VIA MEDICA
RESEARCH PAPER
ISSN 2450–7458
e-ISSN 2450–8187

Isa Mohammadi Zeidi[1], Aisa Maleki[2], Zahra Najafpour[2], Saeideh Moosavi[2], Rohollah Kalhor[1]

[1]Social Determinants of Health Research Centre, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran
[2]Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran

Predictors of Medication Adherence in Patients with Type 2 Diabetes: A Cross-Sectional Study

ABSTRACT

Objective: This study aimed to investigate the predictors of medication adherence behavior and the role of self-efficacy in the medication adherence of people with diabetes.

Materials and methods: This is a cross-sectional descriptive-analytical study. One hundred forty-eight samples were selected through the formula of difference of means. Measure tools consisted of a demographic questionnaire, Morisky Medication Adherence Scale, and psychological constructs questionnaires. SPSS20 software was used for descriptive statistics tests and calculation of correlation coefficients between variables. Amos 8.80 was used to implement the structural equation modeling method.

Results: The mean age of participants was 54.1 ± 8.2 and mean of body mass index (BMI) was 28.3 ± 4.5. Correlation coefficients between medication compliance behavior and the constructs of knowledge ($r = 0.382$, $p < 0.01$), attitude ($r = 0.422$, $p < 0.01$), subjective norms ($r = 0.312$, 05 $p < 0.05$), self-efficacy ($r = 0.481$, $p < 0.05$) and fear ($r = 0.305$, $p < 0.05$) were positive and significant. In general, the strongest correlation coefficient was reported between attitude and self-efficacy ($r = 0.516$, $p < 0.01$). The fit indices generally showed that the data fitted well with the assumed model. Self-efficacy was the most important construct that directly influenced medication adherence ($\beta = 0.585$, $p < 0.05$), followed by attitude ($\beta = 0.328$, $p < 0.05$) and fear ($\beta = 0.265$, $p < 0.05$).

Conclusions: According to the findings of this study, it was shown that various factors affect medication adherence behavior, among which self-efficacy is the most important reason, and subjective norms, attitude and norms and awareness of factors affecting medication adherence behavior. (Clin Diabetol 2023; 12; 4: 253–260)

Keywords: type 2 diabetes (T2D), medication adherence, self-efficiency

Introduction

The World Health Organization (WHO) has emphasized the rise of several diseases worldwide and the importance of medication adherence in disease management [1]. According to the WHO definition that is accepted globally, adherence is 'the extent to which a person's behavior — taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider'. This definition highlights the importance of active patient participation and good communication between patients and healthcare professionals [2].

Address for correspondence:
Rohollah Kalhor
Health Services Management Department, School of Public Health, Qazvin University of Medical Sciences, Shahid Bahonar Blv, Qazvin 3419759811, Iran
Phone: + 98 9127815893; +98 2833369581
e-mail: r.kalhor@qums.ac.ir, r.kalhor@gmail.com
Clinical Diabetology 2023, 12; 4: 253–260
DOI: 10.5603/DK.a2023.0033
Received: 9.04.2023 Accepted: 28.06.2023
Early publication date: 22.08.2023

Medication adherence is important for patients with diabetes because they often have comorbidities such as hypertension, dyslipidemia, coronary artery disease, and depression. In conditions that are controlled by drug therapy, non-compliance with medication is a significant obstacle in the chronic management of patients with diabetes [3].

Various studies show that health literacy and self-efficacy determine how patients can manage drug regimens and regulate their health behaviors in self-management of chronic diseases [4].

Patients with diabetes must use these key skills in managing medication regimens and performing self-care tasks, such as monitoring blood glucose, interpreting laboratory data, making dietary choices, and taking prescribed diabetes medications [5].

This study aimed to investigate the predictors of medication adherence behavior and the role of self-efficacy in the medication adherence of people with diabetes.

Materials and methods

Study design

This cross-sectional descriptive-analytical study was performed to address the predictors of medication adherence behavior in patients with type 2 diabetes (T2D), with the mediating role of self-efficiency, in Qazvin city in 2020. Qazvin is an industrial city near the capital with a population of one million people, which has a very diverse cultural and social context.

Participation and sampling procedures

All patients with T2D who had medical records in one of the health service centers of Qazvin city were considered as the statistical population. Considering the economic, cultural and social differences of Qazvin city, first Qazvin city was divided into four regions and then one health care center was selected from each region to participate in the research. In the next step, while preparing a list of patients in each center based on the inclusion and exclusion criteria, 148 patients were selected to participate in the research using simple random sampling and based on the table of random numbers.

This sample size was enough to perform the path analysis test based on the suggestion of the previous research. For example, Hair et al. (2011) suggested that choosing 30 patients for each of the main structures is a logical approach to fit the structural equation model [6].

In addition, [7], the sample size required to conduct the research using G*Power software and 95% confidence level, 80% test power, 0.3 impact factor was finally 143 patients with diabetes.

Inclusion criteria included: 1) Voluntary and informed participation; 2) A history of T2D of at least six months since the diagnosis; 3) History of medication for T2D; 4) Literacy for reading and writing in Persian, and 5) Age range of 30 to 65 years. Exclusion criteria included: 1) Suffering from advanced physical complications due to diabetes; 2) Suffering from mental disorders, such as depression, (based on the diagnosis of the attending physician and documented in the patient's records) that deter proper answering or active participation; 3) Suffering from type 1 or gestational diabetes during the research period; 4) History of hospitalization during the research period; 5) Suffering from unchecked underlying illnesses such as blood pressure above 130/90 mmHg with medication, and 6) Drug abuse.

Measure tools

1. Demographic information of patients including age, height, weight, BMI, glycated hemoglobin (HbA1c), fasting blood glucose (FBG), disease duration, medical history, family history, marital status, employment status, education status, economic status, care budget and type of insurance collected with face-to-face interview.
2. Morisky Medication Adherence Scale: This tool includes 7 two-choice questions (0 = yes and 1 = no) and 1 five-choice Likert question (0 = never to 4 = always). Adequate adherence to medication depends on obtaining a score higher than 6 [8].
3. Psychological constructs' questionnaires:
   - Knowledge: There were 16 three-choice questions (yes = 1, no and don't know = 0). The score range was from zero to 16, where 16 was the highest level of knowledge [9].
   - Attitude: consists of four 5-point Likert questions (1 = completely disagree to 5 = completely agree). The score range was between 4 and 20, and 20 indicated the highest level of attitude [10].
   - Fear: consists of seven 5-point Likert questions (1 = strongly disagree to 5 = strongly agree). The range of scores is between 7 and 35, where 35 represents the highest level of fear [10].
   - Self-efficacy: consists of nineteen three-point Likert questions (from 1 = not sure at all, 2 = = somewhat sure, and 3 = very sure). The score range is from 19 to 57, where 57 shows the highest level of self-efficacy [11].
   - Subjective norms: consists of four 5-point Likert questions (1 = strongly disagree to 5 = = strongly agree). A higher score indicates higher social support [12].

The questionnaire was completed in approximately 30 to 35 minutes by participants at the health care centers with the initial explanations of the research team. One of the members of the research team provided explanations to the participants about how to answer the questions and the importance of accurate and complete answers to the questionnaires while answering the questions.

The subsequent hypotheses were proposed for the investigation:

H1: Medication Adherence significantly correlated with Knowledge.

H2: Medication Adherence significantly correlated with Attitude.

H3: Medication Adherence significantly correlated with Fear.

H4: Medication Adherence significantly correlated with Self-efficacy.

H5: Medication Adherence significantly correlated with Subjective norms.

Analysis

SPSS20 software was used for descriptive statistics tests and calculation of correlation coefficients between variables. Amos software was used to implement the structural equation modeling method. The fit of the model was evaluated with the root mean square error of approximation (RMSEA), the goodness of fit index (GFI), the modified goodness of fit index (AGFI), and the normalized fit index (NFI).

Ethics

This study is a master's thesis that has been done by obtaining the necessary licenses from Qazvin University of Medical Sciences, the Vice-Chancellor for Health of Qazvin University of Medical Sciences and Qazvin Health Centre. (Ethics code: IR.QUMS.REC.1398.190).

Results

The demographic characteristics of the participants are reflected in Table 1. Only 16 of participants out of 174 patients with diabetes who met the inclusion criteria did not want to participate in the study. Therefore, the participation rate in the research was 85.6 %. Finally, nine of the participants returned the questionnaires incompletely and four questionnaires were excluded due to numerous cases of missing data. The mean age of participants was 54.1 ± 8.2 and the mean of BMI was 28.3 ± 4.5. Most of the participants had primary education (50%) and only 7.3% of them had completed university education. Most people were housewives (66.4%) and married (85.5%). Most of the sample reported poor economic status (52.7%) and none of the participants had good economic status. The care budget of the majority of participants (50.9%) was 1–100. The most reported insurance coverage was social security insurance (41.8%).

Table 1. Demographic Characteristics of Patients with T2D Participating in the Study (n = 148)

Mean ± standard deviation		Variables
Age [years]		54.1 ± 8.2
Weight [kg]		76.2 ± 12.5
Height [cm]		164.1 ± 8.6
BMI [kg/m^2]		28.3 ± 4.5
FBG [mg/dL]		191.1 ± 72.8
HbA1c [mmol]		1 ± 8.0
Duration of illness [years]		3.1 ± 0.7
Variables	**Categories**	**Frequency (%)**
Level of education	Primary school	55 (50.0)
	Middle school	21 (19.1)
	High school no degree	5 (4.5)
	High School diploma	21 (19.1)
	University education	8 (7.3)
Employment status	Housewife	73 (66.4)
	Retired	17 (15.5)
	Employed	4 (3.6)
	Unemployed	15 (13.6)
Marital status	Married	94 (85.5)
	Single	1 (0.9)
	Divorced	1 (0.9)
	Other	14 (12.7)
Economic status	Good	0 (0)
	Moderate	52 (47.3)
	Poor	58 (52.7)
Care budget	1–100	56 (50.9)
	101–200	40 (36.4)
	201–300	7 (6.4)
	> 300	7 (6.4)
Disease historyz	Cardiovascular	19 (17.3)
	Renal	1 (0.9)
	Hypertension	33 (30.0)
	Other	57 (51.8)
Family history	Yes	78 (70.9)
	No	32 (29.1)
Assurance type	Rural	11 (10.0)
	Social security insurance	46 (41.8)
	Armed forces insurance	4 (3.6)
	Health services insurance	16 (14.5)
	Other	33 (30.0)

BMI — body mass index; FBG — fasting blood glucose; HbA1c — glycated hemoglobin

The comparison of the mean and standard deviation of psychological constructs influencing medication

Table 2. Mean, Standard Deviation and Correlation Coefficients between Psychological Variables and Medication Adherence Behavior in Patients with T2D (n = 148)

Variables	1	2	3	4	5	6	7	8	9	10
1. Age	1									
2. BMI	0.287**	1								
3. FBG	0.124	0.034	1							
4. HbA1C	0.035	0.065	0.933	1						
5. Knowledge	0.154	0.029	0.308	0.046	1					
6. Attitude	0.017	0.139	0.029	0.122	0.336**	1				
7. Subjective norm	0.054	0.074	0.115	0.143	0.294*	0.158	1			
8. Self-efficacy	0.068	0.125	0.260	0.138	0.348**	0.516**	0.472**	1		
9. Fear	0.013	0.044	0.082	0.037	0.312*	0.345*	0.389**	0.362*	1	
10. Medication adherence	0.083	0.122	0.042	0.064	0.382**	0.422**	0.312*	0.481*	0.305*	1
Mean ± SD	54.1 ± 8.2	28.3 ± 4.6	191.9 ± 72.9	8.1 ± 1.1	19.2 ± 2.8	42.4 ± 3.5	18.4 ± 2.3	16.6 ± 2.5	22.6 ± 3.2	3.5 ± 1.2

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed)
BMI — body mass index; FBG — fasting blood glucose; HbA1c — glycated hemoglobin

adherence behavior in patients with T2D based on three levels of knowledge (poor, moderate, and good) is reflected in Supplementary Table 1. The results of the one-way analysis of variance showed a significant difference in the mean of subjective norms according to different levels of knowledge. People whose mean knowledge score was reported to be good had higher social support than patients with low knowledge levels ($p < 0.001$). Also, the mean self-efficacy score of patients with a good level of knowledge was significantly higher than other patients ($p = 0.008$). In addition, the findings indicated a significant difference in the mean score of fear in patients according to three levels of knowledge. Patients whose level of knowledge was lower had less fear related to non-compliance, and the higher the knowledge, the higher the mean fear ($p < 0.001$).

Correlation coefficients between some demographic variables and medical records — such as age, BMI, FBG, and HbA1c — psychological constructs influencing medication adherence behavior in patients with diabetes are shown in Table 2. Among the demographic characteristics, only the correlation between BMI and age was positive and significant ($r = 0.287$, $p < 0.01$). Except for the correlation between attitude and subjective norms, other correlation coefficients between psychological constructs used in this research were positive, moderate, and significant ($p < 0.01$). Correlation coefficients between medication compliance behavior and the constructs of knowledge ($r = 0.382$, $p < 0.01$), attitude ($r = 0.422$, $p < 0.01$), subjective norms ($r = 0.312$, $p < 0.05$), self-efficacy ($r = 0.481$, $p < 0.05$) and fear ($r = 0.305$, $p < 0.05$) were positive and significant. In general, the strongest correlation coefficient was reported between attitude and self-efficacy ($r = 0.516$, $p < 0.01$).

The path model related to the impact of psychological constructs on medication adherence behavior in patients with T2D is shown in Figure 1. The fit indices generally show that the data fit well with the assumed model (Tab. 3). In addition, based on the standard regression coefficients and beta coefficients included in the path model, it can be said that self-efficacy is the most important construct that directly influences medication adherence ($\beta = 0.585$, $p < 0.05$), followed by attitude ($\beta = 0.328$, $p < 0.05$) and fear ($\beta = 0.265$, $p < 0.05$) are next.

Knowledge constructs and subjective norms did not have a direct and meaningful effect on medication adherence behavior; however, they exerted their influence indirectly through self-efficacy constructs, attitude and fear.

In addition, 47% of attitude variance is explained by three constructs of subjective norms, fear and knowledge. Attitude, knowledge and subjective norms also predicted 74% of self-efficacy variance. In general, the psychological constructs used in the model were able to describe 62% of the variance of medication adherence behavior in patients with T2D.

Discussion

The current study was conducted on 148 T2D patients in a cross-sectional manner. According to the findings of the study, it was shown that in general, the strongest correlation coefficient was reported between attitude and self-efficacy. Self-efficacy was the most

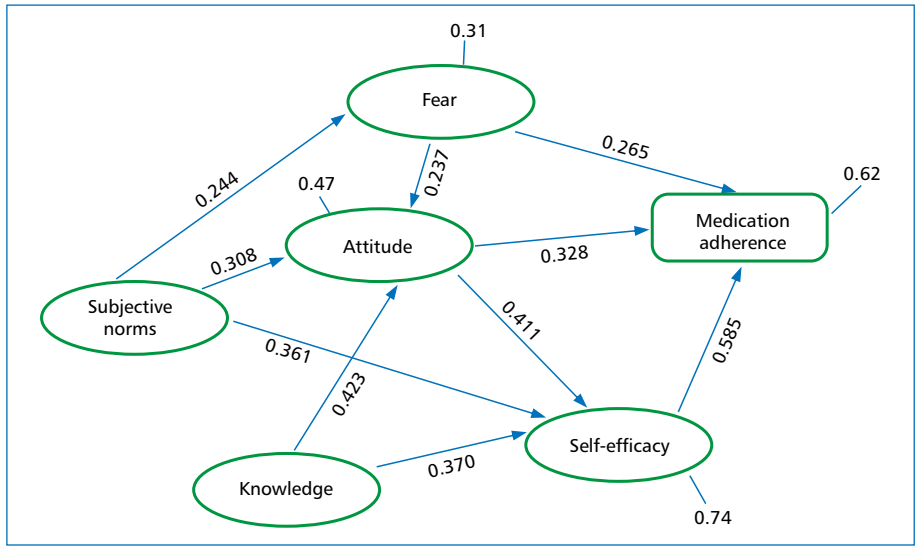

Figure 1. Path Model with Standard Regression Coefficients and Beta Coefficients of Psychological Constructs Affecting Medication Adherence in Patients with Type 2 Diabetes (n = 148)

Table 3. Comparison of Fitness Indices in Conceptual Model and Proposed Model

Index	Limit	Proposed model
χ^2/df	Less than 3	1.27*
GFI1	Higher than .90	0.94
AGFI2	Higher than .90	0.91
RMSEA3	Less than .08	0.061
CFI4	Higher than .90	0.93
NFI5	Higher than .90	0.95
NNFI6	Higher than .90	0.93

*$p < 0.001$
AGFI — adjusted goodness of fit index; CFI — comparative fit index; GFI — goodness of fit index; NFI — normalized fit index; non-normed fit index; RMSEA — root mean square error of approximation

important construct that directly affected medication adherence ($\beta = 0.585$, $p < 0.05$). Also, attitude ($\beta = = 0.328$, $p < 0.05$) and fear ($\beta = 0.265$, $p < 0.05$) were in the next ranks.

According to the findings of Gholamaliei et al.'s study [13], which was a cross-sectional study, 59.4% have poor adherence, and the most important reason for non-adherence to medication is the patient's beliefs, anxiety, self-efficacy, and the care team, which have a significant relationship with medication adherence. In line with the current study, Poya et al.'s study [14] showed that the most important solution for medication compliance was to increase motivation and remove obstacles and concerns in people with diabetes.

The findings of the study by Kelley et al. in Europe, which was aimed at collecting evidence about the knowledge, attitudes and beliefs of patients and caregivers about adherence to medication, showed that the beliefs and experiences of medications, support from families, and communication with doctors were the complications of the disease. The authors found self-efficacy, cost, and access to drugs have an effect on drug compliance, and they recommended appropriate interventions to increase compliance [15].

A higher self-efficacy score indicates the confidence of a person in the abilities and skills necessary to perform their tasks and affairs optimally and better medication adherence. The results of the study by Mohammadinejad et al. also showed that after the educational intervention that was done for 8 weeks the average self-efficacy was (167.60), which increased medication adherence behavior [16].

Also, the present results are consistent with the study of Huang et al. [17] in Taiwan with self-efficacy score (34.69 ± 4.93). The findings of the study showed that in order to improve self-efficacy, doctors should address the concerns of patients who have low health literacy and help patients.

The findings of the present study were also in line with Kang et al.'s study [18], which showed that the most important factor in improving the behavior and clarifying the variance of medication adherence is related to self-efficacy, so the need to create an intervention program that includes methods to increase self-efficacy was recommended.

The results of the study by Nafardi et al. [19] in Europe, which examined the relationship between the construct of self-efficacy and medication adherence,

showed that a high level of self-efficacy and a source of internal health control and attitudinal symmetry between the doctor and the patient, in relation to disease control, increase medication adherence. In Ye-Ming Huang's study [5], it was also shown that increasing self-efficacy will improve medication adherence behavior.

Patients' attitudes and fear reduce drug compliance behavior. In their study, MG Davis et al. also pointed out that fear of injection and embarrassment of injection in public are among the factors that reduce drug compliance behavior [20].

Saniseh Saeedi [21] also showed in her study that the fear of the consequences of diabetes caused by specialists improves the behavior of medication compliance.

The findings of Patnaik et al.'s study [22] in India, which was in line with the present study, in an educational intervention for three months, one text message every week and one phone call every three weeks to reduce stress in people with diabetes, showed that talking with the patient about his/her health and sending health messages was effective in reducing patients' stress and improving their mental state and attitude.

The results of the present study were in line with the findings of a cross-sectional study by Janouzi et al. [23] in Brazil, which showed the children of patients and doctors as important social and information sources. And it was in line with Baghikar et al.'s study [24] in the United States with the title factors affecting medication adherence in low-income people with diabetes. It showed that family support is an essential source of information and facilitator for medication adherence, which was in line with the present study.

The results of the present study were in line with the findings of Nandi et al.'s study [25] in America, which showed that educational interventions, including mobile phones, through social support, including family, friends, and health care professionals, will be effective on adherence and promotion of self-care behavior in people with diabetes.

The results of the study by Perirao et al. [26] in northern Portugal showed that family variables such as marital adjustment, partner support, coping with family and family stress were moderators in medication adherence, and this study shows the importance of family support and the role it plays in medication adherence in people with diabetes.

The findings of Kandasamy et al.'s study [27] in India assessing the effect of a pharmacist counseling intervention on improving follow-up and drug knowledge regarding diabetes showed that counseling by pharmacists and doctors increases knowledge and improves medication adherence in people with diabetes.

The application of theory of planned behavior (TPB) is a logical and scientific approach to predict healthy behavior that was used in this study. Moreover, this study was one of the first studies in the field of simultaneous use of fear and self-efficacy in order to predict medication adherence behavior in patients with diabetes. In addition, the use of AMOS 8.80 software to implement SEM was also one of the strengths of the current research.

Nevertheless, this study also faced several limitations like all research, which include: First, the number and answers of participants were affected by the special conditions related to the COVID-19 pandemic, which in addition to reducing the participation rate, can also lead to carelessness in the answers. Online methods of data collection can also increase the participation rate while reducing the risk of disease. Second, it was not possible to evaluate the causal relationships between the variables due to the cross-sectional nature of the research, and it is recommended to conduct longitudinal studies and follow up the relationships between different psychosocial variables and behavior at different time intervals. Third, despite confirming the validity of the self-report, these methods are always associated with a certain amount of bias, and the use of direct methods such as observation or interview is recommended to assess psychological characteristics. Finally, the participants in the present study were only patients who were referred to health centers in Qazvin city, and due to the different social, economic and cultural characteristics of this city from other cities in Iran, the results of the study cannot be generalized to other Iranians. More extensive studies with more samples from different urban-rural areas and different provinces are also suggested in order to increase the generalizability of the results.

Conclusions

According to the findings of this study, it was shown that various factors affect medication adherence behavior, among which self-efficacy is the most important reason, followed by subjective norms, attitudes and awareness of factors affecting medication adherence behavior.

Acknowledgments

Not applicable.

Conflict of interests

None declared.

REFERENCES

1. Tan JP, Cheng KK, Siah RCJ. A systematic review and meta-analysis on the effectiveness of education on medication adherence for patients with hypertension, hyperlipidaemia and diabetes. J Adv Nurs. 2019; 75(11): 2478–2494, doi: 10.1111/jan.14025, indexed in Pubmed: 30993749.
2. Costa E, Giardini A, Savin M, et al. Interventional tools to improve medication adherence: review of literature. Patient Prefer Adherence. 2015; 9: 1303–1314, doi: 10.2147/PPA.S87551, indexed in Pubmed: 26396502.
3. Khairnar R, Kamal KM, Giannetti V, et al. Barriers and facilitators to diabetes self-management in a primary care setting - Patient perspectives. Res Social Adm Pharm. 2019; 15(3): 279–286, doi: 10.1016/j.sapharm.2018.05.003, indexed in Pubmed: 29776663.
4. Huang YM, Shiyanbola OO, Smith PD. Association of health literacy and medication self-efficacy with medication adherence and diabetes control. Patient Prefer Adherence. 2018; 12: 793–802, doi: 10.2147/PPA.S153312, indexed in Pubmed: 29785094.
5. Huang YM, Shiyanbola OO, Chan HY. A path model linking health literacy, medication self-efficacy, medication adherence, and glycemic control. Patient Educ Couns. 2018; 101(11): 1906–1913, doi: 10.1016/j.pec.2018.06.010, indexed in Pubmed: 29935739.
6. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate Data Analysis. Cengage 2019.
7. Mohammadi Zeidi I, Morshedi H, Shokohi A. Predicting psychological factors affecting regular physical activity in hypertensive patients: Application of health action process approach model. Nurs Open. 2021; 8(1): 442–452, doi: 10.1002/nop2.645, indexed in Pubmed: 33318852.
8. Osborn C, Gonzalez J. Measuring insulin adherence among adults with type 2 diabetes. J Behav Med. 2016; 39(4): 633–641, doi: 10.1007/s10865-016-9741-y, indexed in Pubmed: 27062271.
9. Quandt SA, Ip EH, Kirk JK, et al. Assessment of a short diabetes knowledge instrument for older and minority adults. Diabetes Educ. 2014; 40(1): 68–76, doi: 10.1177/0145721713508824, indexed in Pubmed: 24163359.
10. Gutierrez J, Long JA. Reliability and validity of diabetes specific Health Beliefs Model scales in patients with diabetes and serious mental illness. Diabetes Res Clin Pract. 2011; 92(3): 342–347, doi: 10.1016/j.diabres.2011.02.018, indexed in Pubmed: 21411173.
11. Sleath B, Carpenter DM, Blalock SJ, et al. Development of a new diabetes medication self-efficacy scale and its association with both reported problems in using diabetes medications and self-reported adherence. Patient Prefer Adherence. 2016; 10: 1003––1010, doi: 10.2147/PPA.S101349, indexed in Pubmed: 27354769.
12. Khakzadi H, Morshedi H. Association between Health Literacy and Theory of Planned Behavior with Self-Care Behaviors in Type 2 Diabetic Patients. Journal of Torbat Heydariyeh University of Medical Sciences. 2019; 6(4): 33–46.
13. Gholamaliei B, Karimi-Shahanjarini A, Roshanaei G, et al. Medication Adherence and its Related Factors in Patients with Type II Diabetes. J Educ Community Health. 2017; 2(4): 3–12, doi: 10.21859/jech-02042.
14. Hashemi SM, Bouya S. Treatment adherence in diabetic patients: an important but forgotten issue. J Diabetes Nurs. 2018; 6(1): 341–351.
15. Kelly M, McCarthy S, Sahm LJ. Knowledge, attitudes and beliefs of patients and carers regarding medication adherence: a review of qualitative literature. Eur J Clin Pharmacol. 2014; 70(12): 1423–1431, doi: 10.1007/s00228-014-1761-3, indexed in Pubmed: 25277162.
16. Mohamadinejad F, Pedram Razi SH, Aliasgharpour M, et al. Effect of patient education program on self-efficacy in patients with diabetes. IJNR. 2015; 10(1): 35–41.
17. Huang YM, Shiyanbola OO, Chan HY, et al. Patient factors associated with diabetes medication adherence at different health literacy levels: a cross-sectional study at a family medicine clinic. Postgrad Med. 2020; 132(4): 328–336, doi: 10.1080/00325481.2020.1749499, indexed in Pubmed: 32233892.
18. Kang Y, Hur Y. Medication Adherence and Its Associated Factors in Laotians With Type 2 Diabetes Mellitus. Clinical Nursing Research. 2019; 29(5): 331–338, doi: 10.1177/1054773819849349.
19. Náfrádi L, Nakamoto K, Schulz PJ. Is patient empowerment the key to promote adherence? A systematic review of the relationship between self-efficacy, health locus of control and medication adherence. PLoS One. 2017; 12(10): e0186458, doi: 10.1371/journal.pone.0186458, indexed in Pubmed: 29040335.
20. Davies MJ, Gagliardino JJ, Gray LJ, et al. Real-world factors affecting adherence to insulin therapy in patients with Type 1 or Type 2 diabetes mellitus: a systematic review. Diabet Med. 2013; 30(5): 512–524, doi: 10.1111/dme.12128, indexed in Pubmed: 23323988.
21. Saidi S, Milnes L, Griffiths J. Fatalism, faith and fear: A case study of self-care practice among adults with Type 2 diabetes in urban Malaysia. Journal of Clinical Nursing. 2018; 27(19-20): 3758–3767, doi: 10.1111/jocn.14559.
22. Patnaik L, Joshi A, Sahu T. Mobile phone-based education and counseling to reduce stress among patients with diabetes mellitus attending a tertiary care hospital of India. Int J Prev Med. 2015; 6: 37, doi: 10.4103/2008-7802.156267, indexed in Pubmed: 25984287.
23. Jannuzzi FF, Rodrigues RC, Cornélio ME, et al. Beliefs related to adherence to oral antidiabetic treatment according to the Theory of Planned Behavior. Rev Lat Am Enfermagem. 2014; 22(4): 529–537, doi: 10.1590/0104-1169.3578.2448, indexed in Pubmed: 25296135.
24. Baghikar S, Benitez A, Fernandez Piñeros P, et al. Factors Impacting Adherence to Diabetes Medication Among Urban, Low Income Mexican-Americans with Diabetes. J Immigr Minor Health. 2019; 21(6): 1334–1341, doi: 10.1007/s10903-019-00867-9, indexed in Pubmed: 30798408.
25. Nundy S, Dick JJ, Solomon MC, et al. Developing a behavioral model for mobile phone-based diabetes interventions. Patient Educ Couns. 2013; 90(1): 125–132, doi: 10.1016/j.pec.2012.09.008, indexed in Pubmed: 23063349.
26. Pereira MG, Pedras S, Machado JC. Family variables as moderators between beliefs towards medicines and adherence to self-care behaviors and medication in type 2 diabetes. Fam Syst Health. 2014; 32(2): 198–206, doi: 10.1037/fsh0000029, indexed in Pubmed: 24707825.
27. Kandasamy K, Rajagopal SS. Impact of a Pharmacist Intervention on Improving Medication Adherence and Knowledge towards Diabetes Mellitus: A Randomised Controlled Study. International Journal of Pharmaceutical Research. 2019; 11(1), doi: 10.31838/ijpr/2019.11.01.049.

Supplementary Table 1. Comparison of Mean and Standard Deviation of Psychological Variables According to Level of Knowledge (n = 148)

Variables	Knowledge level			Significant level (One way ANOVA)
	Weak	Medium	Mood	
Attitude	3.61 ± 44.15[a]	3.21 ± 42.21[a]	4.38 ± 42.23[a]	F = 1.744, df = 2, p = 0.180
Subjective norms	15.41 ± 0.85[a]	18.72 ± 1.43[b]	22.23 ± 1.42[c]	F = 110.697, df = 2, p < 0.001
Self-efficacy	15.61 ± 2.05[a]	17.59 ± 3.40[b]	19.47 ± 2.32[c]	F = 29.081, df = 2, p = 0.008
Fear	20.27 ± 3.37[a]	22.99 ± 3.04[b]	24.62 ± 2.39[c]	F = 91.514, df = 2, p < 0.001
Medication adherence	3.43 ± 1.11[a]	3.5 ± 1.17[a]	4.06 ± 1.40[a]	F = 1.936, df = 2, p = 0.259

[a–c]significant difference between means