

The Mediating Role of Resilience and Diabetes Distress in Relationship between Depression and Treatment Adherence in Type 2 Diabetes among Iranian Patients

Masoumeh Rahimi ¹ , Mahsa Jalali ^{2*} , Robabeh Nouri ¹, Mojgan Rahimi ³

1. Department of Clinical Psychology, Faculty of Educational Sciences & Psychology, Kharazmi University, Tehran, Iran
2. Department of Psychology, Faculty of Educational Sciences & Psychology, Islamic Azad University, Buin zahra Branch, Karaj, Iran
3. Internal medicine specialist, Isfahan University of Medical Sciences, Isfahan, Iran

ARTICLE INFO

Original Article

Received: 22 April 2020

Accepted: 23 Jun 2020



Corresponding Author:

Mahsa Jalali

mahsajalali021@gmail.com

ABSTRACT

Introduction: The coexistence of mental health problems in diabetic patients can lead to poor disease management. This study aimed at investigating the mediating role of resilience and diabetes distress in the relationship between depression and treatment adherence in type 2 diabetes among Iranian patients.

Methods: It is a type of analytical study conducted from 2019 to 2020. The statistical population of this study consisted of all-diabetic patients in Tehran. The subjects (200) were selected after purposeful clinical evaluation and qualification of research. In this study, Beck Depression Inventory (BDI), the Persian Version of the Morisky Medication Adherence Scale-8, Diabetes Distress Scale (DDS), Conner & Davison Resilience Scale (CDRS) were used to collect the data. Pearson correlation test by SPSS version 24 and Confirmatory Factor Analysis in AMOS software version 22 were used for analysis ($P < 0.05$).

Results: In the present study, most participants (about 36.5%) were in the age group of 56-65 and 58.5% of them were female. According to the results, the variables of depression and diabetes distress has a negative and significant correlation with adherence to treatment ($r = -.408, p < 0.05$). The resiliency has a positive and significant correlation with adherence to treatment ($r = 0.414, p < 0.05$).

Conclusion: The findings showed a link between depression, diabetes distress, resilience, and treatment adherence. Resilience and anxiety from diabetes play a mediating role between depression and adherence to care. Paying attention to patient resilience may lead to improved depression and diabetes distress in patients with diabetes, to increase the patient's involvement in treatment adherence.

Keywords: Depression, Treatment adherence, Resiliency, Diabetes distress

How to cite this paper:

Rahimi M, Jalali M, Nouri R, Rahimi M. The Mediating Role of Resilience and Diabetes Distress in Relationship between Depression and Treatment Adherence in Type 2 Diabetes among Iranian Patients. J Community Health Research. 2020; 9(2): 107-118.

Copyright: ©2020 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Introduction

According to a national survey, about 592 million people worldwide will be affected by diabetes mellitus by 2035 (1). About 90% of patients with diabetes have type 2 diabetes (T2DM). A bidirectional link between T2DM and depression has recently been recognized. Depression was associated with a 60% increased risk of T2DM according to a meta-analysis report (2). Globally, depression is the second leading cause of disability, and it has been documented that patients with diabetes are more likely to develop depression than people with no diabetes (3). In previous research, the coexistence of psychiatric illnesses such as depression was estimated to be substantially more prevalent in people with T2DM than in the general population with a prevalence ranging from 15 to 24% and an incidence rate of depression in the first year following the initiation of 12, 61 oral anti-diabetic treatment per 1000 people in a year (4,5).

Patients with T2D are frequently treated with various drug regimens including oral drugs and/or exogenous insulin (6). Drug adherence refers to the degree to which patients are following health care providers' medication prescriptions (7). Diabetic patients are at risk of developing hyperglycemia, especially those treated with insulin (8). Hemoglobin A1c (A1C) reduction is a primary indicator of diabetes glycemic regulation (9). Glycemic regulation, which is key to preventing complications, includes strict dietary adherence, sufficient physical activity, and anti-diabetic drugs (10). A systematic review, covering 27 studies, found that adherence to anti-diabetic medications could be as less as 38.5% (11). A recent study showed a 72.4% overall adherence to anti-diabetics in older people (12). Besides, Spanish older patients receiving oral anti-diabetics reported discontinuation rates of 46.8 percent for oral anti-diabetics (13).

Adherence to treatment has been demonstrated to reduce morbidity and mortality while improving glycemic control among those suffering from diabetes. For instance, depression is associated with impaired glucose control, physical impairment, complications of the end-organ, and mortality, when

depression itself is associated with lower rates of adherence to treatment (14). A meta-analysis of 47 independent studies exploring the association between depression and carelessness in people with type 1 or type 2 diabetes found that depression was substantially correlated with non-adherence to the diabetes treatment regimen (4). Findings indicated that individuals with higher depressive symptoms have lower adherence and glycemic control and those with lower depressive symptoms showed that elevated depressive symptoms are correlated with lower adherence. It illustrates the significance of monitoring and tracking depressive symptoms throughout a life-change (15).

Health researchers have recently realized possible associations of high significance between resilience with mental and physical illnesses (16). Resilience refers to the dynamic process of constructive adaptation to negative life experiences, which results in compromising when coping with stressful situations. (17). Studies revealed a close link between low resilience rates and diabetes growth. People gain the capacity to deal effectively with the pressures of family and social life through the resilience process (18).

Research has also shown that resilience has an absolute positive effect on all aspects of diabetic patients' quality of life (19). Positive psychological characteristics in patients acquired T2D were correlated with superior outcomes. Better health, for example, is associated with better control of glucose. Additionally, lower levels of hemoglobin A1C were correlated with resilience, and such resilience was shown to counteract the impact of psychological distress on blood sugar. Eventually, the positive effect of resilience was linked to lower mortality among T2D patients prospectively and independently (14).

It is recognized that psychological health, which was linked to type 2 diabetes mellitus (T2DM), deserves more attention (20). Sources of psychological problems could arise from complex medical treatment regimens, concerns about hypoglycemia and diabetes complications, and unfavorable living environments for adhering to

medical advice (21). Living with diabetes can be difficult due to facing a complex, challenges, and often frustrating set of self-care instructions which will make patients irritated, angry, exhausted, and/or disheartened (22). Nonetheless, recent findings have indicated that high levels of diabetes-specific anxiety rather than depression may account for many published results. For instance, diabetes-specific anxiety in a study of 506 patients with type 2 diabetes showed the same results (23). Diabetes distress (DD), described, as the collective emotional and cognitive stresses caused by daily diabetes management, can be a factor that prevents people with diabetes from achieving optimal glycemic control (24).

Psychological distress and diabetes-specific distress, identified as negative emotional responses to the pressure, concerns, doubts, and fears of diabetes diagnosis (25), have been shown to affect patient outcomes (26). Patients with diabetes frequently feel overwhelmed by the everyday demands of the disease, and are 'burned out'. Researchers note that distress caused by diabetes-related issues leads to lower motivation, better self-care, higher blood glucose levels, increased risk of complications and poor quality of life. Researchers found that diabetes-related distress is more closely linked to self-care and glycemic control comparing to depression (23). Diabetes-related distress is characterized as an emotional response in patients with diabetes to a challenging state of health and should not be confused with clinical depression (27). It has been shown that psychological factors such as diabetes-related emotional distress are associated with lower dietary adherence, exercise, regular blood glucose monitoring, and drug regimens (28).

Diabetes literature has revealed that different factors can affect diabetes self-care practices, adherence to medication, resilience, and diabetes distress on an individual basis. However, except for diabetes distress, most of the previous studies still have to test a model regarding the multiple associations among these variables. As stated above, the purpose of this study is to examine a structural model that links depression and adherence to

treatment by mediating the role of resilience and diabetes distress among patients with diabetes type 2.

Methods

It is a type of analytical cross sectional study conducted from 2019 to 2020. This study adopted a purposeful sampling design in engaging patients with diabetes type 2 from several clinics in district 3 of Tehran. Inclusion requirements included qualified participants among men and women whose diabetes had been controlled for at least one year, and who were able to understand the questionnaires, not suffering from diagnosable mental illness, and psychiatric/psychological problems that could impair their judgment. To complete the questionnaires, all participants should give written consent in their preferred language while waiting for a medical appointment with the doctor at the clinic. The participants included 200 (83 male, 117 female) patients. For sample size calculation of unknown population size, we used the following formula: $n = z^2 \cdot [p \cdot q] / d^2$, which is used to calculate the sample size of a qualitative variable in prevalence or cross-sectional studies. Participants were sampled consecutively as they arrived at the clinics in 2019 over 4 months. Trained research assistants interviewed participants who refused to conduct the questionnaires themselves. Questionnaires were completed following the planned clarification of the study objectives and the consent of the participants which took approximately 30 to 45 minutes to complete the explanations provided in the questions. To comply with the Helsinki Code of Ethics, it was allowed for the patients to leave the research at any time whenever they felt tired. Besides, no private detailed questions were asked. Given the possibility of having any dropouts in the study and/or improper completion of some questionnaires, a sample group was chosen among 250 individuals including a sample size of 200 patients (29). The study was ethically approved under the code number Azad university of Karaj IR. AUK.REC.1398.99 and informed consent were obtained from each subject. The SPSS software (ver. 20.0) and AMOS (ver.

22.0) used the Pearson correlation coefficient test to perform statistical analysis. Researchers used various metrics of goodness-of-fit to test a model based on model compatibility. Some common fit indices used are the Normed Fit Index (NFI), the Non-Normed Fit Index (NNFI), the Incremental Fit Index (IFI), the Comparative Fit Index (CFI), and the Root Mean Square Approximation Error (RMSEA), respectively. CFI and NFI are indicators calculating the goodness of fit model in the independent model which implies that there is no relationship between the data and 1 and 0.96 in the model are identical. These measurements also represent the goodness of fit of the model values of 0.90 and above which are considered as correct. Descriptive indices were used to define data like mean and its standard deviation. Sobel's (29) test was used to investigate the mediating effect of resiliency and diabetes distress on the relationship between depression and adherence to treatment ($P < 0.05$). For the normality of the multivariate distribution, structural equation modeling was used. To achieving this purpose, the AMOS software used Mean, SD, Skewness, and the multivariable Kurtosis coefficient of Mardia. Sobel's (29) test was used to investigate the mediating effect of resiliency and diabetes distress on the relationship between depression and adherence to treatment. One method used to measure the significant effect of the variable mediated effect of Sobel's (29) test is to directly measure the significance of the relative to the normal distribution of Z using the standard error of the mediator variable. Thus, after dividing the result by multiplying the two non-standard coefficients that constitute the intermediate variable paths by the standard error of the product, the ratio obtained is compared with the normal distribution table. If the ratio is greater than 1.96, the mediating variable effect is significant. To apply the Sobel method to determine this relationship, the following equation must be calculated:

$$z\text{-value} = a*b/\text{SQRT}(b2*sa2 + a2*sb2 + sa2*sb2)$$

Sobel (29) believes that this ratio is asymptotically normal, and when the ratio is

greater than 1.96, for large samples, it leads to a null hypothesis of 0 at 0.05 level.

Research Tool

Clinical and sociodemographic characteristics

Patients provided information about gender, age, employment status, education, treatment status. A chart review was conducted to obtain diabetes duration, insulin delivery regimen, and prescreening eligibility criteria.

Beck Depression Inventory (BDI)

The BDI is one of the most widely used self-report studies on depression. It was established as a predictor of depressive symptomatology and severity. To achieve this research goal, the short-form version of the BDI was used. The scale contains 13 items each containing four self-statements. Point ratings are graded from 0 to 3 with higher scores indicating more extreme symptomatology. Total ratings vary from 0 and 39. Individuals were told to accept the claims that have been valid to them over the past week. For statements more reflective of depression, higher point values are issued. This scale was shown to be accurate with a **Cronbach's** alpha of .86 (30). In Iran, it has been used with good validity and reliability (31). The reliability coefficient for the full scale was calculated at 0.81 in the current analysis.

The Morisky Medication Adherence Scale-8

The MMAS-8 is a standardized test of drug-taking actions developed by Morisky et al. (32). This self-reported medication-taking measure was established from a four-item scale which was previously validated. The scale is a one-dimensional scale according to Morisky et al. (33). The Morisky Medicine Adherence Scale contains seven questions with a yes/no response format and one question with a 5-point Likert answer. For items 1 to 7, the answer options are "Yes" or "No". Question No. 8 is a question of the Likert-type and the overall score is 0 to 8. Scores lower than six indicate low adherence, scores between 6 and < 8 indicate moderate adherence, and score equal to 8 indicates high adherence. Additionally, internal consistency was acceptable with the coefficient of 0.697 for a Cronbach overall. In Iranian hypertensive patients,

the Persian version of the MMAS had acceptable reliability and validity. This scale can be used in future studies as a normal and effective method for assessing the medication adherence of Persian-speaking patients with chronic conditions (34). In the sample from the present analysis, the reliability coefficient for the whole scale was estimated to be 0.77.

Conner & Davison Resilience Scale (CDRS):

The questionnaire has 25 items on a 5-point scale. In this questionnaire, the maximum score is 100 and the minimum score is zero. Each test score is equal to the sum of the scores of each question. Conner and Davidson (35) reported the test-retest reliability of this questionnaire on 24 patients with GAD and PTSD of 0.87. The convergent validity of this questionnaire was performed on 30 psychiatric patients using the Kobasa Hardiness Questionnaire and the results showed that the Resiliency Questionnaire with the Kobasa Hardiness Questionnaire was 0.83 which is correlated, but with perceived stress of -0.76. It indicates that high levels of resiliency are associated with low experienced stress (35). In general, the results show the desirability and validity of the resiliency questionnaire. Jowkar et al. (36) have standardized the resiliency questionnaire in Iran and

the results showed that the questionnaire has a Cronbach's alpha of 0.89. The reliability coefficient for the entire scale was updated in the current research model into a calculated 0.79.

Diabetes Distress Scale (DDS): DDS is a seventeen-item scale that addresses four critical dimensions of distress: emotional burden, distress, interpersonal distress, and physical distress, which first announced in 2005. This is considered as a clinical tool for initiating conversations with patients as well as an important inference criterion in numerous studies (37). Each item was measured on a Likert scale of 1 to 6. DDS allows the measurement of the total distress or individual range which is mostly classified as distress. It is genuinely translated into English, and this translation was validated (38). The reliability coefficient for the whole scale has been determined as 0.80 in the pattern of the current research.

Results

Of the 200 participants, 41.5% (83) were male, with the highest prevalence of roughly 36.5% (73) between the age range of 56 to 65 years and the lowest among 4.5% (9) of those aged 25 to 35 years. 72.5% (145) were unemployed. More than 50% (142) of people were literate and the majority 61% (121) used the pill for treatment (Table 1).

Table 1. Frequency distribution of the studied sample by demographic variables

Variables	Variable levels	Frequency	Percent
Gender	Male	83	41.5
	Female	117	58.5
Age	25 to 35 years old	9	4.5
	36 to 45 years old	38	19.0
	46 to 55 years old	53	26.5
	56 to 65 years old	73	36.5
	Older than 65 years	27	13.5
Employment status	Employed	55	27.5
	Unemployed	145	72.5
Education	Illiterate	58	29.0
	Under diploma	91	45.5
	Diploma	34	17.0
	Advanced diploma	8	4.0
	Bachelor degree	9	4.5
Treatment status	Tablets	121	61
	Insulin	42	21.0
	Tablets and insulin	36	18.0

Descriptive statistics of the research variables and the central indices including mean, standard

deviation, Kurtosis, and skewness are summarized in Table1.

Table 2. Descriptive statistics of the variables used in the study

Variable	N	Mean	SD	Skewness	Kurtosis
Depression	200	25.92	9.32	0.63	0.75
Resiliency	200	51.30	15.97	0.32	-0.23
Diabetes distress	200	57.75	17.40	-0.03	-0.47
Adherence to treatment	200	58.49	11.00	0.77	0.90

This section seeks to answer the main research hypothesis that "Is there a mediating role of resiliency and diabetes distress in the relationship between depression and adherence to treatment among type 2 diabetic patients?" Structural equation modeling has used.

One of the assumptions of structural equation modeling is the normality of the multivariate distribution. For this purpose, the AMOS software

uses the multivariable Kurtosis coefficient of Mardia. The value of the Mardia coefficient for the present study is 3.18, indicating that the assumption of multivariate normality is accepted.

Since path analysis is based on a linear correlation between variables, the linear correlation matrix among research variables is reported in this section.

Table 3. Pearson Correlation matrix between variables

Variables	Depression	Resiliency	Diabetes distress	Adherence to Treatment
Depression	1			
Resiliency	-0.473**	1		
Diabetes distress	0.411**	-0.242**	1	
Adherence to Treatment	-0.155*	0.414**	-.408**	1

**p<0.01, *p<0.05

According to the correlation matrix, the variables of depression and diabetes distress have a negative and significant correlation with adherence to treatment (p<0.05). The Resiliency has a positive and significant correlation with adherence to treatment (p<0.05) (Tabe3).

The conceptual model of the research is presented in two states including standardized and non-standardized coefficients.

The most important indicators for fitting the conceptual model of research are reported in Table 3.

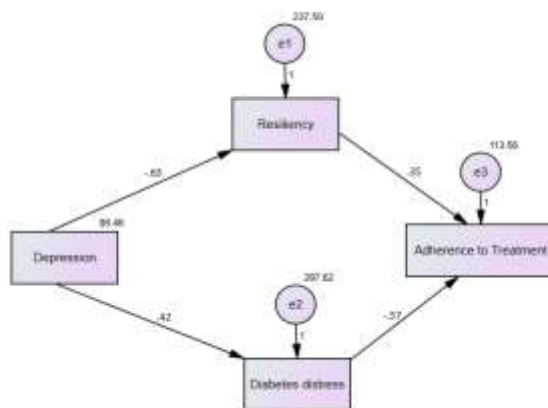


Figure 1. None-standardized coefficient model

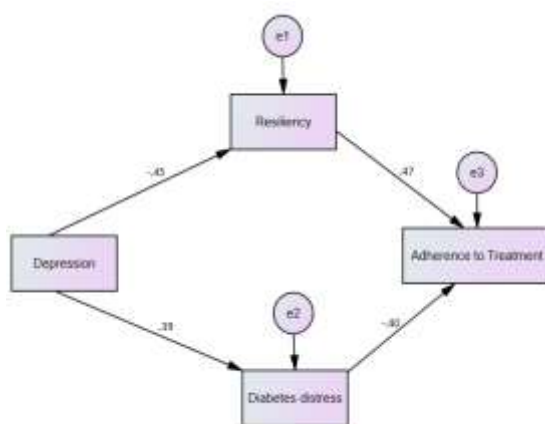


Figure 2. Standardized coefficient model

Table 4. Model fit indicators

Indicator	Value	allowable Limitation	Ideal Limitation
$(\chi^2)/df$	0.75	Less than 5	Less than 3
RMSEA (Root Mean Square Error Approximation)	0.02	Less than 0.1	Less than 0.05
CFI (Comparative Fit Index)	0.95	Above 0.9	Above 0.95
NFI (Normed Fit Index)	0.93	Above 0.9	Above 0.95
GFI (Goodness of Fit Index)	0.96	Above 0.9	Above 0.95
AGFI (Adjusted Goodness of Fit Index)	0.94	Above 0.9	Above 0.95

Based on the results, it can be concluded that the model has a goodness of fit. Since the paths between variables are the same as the research

hypothesis in the model described above, the indirect effect of the research hypothesis is checked.

Table 5. The Sobel test results for the effect of Resiliency and Diabetes distress variables between the Depression and Adherence to Treatment

hypothesis	None-standardized coefficient	β coefficient	Sobel test	Sig	Hypothesis
Depression → Resiliency → Adherence to Treatment	-0.22	-0.18	-2.66	0.007	Accepted
Depression → Diabetes distress → Adherence to Treatment	-0.24	-0.16	-2.80	0.004	Accepted

It can be concluded from the above table that depression has an indirect effect on the adherence to treatment by mediating role of resiliency and diabetes distress ($p < 0.05$), so the hypothesis is confirmed regarding the indirect relationship between depression and adherence to treatment.

Discussion

This study aimed to investigate the relationship between depression and adherence to treatment in type 2 diabetic patients; the mediating role of resilience and diabetes distress in diabetic patients in Tehran. Therefore, the evaluation of these problems is very important. Our results suggest that the variables of depression and diabetes distress have a negative and significant correlation with adherence to treatment. Besides, the resiliency has a positive and significant correlation with adherence to treatment. Thus, after dividing the result by multiplying the two non-standard coefficients that constitute the intermediate variable paths by the standard error of the product, the ratio obtained is compared with the normal distribution table, and if the ratio is greater than 1.96, it means that the mediating variable's effect is significant.

It can be concluded that depression has an indirect effect on the adherence to treatment by mediating role of resiliency and diabetes distress, so the hypothesis regarding the indirect relationship between depression and adherence to treatment is confirmed. Although this subject has been widely discussed in the literature (4-7,11-18,21-28), there are no studies to our knowledge that have evaluated these variables together or considered their potential interrelationships. In the present study, adherence to treatment was associated with more resiliency, which is in agreement with previous evidence (16-19) and with a low level of depression (1-5, 15). Bahremand et al. (39) have shown that family functioning, resilience, and mental wellbeing are related together. Resilience plays a mediating role in the family's functioning and mental wellbeing. Giving the resilience in patients can also lead to an improvement in diabetic patients' mental health. This result also correlates with previous research

that shows that people with diabetes face emotional pressures that can impair their self-care (40).

The study presented that in people living with diabetes, psychological resilience has moderated the effect of depression on diabetes distress. Such findings are consistent with earlier work on the resilience moderating mechanism between emotional deregulation and generalized anxiety disorder (41). The findings are also consistent with those of Grossman (42), who have shown that resilience and endurance are both moderate and strongly related to the outcomes of health and wellbeing. The result is also consistent with that of the research by Davydov et al. (43) which found a strong correlation between psychological resilience and reduced incidence of stress and anxiety. The findings of this study supported the results of previous research that found psychological resistance to successful moderate pain, bipolar disorder, and suicidality (44-46).

Grossman discovered that resilience and toughness are moderate to strongly linked to health and wellbeing outcomes, both in the predicted direction and as mediators of positive emotion and adaptive coping (42). Psychological resilience was described as a facilitator of higher optimism rates; a construction known to promote higher rates of psychological well-being (40). Further studies demonstrated a substantial correlation between psychological resilience and reduced occurrence. According to other authors, people with high levels of anxiety (47) and depression (48-49) have less attention to self-care behaviors. However, no significant association was found in the disagreement between diabetes-related distress and adherence to self-care behaviors in the previous report (48). Alvarado-Martel et al. demonstrated that investigating the factors involved in diabetes such as motivation, diabetes management training, perceptions of the disease, and self-efficacy are key contributors to self-care behaviors. In contrast, anxiety and depression were highly prevalent and related to lower adhesion (49).

To explain these results, it can be said that most people living with diabetes have difficulty attaining the prescribed diabetes management

requirements. Therapeutic education has also proved to be an essential component of the adherence to self-care, but that alone does not guarantee patients' full participation; they may internalize therapeutic guidelines but will then determine whether to adhere to them or not. Adherence is a dynamic, multidimensional process with several factors playing a role in it. Due to all these reasons, it is critical to implement methods that promote behavior change (50). In addition to the need to adapt to self-care behaviors and consequent life changes, patients must also psychologically adjust to chronic disease diagnosis. Additionally, depression symptoms interfere with adherence to diabetes self-care habits, which can lead to a reduction in health and quality of life.

However, it was the patients themselves who mentioned their training level as well as other problems. It is a subjective impression, and patients may have been given genuine responses or may not. The participation of a researcher during the execution of the questionnaires ensured that they were completed by the patients themselves and provided clarification if necessary. Finally, the economic situation of the patients was not taken into consideration, but this can affect the patterns of self-care. However, the present research was intended to identify factors that could be changed in clinical practice. The findings of this study highlight the importance of early diagnosis of depression and diabetic distress in self-care activities in the advancement of treatment, and to avoid potential complications.

This study has a number of limitations. First, this group of patients was included from a referred diabetes clinic, which may be not indicative of patients with type 2 diabetes in a primary care environment. Second, it's important to note that it's difficult to determine causality by being a cross-sectional sample. However, the study results identify the magnitude of distress issues in diabetic patients which allow strategies to be planned to improve this population's well-being.

People with diabetes in this study were selected based on Hemoglobin A1c, which is one of the strengths of this study. Another strength of this study is the consideration of demographic variables. The psychological dimension of these patients is also discussed in this article.

Conclusion

As a result, the strengths of the study included the measurement of HbA1C based on which hyperglycemia patients were included. Based on the findings of this study and other research, it appears that the incidence of depression in diabetic patients is very probable and has a direct impact on diabetes outcomes and psychological issues. In addition to routine checkups to physicians, more attention must be paid to the physical, psychological, and medical causes of diabetes adherence. Frequent visits to a psychiatrist or psychological screening for mental disorders can aid in the early detection of these disorders. Lack of workforce among diabetes care providers at the forefront, and shifting to a unit approach with wider support to chronic care management, considering the variety of psychological interventions are also suggested as useless resources to address the growing burden of diabetes in Iran.

Acknowledgments

Sincere gratitude must be expressed toward the patients for their cooperation who supported us with great care and diligence in this study. This article is the result of the first author's dissertation on the master's degree in Clinical Psychology approved by Vice-Chancellor for Research, Islamic Azad University, Branch of Science and Research No. IR.AUK.REC.1398, 99.

Authors' contribution

Conceptualization, MR, MJ, RN, & MR; Methodology, MR& MJ; Investigation, MR, MJ, RN, &MR; Writing–Original MR, MJ, RN, &MR; Writing–Reviewing & Editing, MR, MJ, RN, &MR; Funding acquisition, MR&MJ; Resources, MR&MJ; Supervision & proofing, RN&MR.

Funding

This research received no specific grants from the public, commercial, or non-profit funding

agencies.

Conflict of interest

The authors declare no conflict of interest.

References

1. Sun N, Lou P, Shang Y, et al. Prevalence and determinants of depressive and anxiety symptoms in adults with type 2 diabetes in China: a cross-sectional study. *BMJ Open*. 2016; 6(8): e 012540.
2. Bai X, Liu Z, Li Z, et al. The association between insulin therapy and depression in patients with type 2 diabetes mellitus: a meta-analysis. *BMJ Open*. 2018; 8(11): e 020062.
3. Khan ZD, Lutale J, Moledina SM. Prevalence of Depression and Associated Factors among Diabetic Patients in an Outpatient Diabetes Clinic. *Psychiatry Journal*. 2019.
4. Kumar N, Unnikrishnan B, Thapar R, et al. Distress and Its effect on adherence to antidiabetic medications among type 2 diabetes patients in Coastal South India. *Journal of Natural Science, Biology, and Medicine*. 2017; 8(2): 216.
5. Wang X, Kindzierski W, Kaul P. Comparison of transient associations of air pollution and AMI hospitalisation in two cities of Alberta, Canada, using a case-crossover design. *BMJ open*. 2015; 5(11): e 009169.
6. Gonzalez JS, Peyrot M, McCarl LA, et al. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care*. 2008; 31(12): 2398–2403.
7. Gonzalez JS, Tanenbaum ML, Commissariat PV. Psychosocial factors in medication adherence and diabetes self-management: Implications for research and practice. *American Psychologist*. 2016; 71(7): 539–551.
8. Luca A, Luca M, Di Mauro M, et al. Alexithymia, more than depression, influences glycaemic control of type 2 diabetic patients. *Journal of endocrinological investigation*. 2015; 38(6): 653-660.
9. Gonzalez JS, Shreck E, Psaros C, et al. Distress and type 2 diabetes-treatment adherence: A mediating role for perceived control. *Health Psychology*. 2015; 34(5): 505–513.
10. Félix IB, Guerreiro MP, Cavaco A, et al. Development of a Complex Intervention to Improve Adherence to Antidiabetic Medication in Older People Using an Anthropomorphic Virtual Assistant Software. *Frontiers in Pharmacology*. 2019; 10: 680.
11. Krass I, Schieback P, Dhippayom T. Adherence to diabetes medication: a systematic review. *Diabetic Medicine*. 2015; 32(6): 725-737.
12. Juste AM, Miguel AG, Plou BP, et al. Adherence to treatment of hypertension, hypercholesterolaemia and diabetes in an elderly population of a Spanish cohort. *Medicina Clínica (English Edition)*. 2019; 153(1): 1-5.
13. Menditto E, Cahir C, Aza-Pascual-Salcedo M, et al. Adherence to chronic medication in older populations: application of a common protocol among three European cohorts. *Patient preference and adherence*. 2018; 12: 1975–1987.
14. Massey CN, Feig EH, Duque-Serrano L, et al. Psychological Well-Being and Type 2 Diabetes. *Current research in diabetes & obesity journal*. 2017; 4(4): e 555641.
15. Baucom KJ, Turner SL, Tracy EL, et al. Depressive symptoms and diabetes management from late adolescence to emerging adulthood. *Health Psychology*. 2018; 37(8): 716-724.
16. Sexton MB, Byrd MR, von Kluge S. Measuring resilience in women experiencing infertility using the CD-RISC: Examining infertility-related stress, general distress, and coping styles. *Journal of psychiatric research*. 2010; 44(4): 236-241.
17. Johnson J, Wood AM, Gooding P, et al. Resilience to suicidality: The buffering hypothesis. *Clinical psychology review*. 2011; 31(4): 563-591.
18. Torabizadeh C, Asadabadi Poor Z, Shaygan M. The Effects of Resilience Training on the Self-Efficacy of Patients with Type 2 Diabetes: A Randomized Controlled Clinical Trial. *International journal of community based nursing and midwifery*. 2019; 7(3): 211-221.
19. Nawaz A, Malik JA, Batool A. Relationship between resilience and quality of life in diabetics. *Journal of the College of Physicians and Surgeons Pakistan*. 2014; 24(9): 670-675.
20. Young-Hyman D, De Groot M, Hill-Briggs F, et al. Psychosocial care for people with diabetes: a position statement of the American Diabetes Association. *Diabetes Care*. 2016; 39(12): 2126–2140.

21. Chew BH, Vos RC, Stellato RK, et al. Diabetes-Related Distress and Depressive Symptoms Are Not Merely Negative over a 3-Year Period in Malaysian Adults with Type 2 Diabetes Mellitus Receiving Regular Primary Diabetes Care. *Frontiers in psychology*. 2017; 8: 1834-1841.
22. Avci D, Kelleci M. Alexithymia in patients with type 2 diabetes mellitus: the role of anxiety, depression, and glycemic control. *Patient preference and adherence*. 2016;10: 1271-1277.
23. Fisher L, Glasgow RE, Mullan JT, et al. Development of a brief diabetes distress screening instrument. *The Annals of Family Medicine*. 2008; 6(3): 246-252.
24. Fukuda N, Gandhi K, Lim E, et al. Validation of the Diabetes Distress Scale in an Asian Pacific Islander Population. *Hawai'i Journal of Medicine & Public Health*. 2019; 78(1): 3-7.
25. Baek RN, Tanenbaum ML, Gonzalez JS. Diabetes burden and diabetes distress: The buffering effect of social support. *Annals of Behavioral Medicine*. 2014; 48(2): 145-155.
26. Yi-Frazier JP, Cochrane K, Whitlock K, et al. Trajectories of Acute Diabetes-Specific Stress in Adolescents With Type 1 Diabetes and Their Caregivers Within the First Year of Diagnosis. *Journal of Pediatric Psychology*. 2018; 43(6): 645-653.
27. Ramkisson S, Pillay BJ, Sartorius B. Diabetes distress and related factors in South African adults with type 2 diabetes. *Journal of Endocrinology, Metabolism and Diabetes of South Africa*. 2016; 21(2): 35-39.
28. Jannoo Z, Wah YB, Lazim AM, et al. Examining diabetes distress, medication adherence, diabetes self-care activities, diabetes-specific quality of life and health-related quality of life among type 2 diabetes mellitus patients. *Journal of Clinical & Translational Endocrinology*. 2017; 9: 48-54
29. Sobel ME. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology*. 1982; 13: 290-312.
30. Beck A, Ward C, Mendelsohn M, et al. An inventory for measuring depression *Arch Gen Psychiatry*. 1961; 4(6): 561-571.
31. Ghassemzade H, Mojtabai R, Karamghadiri N, et al. Psychometric properties of a Persian-language version of the Beck Depression Inventory-second edition: BDI-II-Persian. *Depression and anxiety*. 2005; 21(4): 185-192.
32. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical Care*. 1986; 24(1): 67-74.
33. Morisky DE, Ang A, Krousel-Wood M, et al. Predictive validity of a medication adherence measure in an outpatient setting. *The Journal of Clinical Hypertension*. 2008; 10(5): 348-354.
34. Moharamzad Y, Saadat H, Nakhjavan Shahraki B, et al. Validation of the Persian Version of the 8-Item Morisky Medication Adherence Scale (MMAS-8) in Iranian Hypertensive Patients. *Global journal of health science*. 2015; 7(4): 173-183.
35. Connor KM, Davidson JR. Development of a new resilience scale: The Connor-Davidson resilience scale (CD-RISC). *Depression and anxiety*. 2003; 18(2): 76-82.
36. Jowkar B, Friborg O, Hjemdal O. Cross-cultural validation of the Resilience Scale for Adults (RSA) in Iran. *Scandinavian journal of psychology*. 2010; 51(5): 418-425.
37. Polonsky WH, Fisher L, Esarles J, et al. Assessing psychosocial distress in diabetes: Development of the Diabetes Distress Scale. *Diabetes Care*. 2005; 28(3): 626-631.
38. Baradaran HR, Mirghorbani SM, Javanbakht A, et al. Diabetes Distress and its Association with Depression in Patients with Type 2 Diabetes in Iran. *International journal of preventive medicine*. 2013; 4(5): 580-584.
39. Bahreman M, Rai A, Alikhani M, et al. Relationship between family functioning and mental health considering the mediating role of resiliency in type 2 diabetes mellitus patients. *Global journal of health science*. 2015; 7(3): 254-259.
40. Wojujutari AK, Alabi OT, Emmanuel IE. Psychological resilience moderates influence of depression on sleep dysfunction of people living with diabetes. *Journal of Diabetes & Metabolic Disorders*. 2019; 18(2): 429-436.
41. Webster RE. Moderating effects of resilience and relationship between emotion dysregulation depressions in older. *African Journal of Aging and Depression*. 2018; 2(5): 1-19.
42. Grossman MR. Clarifying the nature of resilience: A MetaAnalytic approach. 2014.
43. Davydov DM, Stewart R, Ritchie K, et al. Resilience and mental health. *Clinical psychology review*. 2010; 30(5): 479-95.

44. Choi JW, Cha B, Jang J, et al. Resilience and impulsivity in euthymic patients with bipolar disorder. *Journal of Affective Disorders*. 2015; 170: 172–177.
45. Min JA, Lee CU, Chae JH. Resilience moderates the risk of depression and anxiety symptoms on suicidal ideation in patients with depression and/or anxiety disorders. *Comprehensive psychiatry*. 2015; 56: 103–11.
46. Newton-John TR, Mason C, Hunter M. The role of resilience in adjustment and coping with chronic pain. *Rehabilitation Psychology*. 2014; 59(3): 360–365.
47. Fisher L, Hessler DM, Polonsky WH, et al. When is diabetes distress clinically meaningful? : establishing cut points for the Diabetes Distress Scale. *Diabetes Care*. 2012; 35(2): 259-264.
48. Rechenberg K, Whittemore R, Grey M. Anxiety in youth with type 1 diabetes. *Journal of Pediatric Nursing*. 2017; 32: 64-71.
49. Hood KK, Rausch JR, Dolan LM. Depressive symptoms predict change in glycemic control in adolescents with type 1 diabetes: rates, magnitude, and moderators of change. *Pediatric Diabetes*. 2011; 12(8): 718-723.
50. Kongkaew C, Jampachaisri K, Chaturongkul CA, et al. Depression and adherence to treatment in diabetic children and adolescents: a systematic review and meta-analysis of observational studies. *European journal of pediatrics*. 2014; 173(2): 203-212.
51. Alvarado-Martel D, Ruiz Fernández M, Cuadrado Vigaray M, et al. Identification of Psychological Factors Associated with Adherence to Self-Care Behaviors amongst Patients with Type 1 Diabetes. *Journal of Diabetes Research*. 2019.
52. Pereira MG, Pedras S, Ferreira G. Self-reported adherence to foot care in type 2 diabetes patients: do illness representations and distress matter ?. *Primary health care research & development*. 2019; 20: e40.