

## Original Article

### Association between medication adherence in patients with type 2 diabetes with their quality of life: A cross-sectional study

Shiva Borzouei<sup>1</sup>, Erfan Ayubi<sup>2</sup>, Saeid Bashirian<sup>2</sup>, Nasim Karimi<sup>3</sup>, Salman Khazaei<sup>4,5</sup>

<sup>1</sup>Department of Endocrinology, School of Medicine, Hamadan University of Medical Sciences, Hamadan, Iran

<sup>2</sup>Social Determinants of Health Research Center, Hamadan University of Medical Sciences, Hamadan, Iran

<sup>3</sup>Department of Epidemiology, Hamadan University of Medical Sciences, Hamadan, Iran

<sup>4</sup>Modeling of Noncommunicable Diseases Research Center, Hamadan University of Medical Sciences, Hamadan, Iran

<sup>5</sup>Autism Spectrum Disorders Research Center, Hamadan University of Medical Sciences, Hamadan, Iran

Corresponding authors\*: [salman.khazaei61@gmail.com](mailto:salman.khazaei61@gmail.com)

#### Abstract

**Background:** Assess the impact of medication adherence on quality of life (QOL) in patients with type 2 diabetes in different setting and societies, can be considered as a great clinical importance. Therefore, this study was designed for evaluation of association between medication adherence in patients with type 2 diabetes with their QOL.

**Methods:** This cross-sectional study was conducted on 279 diabetic type 2 positive cases referred to Endocrinology clinic in Hamadan City at the first six months of 2020. The short-form health survey SF-36 and MMAS-8 questionnaire was used for assessing health related QOL and medication adherence of patients, respectively. Correlations between each QOL domain with medication adherence were tested with Pearson's *r* coefficient.

**Results:** Among investigated patients, 154 (55.2%) of them were male and vast majority were urban dweller (91.07%). The number of 101 patients (36.07%) had high treatment adherence. We found a significant and positive correlation between medication adherence and domains of emotional wellbeing, social functioning, general health and total score of QOL ( $P > 0.05$ ). While there was a significant negative correlation between medication adherence and role limitations due to physical health ( $r = -0.14$ ,  $P = 0.02$ ).

**Conclusion:** Based on the findings of this study, diabetic patients with poor QOL may have less medication adherence, then such patients should be integrated e.g. in self-care education programs and reinforcement interventions to improve QOL and medication adherence.

**Keywords:** Medication Adherence, Quality of life, Diabetes

**Citation :** Borzouei S, Ayubi E, Bashirian S. Association between medication adherence in patients with type 2 diabetes with their quality of life: A cross-sectional study *Ethiop Med J* 61 (4) 351–357

**Submission date :** 6 January 2022 **Accepted:** 1 September 2023 **Published:** 24 September 2023

#### Introduction

Following the industrialization of countries in the 21<sup>st</sup> century, increasing life expectancy and lifestyle changes, the pattern of diseases has changed from acute to chronic such as diabetes mellitus (DM) (1). DM is the most prevalent metabolic disorder worldwide, described by the chronic form of hyperglycemia and resulted from a deficiency in insulin secretion or action or both (2). There are currently more than 415 million people lived with diabetes worldwide (3). Diabetes is responsible for 4 million deaths every year (9% of all deaths) (4). It is predicted that the prevalence of DM increase by 69% in less advanced countries until 2030 (5). The prevalence of diabetes in Iranian men and women is 8% and 10%,

respectively (6). The most prevalent type of DM is type 2 diabetes and affects about 90-95% of all people with diabetes (7). It is one of the major health problems in human life, because of the high prevalence, high cost of treatment as well as due to its severe disability (8, 9). This disease also affect the patient and their family quality of life (QOL) due to its multi organ involvement and chronic nature. The lower QOL has been reported with increased disease severity (5). Quality of life is a multidimensional fundamental factor and a combination of cognitive (satisfaction) and emotional (Happiness) factors. Therefore, the aim of the medical cares should be to improve the quality of life

(5). Self-management has been considered as the basis of success of long-term maintenance cares and prevention of disease comorbidities. Proper diet, physical activity and adherence to drug therapies (medication regimen) are among the self-management behaviors of patients with diabetes (4). Adherence to the medication regimen is defined as taking the prescribed drugs at the correct time and amount during the prescribed period (10).

The clinical effect of drug therapies for diabetic patients has been limited by low adherence behavior (11). The World Health Organization (WHO) has estimated that adherence behavior in diabetic patients for long-term maintenance in less advanced countries is only 50%, and even lower in developing countries (12). Results of the systematic review study showed that adherence to insulin therapy in patients with Type 1 or Type 2 diabetes mellitus was vary widely from 43% to 86% in different studies (13). The discontinuation rates of the drug use in a 30 days period of treatment reached 42% and injectable drugs of diabetes mellitus had the higher risk for discontinuation rather than oral medications (14). Generally, the incidence of non-adherence to drug therapies in diabetic patients is high due to the long length of treatment duration (15).

Low adherence to diabetes drugs regimen leads to treatment failure, damage to vital organs (such as kidneys), imposing financial cost to the patients and their family, lower quality of life and finally increased mortality (16).

It has been reported that patient's features like age, sex, education, income, history of disease in their family, duration of diabetes mellitus, and prescribed treatments could affect patient's quality of life. Also, some prescribed drugs can negatively affect the diabetes mellitus patient's quality of life (10, 17). The results of studies regarding the relation between quality of life of DM patients and adherence to drug treatment and glycemic control was not necessarily a significant relationship (11, 18, 19). We think some of these discrepancies may be due to the ignoring confounding factors and different instruments or methods used to measure diabetic patients QOL and adherence to drug treatment. Therefore, this study was designed for evaluation of association between medication adherence in patients with type 2 diabetes with their quality of life.

## Material and Methods

### Study design and setting

In this cross-sectional study, a total of 279 individuals with type 2 diabetes referred to Endocrinology clinic affiliated to Hamadan University of Medical Sciences, Hamadan City, Hamadan Province, Iran, in the first six months of 2020 were enrolled. This is a referral center for diabetic patients in Hamedan province, which provides diagnostic and treatment services to

patients by an endocrinology specialist. Additionally, nutritional services are provided by a nutritionist in this center. Since we were not aware of the population frame of patients and the pattern of patient referrals, we had no choice but to use non-probability sampling methods for choosing patients. We obtained oral informed consent from the patients.

### Eligibility criteria

To enter the study, at least six months must have passed since the patient was diagnosed with diabetes, and the patient must be willing to contribute in the study. Illiterate patients, patients with neurological diseases or with other known co-morbidities were omitted from the study.

### Data collection tools

We used a researcher-made checklist for gathering demographic variables of the patients including: gender, age, marital status, location and education.

The Iranian version of the health survey SF-36 in the short form was used to evaluate the health related quality of life in diabetic patients (20). The validity and reliability of this instrument was approved in previous studies (20). This questionnaire consists of 36 items with 8 domain including: general health (5 items), physical functioning (10 items), role limitations due to physical problems (4 items), social functioning (2 items), pain (2 items), energy/ fatigue (4 items), role limitations due to emotional problems (3 items) and emotional well-being (5 items). Each domain ranged from 0-100 scale, with higher scores representative better situation (21).

The Persian version of MMAS-8 was used for determine medication adherence of patients. Items 1 -7 are binary (yes/no) and item 8 has a five-point in the Likert response scale. "Yes" response to questions 1-7 is scored as 1 and "no" is scored as 0. About the item 8, to compute a summated score, the scores (0-4) be standardized by dividing the result by 4. Total scores for this questionnaire is ranged from 0 to 8, with scores of 8, 7 or 6 and <6 indicating high adherence, medium adherence and low adherence, respectively (3). The validity and reliability of the questionnaire to use in Iranian context has been approved in previous studies (22, 23).

### Data collection procedures

The data collection process involved asking patients questions by a trained nursing specialist before their visit with the physician or nutritionist. Additionally, some information was extracted from the patient's care and treatment records. The final questionnaire check was performed by the physician who is based at the center.

### Statistical Methods

Descriptive statistics including mean and SD for quantitative data and n (%) for qualitative data were used for describe demographic features of type 2 diabetic patients, and their medication adherence and quality of

life status. The normality assumption of the variables distribution was checked with shapiro-wilk test. An independent Student's t test was used for comparison the means of treatment adherence and quality of life, an analysis of variance (ANOVA) was used for comparison the means of medication adherence and quality of life according variables with more than two categories. Correlations between each quality of life domain with medication adherence were tested with Pearson's r coefficient. Data were analyzed using Stata- 14 software. Significant level was considered at the 5 % level ( $p < 0.05$ ).

### Ethical considerations

We obtained oral informed consent from the patients for participation to the study. The study has been approved by the Ethics Committee of Hamadan University of Medical Sciences (Ethics code: IR.UMSHA.REC.1398.620).

### Results

In total 279 diabetic patents were investigated. 154 (55.2%) of them were male and vast majority of them were urban dweller (91.07%). In regards of their edu-

cation and marital status, 132 (47.14%) had academic education and 239 (85.36%) were married. About half of them were in the age range of 54-60 years and 37 (13.21. %) were under 45 years old. 101 (36.07%) of the patients had high treatment adherence and in 87 (31.07%) of them medication adherence was low.

The relation between medication adherence and quality of life according demographic variables is shown in table 1. As shown, there was not a significant association between patient's demographic characteristics and their treatment adherence status ( $P > 0.05$ ). While, males had reported higher score of quality of life compared women ( $P = 0.008$ ), and increasing the level of education was associated with increasing the quality of life ( $P < 0.001$ ). Also there was a significant association between marital status and quality of life (49.58 for married vs. 45.54 for single patients,  $P = 0.009$ ). With increase in the age of patients, their quality of life has decreased significantly ( $P = 0.03$ ).

**Table 1.** Medication adherence and quality of life by demographic variables

Variable	Total (%)	Medication adherence status (<6: poor, 6-7.9: moderate, 8: good)			Quality of life (SF35 score)				
		Poor 87 (31.07)	Moder- ate 92 (32.86)	Good 101 (36.07)	Mean (SD)	P*	Mean (SD)	p	
Gender	Male	125 (44.8)	40 (31.75)	45 (35.71)	41 (32.54)	6.38 (1.67)	0.21	50.61 (8.96)	0.008**
	Female	154 (55.2)	47 (30.52)	47 (30.52)	60 (38.96)	6.61 (1.47)		47.69 (9.24)	
Educa- tion	Illiterate	56 (20)	21 (37.5)	15 (26.79)	20 (35.71)	6.46 (1.51)	0.31	45.31 (9.92)	<0.001*
	Diploma and less Academ- ic	92 (32.86)	22 (23.91)	34 (36.96)	36 (39.13)	6.71 (1.34)		48.32 (9.22)	
Marital status	Single	41 (14.64)	15 (36.59)	13 (31.71)	13 (31.71)	6.37 (1.6)	0.54	45.54 (7.75)	0.009**
	Married	239 (85.36)	72 (30.13)	79 (33.05)	88 (36.82)	6.53 (1.56)		49.58 (9.33)	
Age group (year)	30-44.9	37 (13.21)	16 (43.24)	12 (32.43)	9 (24.32)	6.09 (1.55)	0.12	52.2 (8.06)	0.03***
	45-59.9	137 (48.93)	37 (27.01)	55 (40.15)	45 (32.85)	6.47 (1.62)		49.81 (8.91)	
	60+	106 (37.86)	34 (32.08)	25 (23.58)	47 (44.34)	6.7 (1.48)		46.84 (9.55)	
Loca- tion	Urban	255 (91.07)	79 (30.98)	83 (32.55)	93 (36.47)	6.52 (1.57)	0.69	49.04 (8.83)	0.72**
	Rural	25 (8.93)	8 (32)	9 (36)	8 (32)	6.39 (1.54)		48.34 (12.7)	

\*Chi- square test, \*\* student t-test, \*\*\* One way ANOV

The mean scores for domains of the quality of life was ranged from 11.79 in the role limitations due to emotional problems domain to 79.74 in the social functioning domain. The total mean (SD) score of quality of life for patients was 48.98 (9.22) (**Table 2**).

**Table 2.** Quality of life components mean score of the study population

SF36 domains	Range	Mean (SD)
Physical functioning	0, 100	69 (28.17)
Role limitations due to physical health	2.5, 100	16.78 (26.04)
Role limitations due to emotional problems	1.33, 100	11.79 (19.88)
Energy/ fatigue	10, 90	45.28 (19.05)
Emotional well being	8, 88	58.2 (18.17)
Social functioning	12.5, 100	79.74 (20.44)
Pain	0, 100	76.53 (28.16)
General health	0.4, 62	34.99 (14.76)
SF36, total score	13.38, 69.37	48.98 (9.22)

The correlation between medication adherence of patients and domains of quality of life is shown in table 3. There was a significant positive correlation between medication adherence and domains of emotional wellbeing, social functioning, general health and total score of quality of life ( $P>0.05$ ). While there was a significant negative correlation between medication adherence and role limitations due to physical health ( $r=-0.14$ ,  $P=0.02$ ).

**Table 3.** Correlation between medication adherence and domains of quality of life

Medication adherence		
SF36 domains	r*	p
Physical functioning	0.04	0.54
Role limitations due to physical health	-0.14	0.02
Role limitations due to emotional problems	-0.09	0.14
Energy/ fatigue	0.09	0.13
Emotional well being	0.18	0.003
Social functioning	0.22	<0.001
Pain	0.2	<0.001
General health	0.16	0.006
SF36, total score	0.18	0.003

\*Pearson correlation coefficient

## Discussion

The aim of the present study was to detect some socio-demographic determinants of treatment adherence and QOL in type 2 diabetes patients. Moreover, we examined the correlation between medication adherence and QOL. In the present study, no association between studied socio-demographic determinants and medication adherence was found while, male patients, well-educated patients, those were married and were younger had a higher score of QOL. We also found a positive correlation between medication adherence and overall QOL.

Since the rate of non-adherence to medications is reported lower than 50% among patients with type 2 diabetes in some previous studies in Iran (24, 25), it is needed to pay attention to the determining factors of medication adherence patients with type 2 diabetes is obvious. In the present study, we found that there was no socio-demographic difference in medication adherence. However, other studies have demonstrated that several factors including education level, type of medication, age, body mass index, the presence of complications, treatment duration, perceived side effect and negative effect of medicines, lack of finances and stage of diabetes may be associated with medication adherence in patients with type 2 diabetes (24, 26-30). Another point that can be mentioned is that other type of adherence in type 2 diabetes patients e.g. exercise, blood test and foot care could be modified by type of treatment. For example, in the study by Zioga et al. (31), they found that the type of treatment (diet, oral medication and insulin) is associated with adherence to blood tests.

In the line of previous studies (32-37), our results have shown that older age patients, women, those with lower education level and singles had a lower score of QOL. Other important sociodemographic characteristics that reported as determinants of QOL and not studied in the present study were income and occupation e.g. unemployment patients (34) and those with lower household income per month (33) had a lower level of overall QOL and domains of QOL. Regardless of sociodemographic characteristics, the factors including exercise, the presence of complications, comorbidities, duration of disease, psychological disorders and diet were also suggested as determinants of QOL in type 2 diabetes patients (38).

The results from previous studies showed tendency toward a positive association (5, 10, 29, 31, 39), however, some studies reported a no association between two aforementioned variables (11, 40). Heterogeneity in the reported association in previous studies may be as results of several factors e.g. type of method for medication adherence and QOL assessment. For example, in the studies that reported a positive association, medication adherence was evaluated using the

methods such as MMAS (5) Brief Medication Questionnaire (BMQ) (10), frequency of statin use (39), Diabetes Self-Care Activities Questionnaire (31) and Diabetes Self-Care Activities Questionnaire (29). In the studies that showed no association, the medication adherence was assessed using the methods such as pill counting (11) and hemoglobin A1c (HbA1c) (40).

Most studies used non-specific tools to measure QOL e.g. WHO Quality of Life (WHOQOL) (11, 39, 41), SF36 (29, 31), EQ-5D (42, 43) when evaluating the association between QOL and medication adherence while some used a diabetes-specific-QOL e.g. Diabetes 39 instrument (5) and Diabetes Quality of Life Clinical Trial Questionnaire (DQLCTQ) (10). In the present study, we used SF36 for QOL assessment and our results showed the positive statistical correlation between medication adherence and QOL domains including physical functioning, emotional well-being, social functioning, pain and general health. In other hands, the negative correlation between medication adherence and physical role as well as no statistical association between medication adherence and QOL domains including physical functioning, physical role and energy/fatigue were found. In a study by Marinho et al. (29), they used SF36 to measure the quality of life and their results suggested that SF-36 emotional domain was also associated positively related to better general medication adherence. In other work (31) suggested that an association between all domains of QOL and all adherence subscales including diet, physical activity, blood sugar test, care of feet and commendations for self-care. In another study by Perwitasari et al (10), they used DQLCTQ a specific tool for QOL assessment in diabetic patients and their results showed that beliefs, recall, and beliefs about adverse event screens as a QOL domain is related positively to medication adherence. In the study by Khayyat et al (44), the mean level of overall QOL and all QOL domains among adherent's patients with diabetes and hypertension was higher than those in non-adherent patients group.

## References

1. Adogu P, Ubajaka C, Emelumadu O, Alutu C. Epidemiologic transition of diseases and health-related events in developing countries: a review. *American Journal of Medicine and Medical Sciences*. 2015;5(4):150-7.
2. Piero M, Nzaro G, Njagi J. Diabetes mellitus-a devastating metabolic disorder. *Asian journal of biomedical and pharmaceutical sciences*. 2015;5(40):1.
3. Satyawali V, Pandey S, Sharma V, Titiyal GS, Panwar N, Kumar P, et al. Assessment of level of awareness for diabetes mellitus, its systemic and ocular complications: a questionnaire-based survey at tertiary care Centre of Kumaon Region. *Journal of evolution of medical and dental sciences-jemds*. 2016;5(68):4856-60.
4. Dashtian M, Eftekhari Ardebili H, Karimzadeh Shirazi K, Shahmoradi M, Azam K. Predicting Factors Affecting Medication Adherence and Physical Activity in Patients with Type-2 Diabetes Mellitus Based on the Theory of Planned Behavior. *Journal of School of Public Health and Institute of Public Health Research*. 2017;15(2):133-46.
5. Alfian SD, Sukandar H, Lestari K, Abdulah R. Medication adherence contributes to an improved quality of life in type 2 diabetes mellitus patients: A cross-sectional study. *Diabetes Therapy*. 2016;7(4):755-64.

There are several limitations to this study. First, the temporal relationship between medication adherence and QOL with a 1-time measurement of them could not be established and this is an intrinsic limitation of a cross sectional study. For example, in one work (44) medication adherence was studied as an independent predictor of QOL while in another study (29) QOL domains were introduced as important determinants of medication adherence in patients with type 2 diabetes. Second, the impact of self-report response bias on the observed results should be considered. Third, several inclusion criteria were considered which may reduce generalizability and external validity of this study, e.g. the results may be not applied to illiterate patients. Forth, it was not possible to measure potential confounders in the causal chain of QOL-medication adherence. For example, depression was not measured in this study which is a determinant for both QOL and medication adherence. (45, 46).

In conclusion, our results show an association between medication adherence and overall QOL and some QOL domains. Based on the findings of this study, diabetic patients with poor QOL may have less medication adherence, then such patients should be integrated e.g. in self-care education programs and reinforcement interventions to improve QOL and medication adherence. Further large-scale longitudinal studies with a bigger dataset are recommended.

## Acknowledgments

The Deputy of Research and Technology from Hamadan University of Medical Sciences financially supported this study (Research Id: 9807305712, Ethics code: IR.UMSHA.REC.1398.620). We would like thanks from all patients that participate in this study.

## Conflict of interest

The authors declare that there is no conflict of interests.

6. Imani A, Dabirian A. Telenursing Benefits in patients with Diabetes: A Review Article. *Advances in Nursing & Midwifery*. 2014;23(83):65-74.
7. Trikkalinou A, Papazafiropoulou AK, Melidonis A. Type 2 diabetes and quality of life. *World journal of diabetes*. 2017;8(4):120.
8. Chaudhury A, Duvoor C, Reddy Dendi VS, Kraleti S, Chada A, Ravilla R, et al. Clinical review of antidiabetic drugs: implications for type 2 diabetes mellitus management. *Frontiers in endocrinology*. 2017;8:6.
9. Razavi Ns, Majlessi F, Mohebibi B, Tol A, Azam K. Assessing the effect of educational intervention on treatment adherence based on aim model among patients with type 2 diabetes. *Iranian Journal of Diabetes and Lipid Disorders*. 2017;16(3):173-82.
10. Perwitasari DA, Urbayatun S. Treatment adherence and quality of life in diabetes mellitus patients in Indonesia. *Sage Open*. 2016;6(2):2158244016643748.
11. Martínez YV, Prado-Aguilar CA, Rascón-Pacheco RA, Valdivia-Martínez JJ. Quality of life associated with treatment adherence in patients with type 2 diabetes: a cross-sectional study. *BMC Health Services Research*. 2008;8(1):164.
12. Saleh F, Mumu SJ, Ara F, Hafez MA, Ali L. Non-adherence to self-care practices & medication and health related quality of life among patients with type 2 diabetes: a cross-sectional study. *BMC public health*. 2014;14(1):431.
13. Davies M, Gagliardino JJ, Gray L, Khunti K, Mohan V, Hughes R. Real-world factors affecting adherence to insulin therapy in patients with Type 1 or Type 2 diabetes mellitus: a systematic review. *Diabetic Medicine*. 2013;30(5):512-24.
14. Zullig LL, Gellad WF, Moaddeb J, Crowley MJ, Shrank W, Granger BB, et al. Improving diabetes medication adherence: successful, scalable interventions. *Patient preference and adherence*. 2015;9:139.
15. Blackburn DF, Swidrovich J, Lemstra M. Non-adherence in type 2 diabetes: practical considerations for interpreting the literature. *Patient preference and adherence*. 2013;7:183-9.
16. Schoenthaler A, Montague E, Baier Manwell L, Brown R, Schwartz MD, Linzer M. Patient–physician racial/ethnic concordance and blood pressure control: the role of trust and medication adherence. *Ethnicity & health*. 2014;19(5):565-78.
17. Daher AM, AlMashoor SAH, Winn T. Glycaemic control and quality of life among ethnically diverse Malaysian diabetic patients. *Quality of Life Research*. 2015;24(4):951-8.
18. Lau CY, Qureshi AK, Scott SG. Association between glycaemic control and quality of life in diabetes mellitus. *Journal of postgraduate medicine*. 2004;50(3):189-93; discussion 94.
19. Pitale S, Kernan-Schroeder D, Emanuele N, Sawin C, Sacks J, Abaira C. Health-related quality of life in the VA Feasibility Study on glycemic control and complications in type 2 diabetes mellitus. *Journal of diabetes and its complications*. 2005;19(4):207-11.
20. Montazeri A, Goshtasebi A, Vahdaninia M, Gandek B. The Short Form Health Survey (SF-36): translation and validation study of the Iranian version. *Quality of life research*. 2005;14(3):875-82.
21. John E. SF-36 health survey: manual and interpretation guide: Health Assessment Lab; 2000.
22. Dehghan M, Nayeri ND, Karimzadeh P, Iranmanesh S. Psychometric properties of the Persian version of the Morisky medication adherence scale-8. *Journal of Advances in Medicine and Medical Research*. 2015:1-10.
23. Moharamzad Y, Saadat H, Shahraki BN, Rai A, Saadat Z, Aerab-Sheibani H, 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.
24. Benrazavy L, Khalooei A. Medication Adherence and its Predictors in Type 2 Diabetic Patients Referring to Urban Primary Health Care Centers in Kerman City, Southeastern Iran. *Shiraz E-Medical Journal*. 2019(In Press).
25. Farsaei S, Sabzghabae AM, Zargarzadeh AH, Amini M. Adherence to glyburide and metformin and associated factors in type 2 diabetes in isfahan, iran. *Iran J Pharm Res*. 2011;10(4):933-9.
26. Aflakseir A. Role of illness and medication perceptions on adherence to medication in a group of Iranian patients with type 2 diabetes. *Journal of diabetes*. 2012;4(3):243-7.
27. Aminde LN, Tindong M, Ngwasiri CA, Aminde JA, Njim T, Fondong AA, et al. Adherence to antidiabetic medication and factors associated with non-adherence among patients with type-2 diabetes mellitus in two regional hospitals in Cameroon. *BMC endocrine disorders*. 2019;19(1):35.
28. Lin L-K, Sun Y, Heng BH, Chew DEK, Chong P-N. Medication adherence and glycemic control among newly diagnosed diabetes patients. *BMJ Open Diabetes Research & Care*. 2017;5(1):e000429.
29. Marinho FS, Moram C, Rodrigues PC, Leite NC, Salles GF, Cardoso CR. Treatment adherence and its associated factors in patients with type 2 diabetes: results from the Rio de Janeiro type 2 diabetes cohort study. *Journal of diabetes research*. 2018;2018.
30. Wabe NT, Angamo MT, Hussein S. Medication adherence in diabetes mellitus and self management practices among type-2 diabetics in Ethiopia. *North American journal of medical sciences*. 2011;3(9):418.

31. Zioga E, Kazakos K, Dimopoulos E, Koutras C, Marmara K, Marmara E-E, et al. Adherence and quality of life in patients with type II diabetes mellitus in northern Greece. *Materia socio-medica*. 2016;28(4):258.
32. Abedini MR, Bijari B, Miri Z, Shakhs Emampour F, Abbasi A. The quality of life of the patients with diabetes type 2 using EQ-5D-5 L in Birjand. *Health and quality of life outcomes*. 2020;18(1):18.
33. Gholami A, Azini M, Borji A, Shirazi F, Sharafi Z, Zarei E. Quality of Life in Patients with Type 2 Diabetes: Application of WHOQoL-BREF Scale. *Shiraz E-Med J*. 2013;14(3):162-71.
34. Javanbakht M, Abolhasani F, Mashayekhi A, Baradaran HR, Jahangiri noudeh Y. Health related quality of life in patients with type 2 diabetes mellitus in Iran: a national survey. *PloS one*. 2012;7(8):e44526.
35. John R, Pise S, Chaudhari L, Deshpande PR. Evaluation of Quality of Life in Type 2 Diabetes Mellitus Patients Using Quality of Life Instrument for Indian Diabetic Patients: A Cross-Sectional Study. *Journal of mid-life health*. 2019;10(2):81-8.
36. Khalili M, Sabouhi F, Abazari P, Aminorroaya A. Comparing the quality of life in insulin recipient and refusal patients with type 2 diabetes. *Iranian journal of nursing and midwifery research*. 2016;21(4):351-6.
37. Zurita-Cruz JN, Manuel-Apolinar L, Arellano-Flores ML, Gutierrez-Gonzalez A, Najera-Ahumada AG, Cisneros-González N. Health and quality of life outcomes impairment of quality of life in type 2 diabetes mellitus: a cross-sectional study. *Health and quality of life outcomes*. 2018;16(1):94.
38. Jing X, Chen J, Dong Y, Han D, Zhao H, Wang X, et al. Related factors of quality of life of type 2 diabetes patients: a systematic review and meta-analysis. *Health and quality of life outcomes*. 2018;16(1):189.
39. Farhat R, Assaf J, Jabbour H, Licha H, Hajj A, Hallit S, et al. Adherence to oral glucose lowering drugs, quality of life, treatment satisfaction and illness perception: A cross-sectional study in patients with type 2 diabetes. *Saudi Pharmaceutical Journal*. 2019;27(1):126-32.
40. Kleefstra N, Ubink-Veltmaat L, Houweling S, Groenier K, Meyboom-de Jong B, Bilo H. Cross-sectional relationship between glycaemic control, hyperglycaemic symptoms and quality of life in type 2 diabetes (ZODIAC-2). *Neth J Med*. 2005;63(6):215-21.
41. Chew BH. Medication adherence on quality of life among adults with type 2 diabetes mellitus: an exploratory analysis on the EDDMQoL study. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*. 2015;24(11):2723-31.
42. Babenko AY, Mosikian AA, Lebedev DL, Khrabrova EA, Shlyakhto EV. Mental state, psychoemotional status, quality of life and treatment compliance in patients with Type 2 diabetes mellitus. *Journal of comparative effectiveness research*. 2019;8(2):113-20.
43. Saleh F, Mumu SJ, Ara F, Hafez MA, Ali L. Non-adherence to self-care practices & medication and health related quality of life among patients with type 2 diabetes: a cross-sectional study. *BMC public health*. 2014;14:431.
44. Khayyat SM, Mohamed MMA, Khayyat SMS, Hyat Alhazmi RS, Korani MF, Allugmani EB, et al. Association between medication adherence and quality of life of patients with diabetes and hypertension attending primary care clinics: a cross-sectional survey. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*. 2019;28(4):1053-61.
45. Lin EH, Katon W, Von Korff M, Rutter C, Simon GE, Oliver M, et al. Relationship of depression and diabetes self-care, medication adherence, and preventive care. *Diabetes care*. 2004;27(9):2154-60.
46. Schram MT, Baan CA, Pouwer F. Depression and quality of life in patients with diabetes: a systematic review from the European depression in diabetes (EDID) research consortium. *Current diabetes reviews*. 2009;5(2):112-9.