



Effect of patients beliefs about medications on adherence to drugs in diabetic patients attending family medicine outpatient clinic in Ismailia, Egypt

Hend Mikhail Salama¹ · Rabab Atta Saudi¹

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Abstract

Background Adherence affected by many factors in the patient or in the treatment. One of these factors is beliefs about medicine, which is modifiable. This study aimed to assess the effect of beliefs about medicines on adherence to medications in diabetic patients.

Methods It is a cross-sectional descriptive-analytic study, conducted between March 2019 and June 2019, in Family medicine outpatient clinic, Suez Canal University, Egypt. A consecutive sample of diabetic patients presented to the clinic in the period of study was included until fulfilling sample size (82 patients). They filled validated questionnaires of the Morisky Medication Adherence Scale, Beliefs about Medicine, and socio-demographic characteristics.

Results About half of the patients were non-adherent (54.9%). The necessity beliefs mean was 18.6, while the median was 20, concerns beliefs mean was 14.2, while the median was 14, overuse beliefs mean was 12.2, while the median was 13, finally mean and median of harm score was 11.0. There was a statistically significant relationship between age, education, concern, and harm score with adherence ($p = 0.04, 0.02, < 0.001, \text{ and } 0.03$). Age was a positive predictor of adherence; and concern beliefs score was a negative predictor of adherence.

Conclusions Physicians should inquire about their patient medication beliefs and its effect on patient adherence to discover and solve concerns of diabetic patients to improve non-adherence.

Keywords Adherence · BMQ · Diabetes · Medication beliefs · MMAS-8

Introduction

Chronic illness is an important worldwide health problem; due to the increasing number of patients affected. World Health Organization (WHO) mentioned that the patients diagnosed with type-2 diabetes mellitus increased from 108 to 422 million [1]. The adherence to medication in diabetes mellitus patients was found to be sub-optimal. There is a need for better approaches of primary health care physicians' in the management of individual patients, by taking into account their

medication adherence levels, which is essential for successful diabetes treatment [2].

Adherence to treatment regimens in type-2 diabetes patients varies widely from 36 to 93%. Patient's acceptance of medical regimens and doctors' advice may be affected by their own beliefs about their illness and medications. Therefore, it is important to consider beliefs when providing health education and/or giving medical treatment [3].

Diabetes leads to complications as increased morbidity and early mortality due to inadequately controlled diabetes, resulting in a high burden to patients, their families, society, and health care systems globally [4]. Diabetic patients need to perform self-care activities to prevent complications related to inadequate glucose control and to improve their quality of life. Hence, it is important to evaluate the adherence to diabetes self-care to identify and solve the problem in diabetes management; which improves diabetes control and alleviates the burden of complications [5].

✉ Hend Mikhail Salama
hind_mikhail@yahoo.com

Rabab Atta Saudi
Rabab.saudi@yahoo.com

¹ Department of Family Medicine, Faculty of Medicine, Suez Canal University, Ismailia, Egypt

Adherence was defined as “the extent to which a person’s behavior, taking medication, following a diet, and/or executing lifestyle changes, corresponds to agreed recommendations from a healthcare provider” [6]. Non-adherence classified as intentional, and unintentional: unintentional if a patient does not take the medicine due to forgetfulness or inaccessible, however, intentional if the cause is personal beliefs or evaluation to the medicine [7].

Non-adherence affected by many factors in the patient or treatment [8, 9]. One of those factors is beliefs about medicine, which can be modified [9]. Many researchers recommend a patient-centered approach when managing non-adherence problem [10]. This can be achieved by asking about patients’ beliefs about medicines, which is an essential factor affecting adherence [11, 12].

In a recent study on 343 participants about the impact of the patient beliefs on adherence; 54% reported low adherence, adherence was affected by at least one barrier in 51%, and 52% of all sample reported negative more than positive beliefs about medicines. When beliefs and barriers are compared together, barriers have no impact on adherence while patients’ negative beliefs affected adherence as 49% of the sample was less likely to adhere than those with more positive beliefs [13]. In another study in Palestine on chronic diseases, 69.5% of the patients were non-adherent [14].

Also, another study about patient beliefs about anti-hyperglycemic and anti-hypertensive treatment reported that diabetic patients with diminished health literacy were concerned about the harmfulness of drugs, so they under-use medicines and have higher blood pressure [15].

In this study, we focus on beliefs about medicines because it is an important and modifiable cause of non-adherence through educational and psycho-social interventions. This study aimed to assess the effect of beliefs about medicines on adherence to medications in diabetic patients to raise physicians’ awareness about the problem and improve the patient-centered approach in managing non-adherence due to patients’ beliefs.

Subjects and methods

Study design and setting

This study is a cross-sectional descriptive-analytic study; it was conducted between March 2019 and June 2019, It was carried out in the Family medicine outpatient clinic in the Suez Canal University Hospital in Ismailia city, Egypt.

Study population

All Patients with type-2 diabetes mellitus presented to Family Medicine outpatient clinic during the study period, which

fulfilled the inclusion criteria and agreed to participate in the study were included.

Inclusion and exclusion criteria

Adult participants aged above 18 years old, male or female, those who have literacy and could understand the questionnaire, have diabetes type 2, and on a treatment regimen for diabetes were included in the study. Those who were very sick or refused to participate were excluded from the study.

Sampling

It was planned to take a sample sufficient to demonstrate a 69.5% prevalence of non-adherence among patients with chronic illness. The sample size was calculated using the following formula: [16].

$$n = \left[\frac{Z_{\alpha/2}}{E} \right]^2 * P(1-P)$$

Where:

n = sample size.

$Z_{\alpha/2}$ = 1.96 (The critical value that divides the central 95% of the Z distribution from the 5% in the tail).

P₁ = Prevalence/proportion in the study group = 69.5% [14].

E = Margin of error = 10%.

So, by calculation, the sample size was 82 patients. Consecutive convenience sample of type-2 diabetic patients from those presented to the family medicine outpatient clinic in the period of study (May–June 2019) was included to fulfill the sample size.

Study tools

The questionnaire contained three parts:

Part 1 contains socio-demographic and medical characteristics: age, sex, residence, level of education, work, income, marital status, if patient lives alone, co-morbidities, and the number of medications used daily.

Part 2 Morisky Medication Adherence Scale (MMAS-8).

Adherence was assessed by the Arabic version of the Morisky Medication Adherence Scale (MMAS) [17], a valid instrument and has been validated on other Arabic patients suffering from chronic diseases. MMAS consists of eight items that target specific medication-taking behavior and adherence. The first seven items with dichotomous responses (yes/no). The total score of MMAS ranges from 0 to 8, with higher scores representing better adherence. In this study, MMAS score below 6 indicates non-adherence, a score between 6 and 7 represent medium adherence and a score of 8 is

high adherence [18]. The tool faced validity and reliability with Cronbach's α of 0.75 [19].

Part 3 Beliefs about Medicine Questionnaire: (BMQ-Specific and BMQ-General) a self-reporting measure with proven validity, and reliability [20]. It consists of 18 items and two sections. The two sections of the BMQ can be used in combination or separately. (1) BMQ-Specific: consists of two 5-item factors to assess beliefs about the necessity of prescribed medication (Specific-Necessity) and concerns about prescribed medication due to beliefs about the danger of dependence and long-term toxicity and disruptive effects of medication (Specific-Concerns). Each part of the specific questionnaire has a score ranging from five to 25. (2) BMQ-General contains two 4-item factors to assess beliefs about the medicines that are harmful, addictive, poisons, and not be taken continuously (General-Harm) and medicines are overused by doctors (General-Overuse). Each part of the general questionnaire has a potential score ranging from four to 20 [20].

Translation of questionnaire

Using accepted guidelines for translation–back-translation. The Beliefs about Medicine questionnaire was translated into Arabic. It was back-translated into English by a bilingual consultant, and then both translators counsel for necessary modifications, restatement, and rewording then the questionnaire faced validity by three expert opinions with no major modifications. A pilot study carried out on 30 patients before the study to assess the feasibility and reliability of the questionnaire, with acceptable Cronbach's α of 0.7.

Data collection

Data collected by a nurse, who works in the Family Medicine Outpatient Clinic. Privacy and confidentiality confirmed throughout the process of data collection. Data were collected from May to June 2019. The research protocol was approved by the Faculty of Medicine, Suez Canal University Research Ethics Committee, protecting human subjects. Participants were provided with information about the background of the study and informed that participation is voluntary, they could withdraw from the study at any time and informed consent was obtained from patients. All data is confidential to the researcher and was anonymous, data saved on a computer with password protection and encryption.

To avoid recall bias counting of patient pills was done as they get their medicines with them to the clinic. To avoid selection bias a nurse was responsible for data collection after training her.

Outcome variables

Adherence to antidiabetic medications and patients' beliefs about medications.

Statistical analysis

Collected data were analyzed using SPSS version 24. Data were tested for normality using the Shapiro-Wilk test. Categorical and descriptive data were presented in frequencies and percentages. Continuous data were presented as mean \pm SD, median and inter-quartile range (IQR). The chi-squared test was used as a test of significance to compare categorical data, and a non-parametric test (Mann-Whitney test) was used for relationships between categorical variables and continuous non-normally distributed variables. Binary Logistic regression analysis for adherence was performed. Tests were two-tailed and *P* value was considered significant if <0.05 .

Research ethics

The Ethics Committee of Faculty of Medicine, Suez Canal University approved the study in November 2018 (code 3223#). Informed consent was obtained from all participants included in the study.

Results

Our study included 82 diabetic patients; age mean \pm SD is 52.98 ± 13.0 years. The majority of patients were married and females. About half of the sample 37 (45.1%) have diabetes for 5 to 10 years. About two-thirds of patients 55 (67.1%) have more than 2 chronic conditions, the mean of total daily medications was 4.3 (Table 1).

Table 2 shows that half of the patients 45 (54.9%) were non-adherent to diabetes treatment. The mean of necessity beliefs score was 18.6 ± 3.5 , while the mean of concerns beliefs was 14.2 ± 4.3 , mean of overuse beliefs was 12.2 ± 2.8 , and mean of harm score was 11.0 ± 3.0 .

Patients aged 50 years or more were more adherent than younger patients ($p = 0.04$), also patients with education lower than secondary school were more adherent than higher educated patients ($p = 0.02$) (Table 3) Educated patients have higher concern beliefs than less educated ($p = 0.01$). Patients with higher scores of concern beliefs were non-adherent ($p < 0.001$). In addition, patients with higher scores of harm beliefs were non-adherent ($p = 0.03$) (Table 4).

Table 5 shows that age was a positive predictor for adherence in diabetic patients; while concern beliefs were a negative predictor for adherence.

Table 1 Socio-demographic characteristics (*n* = 82)

		Count	%
Age(years)	<40	10	12.2
	40-	21	25.6
	50-	25	30.5
	≥60	26	31.7
	Mean ± SD	52.98 ± 13.0	
Gender	Male	12	14.6
	Female	70	85.4
Marital status	Without family	16	19.5
	Have family	66	80.5
Education	No formal Schooling	47	57.3
	Primary/ Prep. school	13	15.9
	secondary school	21	25.6
	High education	1	1.2
Income	Insufficient	55	67.1
	Sufficient	27	32.9
Residency	Rural	45	54.9
	Urban	37	45.1
Duration of diabetes (years)	≤5	17	20.7
	>5–10	37	45.1
	>10 years	28	34.1
Live alone	No	71	86.6
	Yes	11	14.4
Comorbidity (N of chronic conditions)	1	9	11
	2	18	22
	>2	55	67.1
Number of medications for diabetes	1	16	19.5
	2	62	75.6
	>2	4	4.9
Number of all daily medications	Mean ± SD	4.3 ± 2.26	

Table 2 Adherence to diabetes medications and beliefs of study sample (*n* = 82)

		Count	%
Adherence to Diabetes medications	Non-adherence	45	54.9
	Medium adherence	24	29.3
	High adherence	13	15.9
Specific Necessity beliefs	Mean ± SD	18.6 ± 3.5	
	Median (IQR)	20 (18–20)	
Specific Concern beliefs	Mean ± SD	14.2 ± 4.3	
	Median (IQR)	14 (11–17)	
General Overuse beliefs	Mean ± SD	12.2 ± 2.8	
	Median (IQR)	13 (10–14)	
General Harm beliefs	Mean ± SD	11.0 ± 3.0	
	Median (IQR)	11 (8–13)	

Discussion

This study revealed that half of the patients were non-adherent to diabetes treatment. Patients with higher scores of concern or harm beliefs were non-adherent to their treatment. About one third of the sample 29.3% have moderate adherence, and only 15.9% have high adherence to treatment. These findings similar to a study in Nigeria stated that majority of the participants 55.6% had a low-level of medication adherence, while 5.6% had high adherence level. The study demonstrated that patients with a negative belief or a negative perception about the prescribed medication; the tendency for non-adherence very high [21]. Similar findings were reported by Studies conducted in a Chinese type-2 diabetic population; showed that 54.6% of patients with type-2 diabetes reported poor adherence to oral anti-diabetic drugs and 45.4% of patients reported adherence [22]. This rate of low adherence in our study is higher than rates reported in a study in Saudi Arabia which stated that High levels of adherence were reported in 40%, moderate levels with 37%, and low adherence with 23% [23]. However, another study in Palestine revealed better adherence scores; it reported that 58% of diabetic patients were considered highly adherent while 2.5% of patients considered low adherence [24]. The differences in adherence level could be attributed to factors linked to the health care settings, socio-economic status, and methods used for adherence assessment. For example, the Palestine study was conducted in primary health care where treatment regimens may be less complex compared to our patients who received care in a hospital setting.

The current study revealed that patients have a high-level of belief about the specific necessity concerning anti-diabetic treatments, with a mean score of specific necessity (18.6 ± 3.5) indicating high perceptions of personal need for the diabetes medication to maintain the current and future health. Another studies reported a moderate level of specific necessity belief about anti-diabetic medicines in Jordan and Pakistan. [25, 26].

Moderate concerns about potential negative effects of medicines were also observed in the current study with a mean of (14.2 ± 4.3). Moderate concerns about potential negative effects of medicines were also observed in other studies [27]. While the Pakistan study reported a mean of concern beliefs (16.47 ± 2.3) which is higher than that reported by our study [26]. The likely explanation of this finding is that patients usually have negative perceptions about medicines as a whole, and a propensity to see medicine as inherently harmful. Sometimes beliefs may be correlated with bad patient experiences with the use of medicines in general, worse experience acquired from surrounding patients with prior use of medicine, poor patient awareness of drugs.

In the current study, the mean score of specific necessity (18.6 ± 3.5) is more than the mean score of specific concern

Table 3 Comparison between adherent and non-adherent regarding socio-demographic factors (n = 82)

	Non-adherent n (%)	Adherent n (%)	χ^2	P value
Age				
< 50 years	22	9	5.211	0.039*
≥ 50 years	23	28		
Gender				
Male	5	7	0.991	.361
Female	40	30		
Marital status				
Single/divorced/widow	10	6	0.466	.582
Married	35	31		
Education				
< secondary school	28	32	6.090	.023*
≥ secondary school	17	5		
Income				
Insufficient	31	24	0.149	.814
Sufficient	14	13		
Residency				
Rural	26	19	.339	.657
Urban	19	18		
Duration of diabetes (years)				
≤5	12	5	2.138	.178
>5	33	32		
Live alone				
No	40	31	.456	.532
Yes	5	6		
Number of chronic conditions				
≤2	16	11	.312	.641
>2	29	26		
Anti-diabetic medications				
1	11	5	1.545	.269
≥2	34	32		
Number of daily medications				
≤3	24	12	3.602	.075
>3	21	25		

*Statistically significant ($P < 0.05$)

(14.2 ± 4.3), these results are congruent to a study conducted in National Diabetes Center in Iraq which stated that the mean score of specific necessity (19.29 ± 4.51) is more than the mean score of specific concern (14.27 ± 5.58) [28]. Other studies in Pakistan and Gaza [26, 29]; reported that the mean score of specific necessity is less than the mean score of specific concern which indicates the expectation of lower medication adherence likely due to patients' concerns about side-effects and poor health-care quality in the health facility.

The mean of overuse beliefs was lower than another study in Jordan. This may be due to a different culture, and the comparative study on all chronic diseases, not diabetes [20]. However, another study reported a lower mean of overuse beliefs of 8.7 and a median of 9 [19], this result was in patients with chronic conditions in another culture, different awareness, and religion in Indianapolis.

The mean harm score was lower than previous studies mentioned higher harm score [19, 20]. However.

The patients of the comparable study were taking more medications than our study with mean of the number of medications 5.3 ± 4.1 that is higher than our study number of medications. This could be explained by different cultures, religion, and health awareness [30].

Our study analysis showed that positive beliefs about the necessity of medication had recorded the highest mean. While beliefs that medicines are generally harmful recorded the lowest mean level. This result was consistent with Hussein et al. study in 2017 in Iraq who found that most diabetic patients strongly believe that anti-diabetic medications are necessary for their current and future health (highest score) while beliefs that medicines are generally harmful recorded the lowest mean level [28].

Patients aged 50 years or more have higher adherence to treatment than younger patients, Furthermore, patients with education lower than secondary school were more adherent to treatment than higher educated patients. This agreed with the results of another study which revealed that elderly patients with no formal education background showed good adherence compared to the young age group and educated subjects [31]. This could be explained that educated patients had more concern beliefs about medications, so adherence to treatment lowered; further increase in awareness regarding diabetes and its complication might be likely reasons for increased adherence seen in elderly patients. However, this is incongruent with another study reported that the level of education was a factor that affected motivation and adherence in diabetic patients [32]. In another study, high adherence was found in the younger age group and lesser adherence was found in the elderly and middle age group [33].

Also, educated patients have a higher concern belief than less educated patients. This is congruent with another study reported a positive association between level of education and concern and necessity beliefs [15]. Also, another study mentioned that concern beliefs in medicines are a significant predictor of forgetfulness and carelessness in medications taking [9]. Also, a recent meta-analysis reported that higher adherence was associated with fewer concerns about treatment [34]. Our study results are in an agreement with another study reported that concerns were a negative predictor for adherence, and necessity beliefs was positive predictor, however necessity not significant in our study [14].

Table 4 Differences of Beliefs about medicines scores by patient characteristics and adherence

	Necessity mean ranks	Concerns mean ranks	Overuse mean ranks	Harm mean ranks
Age				
< 50 years	36.21	45.98	47.81	42.77
≥ 50 years	44.72	38.77	37.67	40.73
P value	.96	.182	.058	.703
Gender				
Male	42.83	43.96	38.50	37.96
Female	41.27	41.08	42.01	42.11
P value	.824	.697	.633	.573
Marital status				
Single/divorced/widow	49.31	41.44	37.59	32.03
Married	39.61	41.52	42.45	43.80
P value	.121	.991	.459	.074
Education				
< secondary school	42.47	37.42	42.10	40.53
≥ secondary school	38.86	52.64	39.86	44.16
P value	.520	.010*	.703	.537
Income				
Insufficient	43.53	43.11	42.16	43.43
Sufficient	37.37	38.22	40.15	37.57
P value	.243	.380	.715	.291
Adherence				
Not-adherent	41.26	50.71	41.83	46.64
Adherent	41.80	30.30	41.09	35.24
P value	.913	.000**	.888	.029*

*Statistically significant ($P < 0.05$)

In a recent matching study reported 37.0% of the patients were accepting taking medication (a high necessity with low concerns), while 49.7% had a high necessity with a high concerns, the study found that adherence was related to patients'

Table 5 Binary logistic regression for adherence in study sample

	B	S.E.	Wald	df	Sig.	Exp(B)
Age	.072	.029	6.021	1	.014*	1.075
Gender	-.691-	.840	.677	1	.411	.501
education	.986	.657	2.251	1	.134	2.680
Necessity	.003	.085	.001	1	.974	1.003
Concern	-.240-	.081	8.775	1	.003*	.786
Overuse	.181	.104	3.062	1	.080	1.199
Harm	-.120-	.109	1.228	1	.268	.887
Constant	-1.733-	3.298	.276	1	.599	.177

Nagelkerke R Square .370, Chi-square 26.524, $p < .000$,

* Statistically significant ($P < 0.05$)

beliefs about medication; the patients who were accepting medication, have better adherence compared to other groups that had significantly lower adherence similar to this study concerns affected adherence [35].

Patients with higher scores of harm beliefs were non-adherent. A previous study revealed a positive association between specific concerns about medications, perceived general harmful effects of medications, and perceived overprescribing of medications by physicians, and medication non-adherence [19, 36].

Another study stated that the cases of forgetfulness and carelessness in taking medications considered unintentional non-adherence with no reflection on patient's beliefs in medicines; interventions such as phone reminders or alarms not likely to reduce non-adherence. They mentioned that there was a strong association between patient belief in medications and non-adherence [9]. Also, another study showed that negative beliefs affected adherence as 49% of the patients less likely to adhere than those with more positive beliefs compared to barriers for adherence [13].

Limitations of the study

The study may have some limitations as the sample size and sampling method not randomized, with a questionable generalization of results.

Conclusion

Adherence to medications affected by the patient own beliefs about medications, especially concerns of the patients about drugs, and this make a barrier to adherence. So it is important to consider the patient medication beliefs, and solve patients concerns to improve adherence and management of patients by better interventions and education especially on concerns of diabetic patients and side effects of medications to reduce non-adherence.

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Compliance with ethical standards

Conflict of interest None declared.

Ethical approval All procedures performed in the study were following the ethical standards of the institutional research committee of Faculty of Medicine Suez Canal University and with the 1964 Helsinki declaration and its later amendments.

Informed consent was obtained from all individual participants included in the study.

References

- World Health Organization. Diabetes; 2018; Available from: <http://www.who.int/news-room/fact-sheets/detail/diabetes>.
- Alqami AM, Alrahbeni T, Qarni AA, Qarni HMA. Adherence to diabetes medication among diabetic patients in the Bisha governorate of Saudi Arabia - a cross-sectional survey. *Patient Prefer Adherence*. 2019;13:63–71. <https://doi.org/10.2147/PPA.S176355>.
- Hsiao C-Y, Chang C, Chen C-D. An investigation on illness perception and adherence among hypertensive patients. *Kaohsiung J Med Sci*. 2012;28(8):442–7. <https://doi.org/10.1016/j.kjms.2012.02.015>.
- Zimmet PZ, Magliano DJ, Herman WH, Shaw JE. Diabetes: a 21st-century challenge. *Lancet Diabetes Endocrinol*. 2014;2(1):56–64.
- Lu Y, Xu J, Zhao W, Han HR. Measuring self-care in persons with type 2 diabetes: a systematic review. *Evaluation Health Profess*. 2015;39(2):131–84.
- Burkhart PV, Sabaté E. Adherence to long-term therapies: evidence for action. *J Nursing Scholarship: Off Publication Sigma Theta Tau Int Honor Soc Nursing*. 2003;35(3):207.
- Unni EJ, Farris KB. Unintentional non-adherence and belief in medicines in older adults. *Patient Educ Couns*. 2011;83:265–8. <https://doi.org/10.1016/j.pec.2010.05.006>.
- Lehane E, McCarthy G. Intentional and unintentional medication non-adherence: a comprehensive framework for clinical research and practice? A discussion paper. *Int J Nurs Stud*. 2007;44(8):1468–77. <https://doi.org/10.1016/j.ijnurstu.2006.07.010>.
- Unni E, Farris KB. Determinants of different types of medication non-adherence in cholesterol-lowering and asthma maintenance medications: a theoretical approach. *Patient Educ Couns*. 2011;83:382–90. <https://doi.org/10.1016/j.pec.2011.02.017>.
- Marcum ZA, Sevick MA, Handler SM. Medication nonadherence: a diagnosable and treatable medical condition. *JAMA*. 2013;309:2105–6.
- Gatti ME, Jacobson KL, Gazmararian JA. Relationships between beliefs about medications and adherence. *Am J Health Syst Pharm*. 2009;66:657–64.
- Nunes V, Neilson J, O'Flynn N, Calvert N, Kuntze S, Smithson H, et al. Clinical guidelines and evidence review for medicines adherence: involving patients in decisions about prescribed medicines and supporting adherence. London: National Collaborating Centre for Primary Care and Royal College of General Practitioners; 2009.
- Gagnon MD, Waltermayer E, Martin A, Friedenson C, Gayle E, Hauser DL. Patient beliefs have a greater impact than barriers on medication adherence in a community health center. *J Am Board Family Med*. 2017;30(3):331–6. <https://doi.org/10.3122/jabfm.2017.03.160129>.
- Jamous RM, Sweileh WM, El-Deen Abu Taha AS, Zyoud SH. Beliefs about medicines and self-reported adherence among patients with chronic illness: a study in Palestine. *J Fam Med Primary Care*. 2014;3(3):224–9.
- Aikens JE, Piette JD. Diabetic patients' medication underuse, illness outcomes, and beliefs about Antihyperglycemic and antihypertensive treatments. *Diabetes Care*. 2009;32(1):19–24. <https://doi.org/10.2337/dc08-1533>.
- Dawson B, Trapp RG. *Basic & Clinical Biostatistics* (4th ed.). LANGE Basic Science, 2004.
- Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens (Greenwich)*. 2008;10(5):348–54.
- Dias A, Morisky DE, Neves SJN, Lyra DP. The 8-item Morisky Medication Adherence Scale: Validation of a Brazilian-Portuguese version in Hypertensive Adults. *Res Social Administrat Pharm*. 2013;10(3). DOI <https://doi.org/10.1016/j.sapharm.2013.10.006>
- Phatak HM, Thomas J. Relationships between beliefs about medications and nonadherence to prescribed chronic medications. *Ann Pharmacother*. 2006;40:1737–42.
- Alhalaqia F, Deh RM, Batiha AM. Validity of Arabic version of beliefs about medication questionnaire. *Clin Nurs Res*. 2015;24(5):539–55.
- Olorunfemi O, Ojewole F. Medication belief as a correlate of medication adherence among patients with diabetes in Edo State, Nigeria. *Nurs Open*. 2018;6(1):197–202. Published 2018 Sep 14. <https://doi.org/10.1002/nop2.199>.
- Wu P, Liu N. Association between patients' beliefs and oral antidiabetic medication adherence in a Chinese type 2 diabetic population [published correction appears in *Patient Prefer Adherence*. 2016;10:1697]. *Patient Prefer Adherence*. 2016;10:1161–7. Published 2016 Jun 27. <https://doi.org/10.2147/PPA.S105600>.
- Aloudah NM, Scott NW, Aljadhey HS, Araujo-Soares V, Alrubeaan KA, Watson MC. Medication adherence among patients with Type 2 diabetes: A mixed-methods study. *PLoS One*. 2018;13(12):e0207583. Published 2018 Dec 11. <https://doi.org/10.1371/journal.pone.0207583>.
- Elsous A, Radwan M, Al-Sharif H, Abu MA. Medications adherence and associated factors among patients with type 2 diabetes mellitus in the Gaza strip. *Palestine Front Endocrinol*. 2017;8:100. <https://doi.org/10.3389/fendo.2017.00100>.
- Basheti IA, El Hait SS, Qunaibi EA, Aburuz S, Bulatova N. Associations between patient factors and medication adherence: a Jordanian experience. *Pharm Pract*. 2016;1:639.
- Raza S, Iqbal Q, Haider S, Khalid A, Hassali MA, Saleem F. Beliefs about medicines among type 2 diabetes mellitus patients in Quetta city, Pakistan: a cross-sectional assessment. *J Public Health*. 2019;28:277–83. <https://doi.org/10.1007/s10389-019-01046-8>.
- Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. *Patient Prefer Adhere*. 2016;10:1299–307.
- Hussein EA, Kadhim DJ, Al-Auqi TF. Belief About Medications Among Type 2 Diabetic Patients Attending the National Diabetes Center in Iraq. *Iraqi J Pharm Sci*. 2017;26(2).
- Almadhoun MR, Alagha HZ. Assessment of medication adherence and its association with glycemic control among Type-2 diabetes mellitus patients in Gaza–Palestine. *Clin Exp Pharmacol*. 2018;3:1–10.
- Al-Saeedi M, Elzubier AG, Bahnassi AA, Al-Dawood KM. Patterns of belief and use of traditional remedies by diabetic patients in Mecca. *Saudi Arabia East Mediterr Health J*. 2003;9:99–107.
- Kavitha S, Nalini GK, Suresh RM, Sahana G, Deepak P, Nagal JV. Treatment adherence and factors contributing to nonadherence among type 2 diabetes mellitus patients in a tertiary care hospital: a cross-sectional study. *Int J Basic Clin Pharmacol*. 2017;6(3):689–94.
- Son NE, Taskiran B, Yorulmaz G, Son O, Kokoglu B, Bilgin M, et al. Relationship between the 6-item Morisky medication adherence scale (mmas-6) score and glycemic control in a Turkish population with type 2 diabetes mellitus. *Acta Medica Mediterr*. 2017;6:921–8.
- Shams MEE, Barakat EAME. Measuring the rate of therapeutic adherence among outpatients with T2DM in Egypt. *Saudi Pharmaceut J*. 2010;18:225–32.
- Horne R, Chapman SCE, Parham R, Freemantle N, Forbes A. Understanding Patients' adherence-related beliefs about medicines prescribed for long-term conditions: a meta-analytic review of the necessity-concerns framework. *PLoS One*. 2013;8(12):e80633. <https://doi.org/10.1371/journal.pone.0080633>.
- Park HY, Seo SA, Yoo H, Lee K. Medication adherence and beliefs about medication in elderly patients living alone with chronic

- diseases. *Patient Prefer Adherence*. 2018;12:175–81. <https://doi.org/10.2147/PPA.S151263>.
36. Sweileh WM, Zyoud SH, Abu Nab'a RJ, Deleq MI, Enaia MI, Nassar SM, Al-Jabi SW. Influence of patients' disease knowledge and beliefs about medicines on medication adherence: findings from a cross-sectional survey among patients with type 2 diabetes mellitus in Palestine. *BMC Public Health*. 2014; 14(1). <https://doi.org/10.1186/1471-2458-14-94>.

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