general dimensions variable is a significant precursor on SMMSE general score

Table 1 - Distribution of mean subscale scores among the diabetic participants.

Subscale scores	Mean ± SD	Minimum - Maximum	n (%)
SMMSE			
Orientation	8.87 ± 1.82	3.00 - 10.00	
Registration/memory	2.50 ± 0.92	0.00 - 3.00	
Attention	1.79 ± 1.94	0.00 - 5.00	
Recall	2.04 ±1.16	0.00 - 3.00	
Language	6.33 ± 2.19	1.00 - 9.00	
Total score	**21.55 ± 5.72**	**6.00 - 30.00**	
Grouping of SMMSE			
Cognitive dysfunction			
Yes, 0-24 score			79 (65.3)
No, ≥25 score			42 (34.7)
MSPSS			
Family	24.04 ± 5.04	4.00 - 28.00	
Friends	19.17 ± 6.62	4.00 -28.00	
Special person	23.39 ± 5.06	4.00 - 28.00	
Total score	**66.61 ± 14.42**	**14.00 - 84.00**	

SMMSE - Standardized Mini Mental State Examination, SD - standard deviation, MSPSS - Multidimensional Scale of Perceived Social Support

(R=0.273, R2=0.075, p=0.002). The comparison of the mean scores for SS according to whether the participants had CD or not is shown in **Table 4**. In accordance with the correlation analysis, the participants with CD were determined to have significantly lower SS mean scores than those without CD (p=0.008). It was also determined that support especially from family and significant others affected the development of CD in individuals with DM.

Table 2 - Comparison of the demographic and disease characteristics of diabetic participants in terms of the mean scores for SMMSE.

Variables	n (%)	SMMSE*	*P*- value
Age, years			0.011*
18-35	8 (6.6)	25.25 ± 4.97	
36-55	47 (38.8)	22.91 ± 4.55	
56-75	66 (54.5)	20.13 ± 6.17	
Gender			0.003†
Female	69 (57.0)	20.24 ± 5.81	
Male	52 (43.0)	23.28 ± 5.16	
Marital status			0.320
Single	14 (88.4)	22.78 ± 6.94	
Married	107 (11.6)	21.39 ± 5.56	
Educational status			0.000†
Literate	38 (31.4)	18.07 ± 5.15	
Primary school	57 (47.1)	22.07 ± 5.24	
Secondary school and higher	26 (21.5)	25.50 ± 4.64	
Occupation			0.001†
Housewife	61 (50.4)	19.59 ± 5.50	
Retired	25 (20.7)	24.00 ± 4.12	
Worker/Officer	22 (18.2)	22.07 ± 6-48	
Other chronic disease			0.001†
Free	13 (10.7)	23.90 ± 5.74	
Yes	75 (62.0)	20.17 ± 5.88	
No	46 (38.0)	23.80 ± 4.71	
Type of DM			0.071
Type 1	12 (9.9)	24.16 ± 6.11	
Type 2	109 (90.1)	21.26 ± 5.63	
Values of HbA1C, %			0.398
5.0-9.9	51 (42.1)	23.35 ± 5.71	
10.0-13.9	56 (46.3)	21.66 ± 4.72	
14.0 and higher	14 (11.6)	20.94 ± 6.66	
1-5	50 (41.3)	22.30 ± 5.70	
Duration of diabetes, years			0.266
6-10	29 (24.0)	21.93 ± 4.58	
>11	42 (34.7)	20.40 ± 6.37	
Treatment			0.186
Oral antidiabetic	37 (30.6)	20.59 ± 6.47	
İnsulin	40 (33.1)	22.87 ± 5.72	
Oral antidiabetic and insulin	44 (36.4)	21.15 ± 4.91	
Regular exercise			0.004†
Yes	25 (20.7)	23.24 ± 5.15	
Partly	47 (38.8)	22.89 ± 5.45	
No	49 (40.5)	19.40 ± 5.68	

SMMSE - Standardized Mini Mental State Examination, HbA1C - glycosylated hemoglobin. *p<0.05, †p<0.01

Discussion. Cognitive dysfunction is a serious complication that people with DM are most likely to have, however, it is not as well known as other chronic complications.[5,19] The study found that more than half of individuals with DM have symptoms of cognitive function disorder. Studies conducted recently have revealed that the prevalence of CD is on the increase in individuals with DM.[20-22] In studies that compared individuals with DM with those without DM, it was found that SMMSE test scores were lower,[23-25] and CD was 1.5 times more prevalent with DM group.[7,26] It is reported that people with DM develop CD due to complications of DM, such as hyperglycemia, or due to other diseases accompanying DM or caused by DM,[20,27] or age, or diabetes type.[28] In this study, it was supposed that CD in individuals with DM developed as a result a failure in the regulation of glucose resulting from the following factors: increased age; presence of another chronic disease; and not complying with proposed treatment options other than pharmacological treatments, such as regular exercise. For instance, in their 2-year follow-up study, Yamamoto et al[29] determined that lifestyle changes, such as joining an exercise program, or having medical nutrition therapy prevented the deterioration of cognitive functions. In their study, Mahakaeo et al[30] found an association between good glycemic control and less cognitive impairment. The results of these 2 studies indicate that effective disease management is of importance in controlling cognitive function.

In patients with DM, cognitive domains, such as memory, psychomotor speed, executive function, processing speed, and verbal fluency are especially adversely affected.[5,6] In this study, it was determined that of the cognitive domains, the most adversely affected one was attention. In a meta-analysis involving individuals in the adult group, from the cognitive domains, attention, perception, psychomotor speed, cognitive flexibility, and visual perception were affected significantly more in individuals with DM compared with healthy individuals.[31] In another study performed in patients with DM,[32,33] it was emphasized that learning, memory, mental clarity, and perception domains were affected. If domains, such as perception of attention, recall, language, and registration are adversely affected in people with DM, this may prevent those people from complying with the treatment, or may accelerate the development, or severity of complications related to DM. Therefore, it seems to be important that health professionals should regularly evaluate cognitive functions in individuals with DM, and that they should

Table 3 - Relationship between the Standardized Mini Mental State Examination (SMMSE) and Multidimensional Scale of Perceived Social Support (MSPSS).

Scales	1	2	3	4	5	6	7	8	9	10
SMMSE	-									
Orientation	0.68†	-								
Registration/memory	0.44†	0.34†	-							
Attention	0.75†	0.28†	0.10	-						
Recall	0.61†	0.27†	0.38†	0.27†	-					
Language	0.85†	0.42†	0.15	0.64†	0.45†	-				
MSPSS	0.27†	0.24†	0.05	0.15	0.21†	0.23*	-			
Family	0.26†	0.24†	0.07	0.16	0.13	0.24†	0.86†	-		
Friends	0.18*	0.17	0.00	0.07	0.22*	0.14	0.81†	0.44†	-	
A special person	0.27†	0.21*	0.07	0.18*	0.19*	0.23†	0.92†	0.88†	0.57†	-

*p<0.05, †p<0.01. 1 - Total score of SMMSE, 2 - Orientation, 3 - Registration/memory, 4 - Attention, 5 - Recall, 6 - Language, 7 - Total score of MSPSS, 8 - Family, 9 - Friends, 10 - A special person

Table 4 - Relationship between perceived social support and cognitive dysfunction in individuals with diabetes mellitus.

Characteristics	Cognitive dysfunction		*P*-value
	Yes	No	
MSPSS	n=79 (65.3%)	n=42 (34.7%)	
Family	23.24 ± 5.69	25.54 ± 3.05	0.016*
Friends	18.39 ± 6.86	20.64 ± 5.97	0.075
A special person	22.45 ± 5.56	25.16 ± 3.33	0.005†
Total	**64.08 ± 15.79**	**71.35 ± 9.95**	**0.008†**

MSPSS - Multidimensional Scale of Perceived Social Support.
*p<0.05, †p<0.01

encourage patients to comply with treatment in order to prevent complications from developing.

One of the factors affecting compliance with the treatment and health outcomes in individuals with DM is the perceived SS.[8] In the study, it was determined that the level of perceived SS among the participants was good, and most of the SS was provided by families. Data obtained from the study revealed that although the level of family support was high in the participants, their FBG and HbA1c levels were not at the desired level. In studies however, it has been reported that family support, including guidance provided by the family to manage DM has a positive effect on patients' improving behavior to comply with the treatment,[34,35] and achieving good glycemic control.[15,36] This findings of the study suggest that patients had trouble using available SS effectively. Therefore, health professionals should raise both patient's and families' awareness of disease management, and include them in the treatment process by encouraging them to cooperate with the health care team.

The relationship between SS and disease management and prevention of DM-related complications is an issue that has been investigated recently.[8] In our study, it was found that the perception of SS affected all domains of cognitive function, and that cognitive functions are better as the perception of SS increased. The support from the family and significant others was determined to affect the development of CD. The contribution of SS systems to disease management and compliance with the disease in patients with DM is high. With a good level of perceived SS, desirable behavioral and lifestyle changes, including eating habits can be achieved in people with DM. Thus, risk factors leading to CD, a less known complication of DM compared with other complications of DM, can be controlled. Therefore, the presence of SS and effective use of this support can be considered an important issue for the preservation of cognitive function in diabetic individuals.

Study limitation. It is inevitable that the results are subjective since perceptions of SS and cognitive function of individuals with diabetes are evaluated with scale results. "It is suggested that in further studies, this study should be repeated with a larger sample group."

In conclusion, this study investigating the effects of SS on the cognitive function of individuals with DM revealed that the participants were not complement with diabetes management, and more than half had CD. It was determined that the level of perceived SS was moderate, and that while families provided most of the SS, friends provided the least. It was also determined that cognitive function improved as the perception of SS increased, and that inadequate support from families and significant others contributed to the

development of CD. On the other hand, although the level of perception of SS in this study was good, the SS available was not effectively used in the management of the disease. In line with these findings, health professionals are recommended to determine individualistic risk factors that can affect the cognitive function of individuals with DM, to routinely evaluate the cognitive function of diabetic patients, to carefully follow especially those who are female, elderly, with low levels of education, have another chronic diseases, or do not exercise regularly in terms of CD, to include patients' families and significant others in the treatment team from the day the patients were diagnosed with DM, and to arrange individual training programs for families.

References

1. International Diabetes Federation. The Diabetes Atlas. 6th ed. Brussels (Belgium): International Diabetes Federation; 2013. Available from: http://www.idf.org/diabetesatlas
2. Mustapha W, Hossain ZS, O'Loughlin K. Management and impact of diabetes on quality of life among the Lebanese community of Sydney: A quantitative study. ***J Diabetes Metab*** 2014; 5: 329-338.
3. Alvarez EO, Beauquis J, Revsin Y, Banzan AM, Roig P, De Nicola AF, et al. Cognitive dysfunction and hippocampal changes in experimental type 1 diabetes. ***Behav Brain Res*** 2009; 198: 224-230.
4. Kawamura T, Umemura T, Hotta N. Cognitive impairment in diabetic patients: Can diabetic control prevent cognitive decline? ***J Diabetes Investig*** 2012; 3: 413-423.
5. Kodl CT, Seaquist ER. Cognitive dysfunction and diabetes mellitus. ***Endocr Rev*** 2008; 29: 494-511.
6. Pasquier F. Diabetes and cognitive impairment: how to evaluate the cognitive status? ***Diabetes Metab*** 2010; 36 Suppl 3: S100-S105.
7. Taskin Yilmaz F, Karakoc Kumsar A, Olgun N. Cognitive dysfunction in individuals with diabetes. ***Diabetes, Obesity and Hypertension Nursing Forum*** 2013; 5: 12-20.
8. Miller TA, DiMatteo MR. Importance of family/social support and impact on adherence to diabetic therapy. ***Diabetes Metab Syndr Obes*** 2013; 6: 421-426.
9. Barker G. Adolescents, social support and help-seeking behaviour. WHO Library Cataloguing-in-Publication 2007. Geneva (CH): World Health Organization; 2007. Available from: http://www.popline.org/node/197567
10. Gomes-Villas Boas LC, Foss MC, Freitas MC, Pace AE. Relationship among social support, treatment adherence and metabolic control of diabetes mellitus patients. ***Rev Lat Am Enfermagem*** 2012; 20: 52-58. English, Portuguese, Spanish
11. Klomegah RY. The social side of diabetes: The influence of social support on the dietary regimen of people with diabetes. ***Sociation Today*** 2006; 4: 104-108.
12. Rad GS, Bakht LA, Feizi A, Mohebi S. Importance of social support in diabetes care. ***J Educ Health Promot*** 2013; 30: 62.
13. Bal Yılmaz H, Taş F, Yavuz B, Erol H. Determining social support levels of adolescents with diabetes type 1. ***Dirim Medical Gazette*** 2011; 86:13-19.
14. Chew BH, Khoo EM, Chia YC. Social support and glycemic control in adult patients with type 2 diabetes mellitus. ***Asia Pac J Public Health*** 2015; 27: 166-173.
15. Galhardo Figueira AL, Boas LC, de Freitas MC, Foss MC, Pace AE. Perception of social support by individuals with diabetes mellitus and foot ulcers. ***Acta Paul Enferm*** 2012; 25: 20-26.
16. Gungen C, Ertan T, Eker E, Yasar R, Engin F. [Reliability and validity of the standardized Mini Mental State Examination in the diagnosis of mild dementia in Turkish population] ***Turk Psikiyatri Derg*** 2002; 13: 273-281. Turkish
17. Tekin O, Çukur S, Karadağ R, Tunca A, Göktaş O, Özkara A, et al. Cognitive impairment among type-2 diabetic subjects and its relationship with long-term complications. ***Turkish Journal of Medical Sciences*** 2009; 39: 661-669.
18. Eker D, Arkar H, Yaldiz H. Factorial structure, validity, and reliability of the Multidimensional Scale of Perceived Social Support. ***Turkish Journal of Psychology*** 1995; 34: 45-55.
19. Mehrabian S, Raycheva M, Gateva A, Todorova G, Angelova P, Traykova M, et al. Cognitive dysfunction profile and arterial stiffness in type 2 diabetes. ***J Neurol Sci*** 2012; 322: 152-156.
20. Wessels AM, Lane KA, Gao S, Hall KS, Unverzagt FW, Hendrie HC. Diabetes and cognitive decline in elderly African Americans: A 15-year follow-up study. ***Alzheimers Dement*** 2011; 7: 418-424.
21. Hazari MAH, Reddy BR, Uzma N, Kumar BS. Cognitive impairment in type 2 diabetes mellitus. ***International Journal of Diabetes Mellitus*** 2015; 3: 19-24.
22. Allen KV, Frier BM, Strachan M. The relationship between type 2 diabetes and cognitive dysfunction: Longitudinal studies and their methodological limitations. ***Eur J Pharmacol*** 2004; 490: 169-175.
23. Ebady SA, Arami MA, Shafigh MH. Investigation on the relationship between diabetes mellitus type 2 and cognitive impairment. ***Diabetes Res Clin Pract*** 2008; 82: 305-309.
24. Watari K, Letamendi A, Elderkin-Thompson V, Haroon E, Miller J, Darwin C, et al. Cognitive function in adults with type 2 diabetes and major depression. ***Arch Clin Neuropsychol*** 2006; 21: 787-796.
25. Mogi N, Umegaki H, Hattori A, Maeda N, Miura H, Kuzuya M, et al. Cognitive function in Japanese elderly with type 2 diabetes mellitus. ***J Diabetes Complications*** 2004; 18: 42-46.
26. Szeman B, Nagy G, Varga T, Veres-Székely A, Sasvári M, Fitala D, et al. Changes in cognitive function in patients with diabetes mellitus. ***Orv Hetil*** 2012; 153: 323-329. Hungarian
27. McCrimmon RJ, Ryan CM, Frier BM. Diabetes and cognitive dysfunction. ***Lancet*** 2012; 16: 2291-2299.
28. Biessels GJ, Kerssen A, de Haan E, Kappelle LJ. Cognitive dysfunction and diabetes: implications for primary care. ***Prim Care Diabetes*** 2007; 1: 187-193.
29. Yamamoto N, Yamanaka G, Takasugi E, Ishikawa M, Yamanaka T, Murakami S, et al. Lifestyle intervention reversed cognitive function in aged people with diabetes mellitus: two-year follow up. ***Diabetes Res Clin Pract*** 2009; 85: 343-346.
30. Mahakaeo S, Zeimer H, Woodward M. Relationship between glycemic control and cognitive function in patients with type 2 diabetes in a hospital aged care unit. ***European Geriatric Medicine*** 2011; 2: 204-207.
31. Brands AM, Biessels GJ, de Haan EH, Kappelle LJ, Kessels RP. The effects of type 1 diabetes on cognitive performance: a meta-analysis. ***Diabetes Care*** 2005; 28: 726-735.
32. Ruis C, Biessels GJ, Gorter KJ, van den Donk M, Kappelle LJ, Rutten GE. Cognition in the early stage of type 2 diabetes. ***Diabetes Care*** 2009; 32: 1261-1265.

33. van den Berg E, Reijmer YD, de Bresser J, Kessels RP, Kappelle LJ, Biessels GJ. A 4 year follow-up study of cognitive functioning in patients with type 2 diabetes mellitus. ***Diabetologia*** 2010; 53: 58-65.
34. Rintala TM, Jaatinen P, Paavilainen E, Astedt-Kurki P. Interrelation between adult persons with diabetes and their family: A systematic review of the literature. ***J Fam Nurs*** 2013; 19: 3-21.
35. Nicklett E, Liang J. Diabetes-related support, regimen adherence, and health decline among older adults. ***J Gerontol B Psychol Sci Soc Sci*** 2010; 65: 390-399.
36. Pereira M, Berg-Cross L, Almeida P, Machado J. Impact of family environment and support on adherence, metabolic control, and quality of life in adolescents with diabetes. ***Int J Behav Med*** 2008; 15: 187-193.

Related Articles

Kara G, Cifcibasi E, Karsidag K, Cintan S. Short term effects of periodontal therapy on inflammatory markers in patients with type-2 diabetes. ***Saudi Med J*** 2015; 36: 469-476.

Al-Hayek AA, Robert AA, Braham RB, Turki AS, Al-Sabaan FS. Frequency and associated risk factors of recurrent diabetic ketoacidosis among Saudi adolescents with type 1 diabetes mellitus. ***Saudi Med J*** 2015; 36: 216-220.

Al-Agha AE, Alafif MM, Abd-Elhameed IA. Glycemic control, complications, and associated autoimmune diseases in children and adolescents with type 1 diabetes in Jeddah, Saudi Arabia. ***Saudi Med J*** 2015; 36: 26-31.