Article

The relationship between psychological stress and medication regimen adherence in patients with type 2 diabetes

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Article Info

Article history:
Received: 30 Jan 2024
Accepted: 26 July 2024

Keywords:
Psychological stress,
Medication adherence,
Type 2 diabetic patients

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Abstract

Background: Diabetes is considered one of the most arduous chronic diseases emotionally and behaviorally. This disease is an integral part of the patient's lives, and not paying attention to the psychological stress stemming from it, not only leads to the occurrence of psychological symptoms and frustration, but also influences self-care behaviors, such as blood sugar control, proper use of medicines, and medication regimen adherence.

Objectives: This study was conducted to determine the relationship between psychological stress and medication regimen adherence in patients with type 2 diabetes.

Methods: This descriptive-correlational study was conducted on 101 patients referring to diabetes clinics affiliated with Zanjan University of Medical Sciences in 2023. Sampling was carried out using the convenience sampling method. A demographic characteristics questionnaire, the Problems Areas in Diabetes-5 (PAID-5) Scale, and the Mo risky Medication Adherence Scale-8 (MMAS-8) were used to collect data. Data were analyzed using descriptive statistics, the Mann-Whitney U test, the Kruskal-Wallis test, and Spearman's test, with SPSS-26 software.

Results: In the present research, 68.3% of the participants were female and 31.7% were male. The mean (standard deviation) stress score was 9.579 (7.448). Also, 58.4% of the participants had a stress score of ≥8, indicating high psychological stress. The mean (standard deviation) of medication adherence was 6.054 (1.874), which based on the findings, 43.6% had a poor adherence score. Spearman's correlation coefficient showed an inverse and significant statistical relationship between psychological stress and medication adherence ($p = 0.002$, $r = -0.307$).

Conclusion: According to the results, the higher the psychological stress of diabetic patients, the lower their medication adherence. It is suggested that targeted interventions should be designed to manage psychological stress and improve medication adherence in diabetic patients.

Implications of this paper in nursing and midwifery preventive care:

- By recognizing the psychological problems that threaten chronic patients, caregivers of diabetic patients can take a step toward improving the physical health of these patients. Encouraging patients to participate in educational programs or follow the trainings provided can be effective in controlling the disease, improving symptoms, and preventing disease relapse, subsequently relieving the stress and tensions due to the disease complications. Therefore, medication adherence increases to reduce these tensions, which can be greatly influential in improving physical health.

Introduction

Type 2 diabetes, a common health problem in the world and also in Iran, is regarded as the most prevalent and crucial metabolic disease in humans [1,2]. Type 2 diabetes is characterized by relative insulin imbalance arising from pancreatic-β cell dysfunction and insulin resistance in target organs [3]. According to research, 415 million diabetic patients live all around the world, and despite the increased knowledge regarding this disease, its incidence and prevalence are increasing globally [4]. The number of diabetic patients is anticipated to increase by 48% by 2045, reaching 629 million people [5].

The prevalence of diabetes mellitus in Iran has been reported to be 9.90% to 14.40% [6]. Currently, there are more than three million diabetic patients in Iran, and according to the World Health Organization (WHO) estimates, if effective measures are not taken, this number will reach 7 million people by 2030 [7]. As reported by the WHO, 4-5% of the health budget is allocated to diabetes-related illnesses, and the medical expenses of diabetic patients are 2-5 times higher than those of healthy individuals [8]. One of the behaviors associated with chronic diseases, which predicts successful treatment and mitigates negative complications and disease

severity, is patients' treatment regimen adherence [9].

Since these patients usually do not comply with all these principles, they ultimately have to use oral blood sugar control drugs and even insulin. Thus, one of the principles of diabetes control is the patient's adherence to the doctor's treatment recommendations. These principles culminate in improved blood sugar control and reduced glycosylated hemoglobin, consequently mitigating disease complications and related costs [10]. The WHO suggests the term "adherence" to be used in chronic diseases. According to the WHO definition, adherence refers to an individual's level of behavior, including taking medication, adhering to a diet, or changing a lifestyle according to the recommendations provided by healthcare workers, and patients' low level of adherence is among the most critical challenges for the success of disease treatment in chronic diseases, such as blood pressure, dyslipidemia, and diabetes [11]. Medication adherence facilitates the control of other diabetes-related illnesses, such as hypertension and dyslipidemia, thereby helping a better quality of life, mitigating the risk of microvascular and macrovascular complications, and reducing mortality and healthcare costs [12]. According to the results of a systematic review, a large number of patients with type 2 diabetes have poor medication adherence [13]. Another review also indicated that the levels of adherence and persistence in the use of cardiovascular and antidiabetic medications, as well as medications to control blood pressure and blood lipids, in diabetic patients were low [14].

Patients' treatment and medication non-adherence or poor adherence is one of the principal reasons for treatment failure, increased disease complications, prolonged treatment, increased care costs, and even devaluation of best treatment regimens, which is associated with frequent hospitalizations, not receiving treatment benefits, and a large number of doctor visits [15,16]. It can also lead to many risks, such as more severe disease relapse and increased risk of rebound effects stemming from sudden medication discontinuation [17]. Other factors such as multi-medication regimens, complexity of consumption plans, emergence of medication complications, cultural aspects, and problems in access to medications due to high costs can be associated with the level of medication adherence in patients, including in the elderly [18].

On the one hand, diabetes is considered a source of psychological stress for patients, and on the other hand, stress itself negatively affects the symptoms of these patients. For example, by further activating the sympathetic nervous system, stress increases blood sugar [19]. In other words, stress can be regarded both as one of the triggers and one of the consequences of diabetes [20]. Stress can be defined as any uncomfortable feeling accompanied by predictable biochemical, behavioral, and physiological changes [21]. Diabetes is closely linked to the level of stress, and when an individual is dealing with stress, various hormones are released, which neutralize the effects of insulin and, consequently, culminate in the body's resistance to insulin. Furthermore, the daily management of diabetes can cause a high level of stress, leading to anxiety and depression in these patients [22]. During the last decades, the psychological aspects of diabetes have attracted the attention of many experts because diabetes is taken into account as one of the most arduous chronic diseases emotionally and behaviorally [23]. Numerous domestic and foreign studies have addressed psychological issues and medication adherence in diabetic patients. In Iran, Rahimi et al.'s study indicated that diabetes distress and depression were correlated with treatment adherence [24]. In another study, diabetes-related distress and severity of depressive symptoms were reported as risk factors for non-adherence to type 2 diabetes medications [25]. Eqbali et al.'s study (2022) also showed that patients with better mental status had better medical treatment adherence [26].

Since diabetes is an integral part of the patients' lives, not paying attention to the psychological stress stemming from it, not only leads to the occurrence of psychological symptoms and frustration [27], but also influences self-care behaviors, such as blood sugar control, proper use of medicines, and medication regimen adherence, that play a significant role in the treatment of these patients [28]. Based on the available literature, no study was found in Iran addressing the relationship between psychological stress and medication regimen adherence in diabetic patients. Hence, the current study was conducted to investigate the relationship between

psychological stress and medication regimen adherence in patients with type 2 diabetes referring to clinics affiliated with Zanjan University of Medical Science in 2023.

Methods

The present research is a descriptive-correlational study. The research population consisted of all patients with type 2 diabetes referring to clinics affiliated with Zanjan University of Medical Sciences (Vali-e Asr, Shafieeyeh, Emdadi Abhar, Amir-al-Momenin Khodabandeh, and Bu-Ali Sina Khorramdareh hospitals) in May, June, and July 2023. The sample size in this study was calculated with a 95% confidence level and a percentage error of 0.05. The p ratio was also considered based on the medication adherence variable [29].

The sample size was determined to be 101 people. Sampling was carried out using the convenience sampling method. After obtaining permission to conduct the research and the code of ethics, the researcher visited these clinics during the weekdays. Patients who met the inclusion criteria were selected to participate in the study. The researcher first explained the research objectives and procedures to the patients and then invited them to participate in the research. In case of willingness to participate, informed consent was provided to the patients. Finally, the questionnaires were filled out by the interview method or by the participants, depending on whether they were literate or illiterate.

The inclusion criteria included diagnosis and confirmation of type 2 diabetes by a treating physician, at least one year has passed since the disease diagnosis, taking type 2 diabetes medications in the past year, no history of severe mental disorders, and possessing acceptable vision and hearing ability and alertness to respond to the questions to fill out the questionnaires.

In this study, three questionnaires were used to collect data: A demographic characteristics questionnaire, the Problems Areas in Diabetes-5 (PAID-5) Scale, and the Morisky Medication Adherence Scale-8 (MMAS-8).

The demographic information questionnaire used in this study includes age, gender, marital status, diabetes duration, number of children, occupation, insurance coverage, housing type, living status, primary caregiver, treatment type, income status, history of hospitalization, cigarette use, education level, place of residence, history of other diseases, and number of medications used.

The PAID-5 Scale, designed by Polonsky et al., has been used in numerous studies to screen diabetic patients' psychological stress [30]. The 5-statement short version of this scale is a beneficial tool for identifying patients experiencing diabetes-related emotional stress. The scale contains 5 items rated on a 5-point Likert scale from 0 to 4 (no problem, mild problem, moderate problem, sometimes seems serious, and completely serious problem). The total score of the 5 statements is multiplied by 1.25 and the final score is calculated from zero to 25. A higher calculated score denotes a higher level of stress [31]. The cut-off point for this questionnaire is 8, with scores $\geq$ 8 indicating high psychological stress [32]. The validity and reliability of this questionnaire were assessed in Iran by Ameri et al. (2016). Exploratory factor analysis was used to evaluate validity and Cronbach's alpha coefficient was calculated to be 0.75 [31]. In the current research, Cronbach's alpha coefficient of 0.878 was obtained to assess the reliability of the PAID-5 Scale.

The MARS-8, designed and formulated by Morisky (2008), contains 8 items. This questionnaire consists of 7 two-choice questions (with yes/no answers) and one Likert-type question (with never, rarely, sometimes, usually, and always answers). Question 5 is rated in the opposite direction compared to the other questions. The total range of scores of this questionnaire is between 0 and 8; a higher score indicates higher medication adherence. In questions 1 to 7, "yes" answers are assigned a score of zero, "no" answers are assigned a score of one, and question 5 is scored in reverse. In addition, in question 8, "never" is assigned a score of 0, "rarely" is assigned a score of 0.25, "sometimes" is assigned a score of 0.5, "usually" is assigned a score of 0.75, and "always" is assigned a score of 1 [29]. The cut-off point for this questionnaire is in this way: 0-5 = poor adherence, 6-7 = moderate adherence, and 8 = high and complete adherence [33]. The reliability of this questionnaire in Iran has been calculated by Ghanei Qeshlaq et al. based on Cronbach's alpha coefficient of 0.72 [29]. In the present research, Cronbach's alpha coefficient of 0.732

was also calculated to confirm the reliability of the scale.

In this study, SPSS software version 26 was used for data analysis. The variables were described using descriptive statistics (frequency, percentage, mean, and standard deviation). The data distribution was determined using the Kolmogorov–Smirnov test. Since the data distribution was not normal, the Mann-Whitney U test (for two-mode variables) and Kruskal-Wallis test (for multi-mode variables) were used to compare the distribution of variables in terms of demographic variables, and Spearman's test was used to compare the two main variables. The significance level was considered 0.05.

Results

In this study, 101 patients with type 2 diabetes referring to clinics affiliated with Zanjan University of Medical Sciences participated. Most of the participants were female (68.3%), with an age range of ≥ 55 years (50.5%), married (87.1%), with a diploma or lower education level (91.1%), with a history of diabetics for 5 years and above (65.3%), and were urban residents (86.1%). Table 1 provides the distribution of demographic variables of patients with type 2 diabetes referring to clinics affiliated with Zanjan University of Medical Sciences. According to the results, most of the participants in this study had high psychological stress (58.4%) and poor medication adherence (43.6%) (Table 2).

Table 1: Demographic variables of patients with type 2 diabetes

Variable		N(%)*	Variable		N(%)*
Gender	Female	69 (68.3)	Marital status	Single	4 (4.0)
	Male	32 (31.7)		Married	88 (87.1)
Age	33-55 years	50 (49.5)		Divorced	2 (2.0)
	Over 55 years	51 (50.5)		Widow	7 (6.9)
Place of residence	City	87 (86.1)	Number of children	No children	7 (6.9)
	Village	14 (13.9)		≥2 children	24 (23.8)
Housing type	Private house	93 (92.1)		2 children <	70 (69.3)
	Rental house	8 (7.9)	Occupation	Employee	3 (3.0)
Living status	Alone	2 (2.0)		Self-employed	25 (24.8)
	Family	99 (98.0)		Housewife	61 (60.4)
Primary caregiver	Patient	94 (93.1)		Retired	9 (8.9)
	Family	7 (6.9)		Farmer	3 (3.0)
Income status	Governmental	29 (28.7)	Education level	Illiterate	31 (30.7)
	Non-governmental	72 (71.3)		Elementary school	36 (35.6)
Cigarette use	Yes	7 (6.9)		Secondary and high school	12 (11.9)
	No	94 (93.1)		Diploma	13 (12.9)
Diabetes duration	>5 years	35 (34.7)		University education	9 (8.9)
	≤5 years	66 (65.3)	Medications used	1	15 (14.9)
History of hospitalization for diabetes	Yes	38 (37.6)		2	25 (24.8)
	No	63 (62.4)		3	21 (20.8)
Other diseases	Yes	65 (64.4)		More than 3	40 (39.6)
	No	36 (35.6)	Treatment type	Oral	71 (70.3)
				Insulin	11 (10.9)
				Both	19 (18.8)
			Insurance coverage	No	4 (4.0)
				Social security	56 (55.4)
				Health	20 (19.8)
				Other	21 (20.8)

N: Number

Table 2: Frequency and mean of psychological stress and medication adherence of patients with type 2 diabetes

Variable	Score range	N(%)**	Mean (SD)*
Psychological stress	Low: < 8	42 (41.6)	9.579(7.448)
	High: ≥ 8	59 (58.4)	
Medication adherence	High: 8	24 (23.8)	6.054(1.874)
	Medium: 6	33 (32.7)	
	Poor: 0 to 5	44 (43.6)	

*SD: Standard Deviation
**N: Number

Based on the Mann-Whitney U test, the mean stress levels according to age indicated a statistically significant relationship (p=0.025). Individuals in the age range of 30-55 years had higher mean stress scores than those over 55. According to the findings, a history of hospitalization due to diabetes showed a significant relationship with psychological stress (p=0.001), and individuals with a history of hospitalization gained a higher stress score. Also, a statistically significant relationship was observed between the income status and the mean score of stress (p=0.041), indicating that patients with non-governmental income had higher psychological stress than those with a fixed income. According to the Mann-Whitney U test, there was a statistically significant relationship between the mean score of medication adherence and age (p=0.027) so individuals over 55 years of age reported more desirable medication adherence than younger individuals. Additionally, the comparison of the mean medication adherence scores according to a history of hospitalization showed a statistically significant difference (p=0.012). This finding reveals that patients without a history of hospitalization had higher medication adherence (Table 3).

Table 3: The relationship of demographic characteristics with psychological stress and medication adherence of patients with type 2 diabetes

	Variable		Mean (SD)*	Mean ratings	Sum of Ranks	Mann-Whitney U Test	p
Psychological stress	Age	30-55 years	11.25 ±7.76	57.57	2878.50	964.500	0.025
		Over 55 years	7.94±6.81	44.56	2272.50		
	Income status	Governmental	7.28 ±6.94	41.67	1208.50	773.500	0.041
		Non-governmental	10.50 ±7.49	54.76	3642.50		
	A history of hospitalization	Yes	12.73 ±7.76	63.01	2394.50	740.500	0.001
		No	7.68 ±6.61	43.75	2756.50		
Medication adherence	Age	30-55 years	5.59±2.02	44.63	2231.50	956.500	0.027
		Over 55 years	6.50±1.62	57.25	2919.50		
	A history of hospitalization	Yes	5.35±2.16	41.84	1590.00	849.000	0.012
		No	6.48±1.55	56.52	3561.00		

*SD: Standard Deviation

The results of the Kruskal-Wallis test indicated a statistically significant relationship between stress and the number of children (p=0.049) so that participants with no children had a higher stress score compared to those with more than 2 children. The results also revealed that individuals without insurance had an unfavorable mental state compared to those with insurance, and reported a significantly higher mean stress score (p=0.030). The results of the Kruskal-Wallis test demonstrated a statistically significant difference in the comparison of the mean medication adherence score according to the education level variable (p=0.003) (Table 4).

Table 4: The relationship of demographic characteristics with psychological stress and medication adherence of patients with type 2 diabetes

Variable			Mean (SD)*	Mean ratings	Kruskal-Wallis Test	p
Psychological stress	Children	No	15.53 ±6.57	74.71	6.020	0.049
		Less than 2 children	10.16 ±6.51	54.50		
		More than 2 children	8.79 ±7.62	47.43		
	Insurance coverage	No	15.63 ±4.84	76.13	8.963	0.030
		Social security	8.01 ±7.50	44.82		
		Health	12.94 ±7.09	63.18		
		Other	9.40 ±6.76	51.10		
Medication adherence	Education level	Illiterate	5.47±1.99	41.85	16.213	0.003
		Elementary school	6.95±1.04	63.65		
		Secondary and high school	4.97±2.32	36.21		
		Diploma	5.42±2.10	42.77		
		University education	6.83±1.45	63.50		

*SD: Standard Deviation

Based on the findings, there was a statistically significant and inverse relationship between psychological stress and medication adherence, meaning that the higher the psychological stress, the lower the patient's medication adherence (r=-0.31, p=0.002).

Discussion

This study was conducted to investigate the relationship between psychological stress and medication adherence in patients with type 2 diabetes referring to clinics affiliated with Zanjan University of Medical Sciences in 2023. The results revealed an inverse relationship between psychological stress and medication adherence in patients with type 2 diabetes in this study, i.e., the higher the patients' psychological stress, the lower their medication adherence. The results of Gonzalez et al.'s study (2015) indicated that diabetes-related emotional distress was related to poorer treatment adherence among adults with type 2 diabetes [34]. Another research result (2020) in Ghana showed that patients with higher distress had significantly lower medication adherence scores [35], which are in line with the results of our study. Eqbali et al. (2022) also reported that patients with better mental status had better medical treatment adherence [26]. The results of Rahimi et al.'s study also reported a negative and significant relationship between diabetes-related distress and treatment adherence [24]. The results of the present research confirm the findings of the mentioned studies.

According to the obtained results, most of the diabetic patients referring to clinics in this study experienced high psychological stress. In Kretchy et al.'s study (2020), conducted on adults with type 2 diabetes, the patients reported higher psychological stress scores, which is consistent with the present research [35]. In a study

conducted by Fadaei Aghdam et al., the patients reported low stress scores, the results of which are contrary to the results of the current study [36]. In this study, the 20-question version of the PAID Scale was used to measure psychological stress. Among the reasons for less psychological stress in Fadaei Aghdam et al.'s research may be the different demographic characteristics, levels of awareness, research setting, and patients' cultures. Furthermore, since the present study was conducted on patients referring to clinics, it may be a reason for discrepant results with other studies.

The present study results revealed that psychological stress was significantly correlated with age, income status, a history of hospitalization, insurance coverage, and number of children. In Fadaei Aghdam et al.'s study, which was conducted to address psychological stress and its related factors in type 2 diabetic patients, elderly individuals had less stress, which is in line with our study. Hence, it can be concluded that young individuals were more reactive to life stressors and regarded a chronic disease as an unexpected event; consequently, they had less ability to deal with this disease [36]. In the present research, individuals with a history of hospitalization had high stress, in Fadaei Aghdam et al.'s study psychological stress was significantly related to a history of hospitalization, too [36]. The present study results demonstrated that the participants who had non-governmental income, had no children, and had no insurance coverage reported higher psychological stress. In Jafari et al.'s study, there was a significant relationship between anxiety and individuals' occupations [37]. However, in a study conducted in Australia, no relationship was observed between household income and stress [38]. This discrepancy in the results can be attributed to the difference in the living place of the investigated samples.

The level of medication adherence among diabetic patients in this study was low, with most of the patients reporting poor medication adherence. In Shareinia's study (2023), the level of treatment adherence in the participants was reported to be low [39], being consistent with the results of this study. However, the results of Mashruteh et al.'s research revealed that the diabetic subjects investigated had high medication adherence [40], which was contrary to the present study results. These differences can be due to different physical, mental, and quality of life of the investigated community samples. Moreover, the different research results can be due to individual differences and cultural and social factors.

According to the results obtained in the current study, there was a significant relationship between age and medication adherence. Elderly individuals had better adherence than younger individuals, which is consistent with the results of Gholamaliyeh et al.'s study. It seems that elderly individuals regard themselves to be more at risk of diabetes complications than younger individuals [41]. However, the findings of Shareinia et al.'s study reported no significant relationship between age and medication adherence, which is not consistent with the present study [39]. This difference may be due to the age of patients participating in this research, who were only individuals aged 60 years and higher. In the present study, among other demographic variables, education level was also significantly correlated with medication adherence, and individuals with secondary and high school education levels had more medication adherence. In their study, Gholamaliyeh et al. also reported the education level to be related to medication adherence [41], which was in line with the present study. Another result of the current research is the presence of a statistically significant relationship between medication adherence and a history of hospitalization due to diabetes. Patients with a history of hospitalization reported better medication adherence. Dianati et al.'s study also reported the relationship between medication adherence and hospitalization frequency [33], which was consistent with the present study. However, in Firouz et al.'s study on diabetic patients, no significant relationship was found between a history of hospitalization and self-care behaviors [42].

This project was conducted in outpatient clinics affiliated with Zanjan University of Medical Sciences, and its results cannot be generalized to inpatients. Thus, it is suggested that researchers in their studies investigate the relationship between psychological stress and medication adherence in type 2 diabetic inpatients.

Conclusion

The findings of this study demonstrate that diabetic patients with higher levels of psychological stress tend to have lower medication adherence levels. Most of the patients participating in this study had high psychological stress, with poor medication adherence. Due to the significance of medication regimen adherence in diabetic patients and the impact of psychological status on medication adherence, the health system should provide diabetic patients with educational and counseling programs to prevent or relieve stress and increase patient engagement in treatment.

Ethical Consideration

After receiving the code of ethics (IR.ZUMS.REC.1402.020) through a written letter of introduction from Zanjan University of Medical Sciences and presenting it to the officials and managers of the research setting, the researcher obtained the required permission from them. The research objective was explained to each research unit and the officials of the research setting. The research units had the right to decide on their participation in the research, and if they met the inclusion criteria, written consent was obtained from them. The research units and officials were assured that the received information would be kept confidential, and no additional cost was imposed on the patients during the research.

Acknowledgments

This article has been extracted from a master's thesis in nursing and has been approved by the Research and Technology Vice-Chancellor (project code: 5385) and the Ethics Committee of Zanjan University of Medical Sciences (ethics code: IR.ZUMS.REC.1402.020). The authors would like to thank the participants of this study.

Conflict of interest

No conflict of interest.

Funding

This study was financially supported by the Research and Technology Vice-Chancellor of Zanjan University of Medical Sciences.

Authors' contributions

Study design: Z.Y. and M.A.; Collecting data, writing the draft, and replying to the reviewers: Z.Y. [a master's student]; Revising and finalizing the article: M.A.; data analysis: Z.Gh. The final version of the article was approved by all authors.

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