


Adherence to Antidiabetic Medications Among Sudanese Individuals With Type 2 Diabetes Mellitus: A Cross-Sectional Survey

Journal of Patient Experience
2020, Vol. 7(2) 163-168
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DOI: 10.1177/2374373519831073
journals.sagepub.com/home/jpx


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Abstract

Background: Adherence to antidiabetic medications is crucial for optimum glycemic control and decreasing complications. This study aimed to assess adherence to antidiabetic medications and the associated factors among individuals with type 2 diabetes attending Jabir Abu Eliz Diabetes Centre in Khartoum state, Sudan. **Methods:** This was a descriptive cross-sectional study, recruited 213 individuals with type 2 diabetes, and used a pretested questionnaire. Data were analyzed using the Statistical Package of Social Sciences version 21. Logistic regression analysis was used to check for factors that linked to poor adherence to diabetes medication. **Results:** The median duration of antidiabetic medications use was 8 years; 15.0% were highly adherent to diabetes medications, 44.6% were medium adherent, and 40.4% showed low adherence. Main factors and barriers were medication side effects (18.3%), use of herbal medicine (12.3%), and unavailability of medication (7%). Predictors of nonadherence were gender, and housing status (0.043 and 0.042, respectively). **Conclusion:** Level of adherence to diabetes medication was unsatisfactory as only 15% showed high adherence. Predictors of nonadherence were gender, and housing status. Effective interventions should be implemented to improve medication adherence, like appropriate patient education and involvement in the treatment plan.

Keywords

adherence, antidiabetic medication, type 2 diabetes mellitus, patients

Introduction

Diabetes mellitus is associated with macrovascular and microvascular complications, reduced quality of life, and a high burden on health-care systems (1). Diabetes mellitus is a worldwide public health problem. World Health Organization (WHO) reported that the global prevalence of diabetes increased from 4.7% in 1980 to 8.5% in 2014 (1). In Sudan, WHO estimated that in 2000 that 447 000 were having diabetes and this number will increase by almost 3-fold in 2030 (2). The prevalence of diabetes in the North of Sudan was estimated to be around 19% (3). Management of diabetes mellitus requires setting a proper treatment plan including medications, healthy diet, weight loss, and regular physical activity. Patient adherence, education, and integration into the health-care team are essential for the successful management of diabetes. Adherence is defined as “the extent to which a person’s behavior, taking medication, following a prescribed diet, and/or executing lifestyle changes corresponds with agreed recommendations from

the health care provider” (4). A number of reviews found that the average adherence rates among patients with chronic diseases are only 50% in developed countries, and this is expected to be lower in developing countries because of the limited health resources and accessibility to health care (4).

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Poor adherence to antidiabetic medications leads to inadequate blood glucose control, treatment failure, accelerated development of complications, and increased mortality. For instance, Awadalla et al (2017) reported a high prevalence of diabetes complications in Sudan (5). Almobarak et al (2017) showed that the prevalence of diabetic foot in Sudan was around 18% (6), while retinopathy was reported to affect 78% of individuals with type 2 diabetes in Sudan (7). Importantly, several studies worldwide documented that the rates of adherence are suboptimal (8-13). Different factors have been associated with poor adherence including diabetes duration, inadequate patient education, side effects, the complexity of treatment regimen, unavailability of medicines, the high cost of medications, forgetfulness, and irregularity of follow-up (14-17). The adherence rates of Sudanese patients are generally low. For instance, a study of the adherence among cardiac patients found that only 49% of respondents were optimally adhering to their treatment (18). In a rural area in Sudan that included patients with hypertension and/or diabetes, the main adherence rate was 39.6% (19). Intervention schemes in the West of Sudan showed to improve drug adherence to antidiabetic and cardiovascular medications (20).

In the view of the scarcity of studies that have assessed adherence of patients with type 2 diabetes in Sudan, this study aimed to assess the adherence to antidiabetic medications and to determine the associated factors and the perceived barriers among individuals with type 2 diabetes.

Methods

Study Setting

The study was conducted in Jabir Abu Eliz diabetes health center in Khartoum, Sudan. The estimated sample size was calculated based on the formula $n = z^2 p \cdot q / d^2$, where n is the estimated sample size; z the standard value for 5% level of significance ($z = 1.96$); d , the margin of desired error taken as 5%; p the prevalence rate of diabetes = 0.179 (21) and $q = 1 - p$. The calculated sample size was 226 patients. A systematic random sampling technique was used to select the patients until the estimated sample size was reached. The sampling fraction was estimated by dividing the sample size ($n = 226$) by the total daily frequency ($n = 150$). Thirteen patients refused to participate in the study, so the total number of participants was 213 individuals with type 2 diabetes mellitus.

Study Participants and Data Collection

This was a descriptive cross-sectional study that recruited 213 individuals with type 2 diabetes who provided a written informed consent to participate in the study. Those who were newly diagnosed with diabetes (less than one month) were excluded, and random sample selection of participants was used. Data were collected by interviewing the participants using a pretested standardized questionnaire that included

Table 1. Sociodemographic Characteristics of Respondents.

Variable	Number	%
Gender, N = 213		
Male	102	47.9
Female	111	52.1
Age, N = 213		
Mean age, SD	55.9	10.9
Min–Max	28	82
Marital status, N = 213		
Married	181	85.1
Widow	15	7.0
Single	12	5.6
Divorced	3	1.4
Separated	2	0.9
Education level, N = 213		
Primary school	84	39.4
Illiterate	50	23.5
High school	49	23.0
Bachelor degree	26	12.2
Postgraduate degree	4	1.9
Profession, n = 199		
Unemployed	114	57.3
Employed	85	42.7
Housing, N = 213		
Owner	170	79.8
Renting	43	20.2

questions about demographic data, disease, and medications. Modified Morisky Scale for medication adherence was used and explained in simple language for local people to make the data collection easier (22).

Data were entered and analyzed using the Statistical Package of Social Sciences (SPSS) version 21 (IBM, Chicago). Univariate analysis was used to summarize the data related to sociodemographic characteristics of the study participants and to determine the level of adherence. Logistic regression was used to predict the factors affecting adherence. Crude odds ratios with their corresponding 95% confidence intervals were reported.

Ethical Considerations

Ethical approval was obtained from University of Medical Sciences and Technology Institutional Review Board and participants provided written consent to participate. The participants were assured of their confidentiality and not disclosing their names or identities.

Results

Sociodemographic Characteristics of Respondents

A total of 213 participants were included in the study with a mean age of 55.9 ± 10.9 years. Of them, 52.1% were females, 85.1% were married, and 39.4% were primary school educated. Details of the respondents' background characteristics are summarized in Table 1.

Table 2. Knowledge about Diabetes Medication, Source, and Doctor Explanation of the Management.

Variables	Number	%
Number of prescribed medications, N = 213		
One medication	76	35.7
Two medications	120	56.3
Three medications	17	8.0
Patient's knowledge of the medication name, N = 213		
Yes	80	37.6
No	133	62.4
Source of anti-diabetic medicines, N = 213		
I buy it from Jabir Abu Eliz center	133	62.4
I buy it from any pharmacy which has it	59	27.7
I buy it from my neighborhood pharmacy	21	9.9
Location of medication provision, n = 211		
Health Center	133	62.4
Pharmacy	80	37.6
Monetary accessibility of antidiabetic medication, n = 211		
Affordable	136	64.5
Expensive	75	35.5
Had ever experience medication shortage, N = 213		
No	205	96.2
Yes	8	3.8
Did your doctor explain your condition, N = 213		
Yes	190	89.2
No	20	9.4
No answer	3	1.4
Topics discussed with the treating doctor, n = 190		
Treatment schedule	187	98.4
Treatment compliance	180	94.7
Treatment regimen	173	91.1
Regular control of glycemia	169	88.9
Alert symptoms	145	76.3
Side effects	91	47.9

Table 3. Factors Preventing the Participants From Taking Their Medications as Prescribed.

Factor	n	%
Side effects	39	18.3
Consumption of herbal medicine	27	12.7
Unavailability of the medication	15	7.0
Treatment scheduled	11	5.2
Fasting	11	5.2
Forgetfulness	10	4.7
Carelessness	6	2.8
Unaffordability of the medication	5	2.3
Inconvenience	2	0.9
Being busy	1	0.5

Knowledge About Diabetes Medication, Source, and Doctor Explanation of the Management

Of the participants, 56.3% were using 2 medications for diabetes control. Only above one-third had good knowledge about medication. Importantly, two-third mentioned they

Table 4. Adherence to Medication of the Study Population and the Number of Medications Used by Each Group.

Adherence to Medication	Number (%)	One Medication	Two Medications	Three Medications
High adherence	32 (15.0)	39.0%	53.7%	7.3%
Medium adherence	95 (44.6)	33.6%	55.8%	10.6%
Low adherence	86 (40.4)	36.8%	58.8%	4.4%
Total	213 (100.0)			

Table 5. Logistic Regression Model is Predicting Adherence to Medication.

Variable	B	S.E.	Wald	P Value	Odds Ratio
Age	-0.046	0.024	3.617	.057	0.955
Gender	-1.015	0.502	4.09	.043	0.362
Marital status	-0.399	0.238	2.806	.094	0.671
Education level	0.304	0.239	1.629	.202	1.356
Housing	-0.633	0.311	4.143	.042	0.531
Duration of disease	0.009	0.031	0.095	.758	1.009
Constant	6.237	2.277	7.505	.006	511.347

buy their medication from the diabetes center. Doctor's explanations about medication and side effects received very good level of satisfaction (Table 2)

Factors Preventing the Participants From Taking their Medications as a Prescribed

Side effect and use of herbal medication were the common factors preventing medication adherence. Unavailability of the medication was reported by 7% and forgetting medications by 4.7%. Other factors are mentioned in Table 3.

Adherence to Antidiabetic Medication

The average score of adherence to antidiabetic medications was 2.3 ± 1.8 ranging from 0 to 10. The participants individual scores (N = 213) were classified according to Morisky scale as "high adherence" when participant score 0 for all 10 questions, "medium adherence" when their score ranged from 1 to 2, and as "low adherence" when the score was between 3 and 10. Of the 213 participants, 15.0% were highly adherent to their medications, 44.6% were medium adherent, and 40.4% demonstrated low adherence to medications as shown in Table 4. Adherence ("Adherent" and "non Adherent") to medications was predicted by using logistic regression analysis which revealed that the age of participants was a borderline predictor ($P = .057$), while gender and housing were statistically significant with a P value of .043 and .042, respectively. Details are summarized in Table 5.

Discussion

Only 15% of 213 participants were fully adherent to their medications constituting a lower percentage than those

reported in Saudi Arabia (32.1%) (17), south India (45.4%) (12), and Malaysia (47%) (13). Importantly, the high percentage of medication adherence reported in our study is less than other countries such as the United States (71%) (23), Eastern Uganda (83.3 %) (16), Ethiopia (85.1) (14), Harar, Eastern Ethiopia (70.4%) (24), France (88%) (25), and United Arab Emirates (84%) (15). Poor adherence to antidiabetic medications leads to inadequate blood glucose control, treatment failure, accelerated development of complications, and increased mortality. We have previously shown that 85% of Sudanese individuals with type 2 diabetes have poor diabetes control ($HbA_{1c} > 7\%$) (26). This poor diabetes control can be attributed in part to poor diabetes medication adherence. A recent study in Eastern Sudan showed that 72% of type 2 diabetes have poor diabetes control (27). Another factor for poor adherence to medication is the fact that 62.4% of participants couldn't name the antidiabetic medications they were using. Many patients particularly elders relied on memorizing the package to recognize their medications or were dependent on their family as we noticed during data collection. However, affordability was not a significant problem as 64.5% of participants ($n = 211$) considered their antidiabetic medications affordable. This is justifiable provided that 62.4% of the 213 participants had insurance and were charged for only 25% of their medications cost in Jabir Abu Eliz center. Hence, the affordability of antidiabetic medications appeared to have an insignificant effect on adherence ($P = .876$) unlike reports from East Uganda (16) and Tanzania (8).

Furthermore, another positive finding of this study was that over 89% of participants received an explanation of their diabetes condition and medication regimen. However, only 47% received an explanation about side effects of medication. This is likely related to the physician assumption that the pharmacist will explain the side effect, and explaining about side effects may also lead to longer clinical consultation. A similar problem was also reported in Saudi Arabia and India (17-24), the United States (23), Brazil (10), and Tanzania (8). Importantly, this study showed that experiencing side effects was the main barrier (18.3%) that prevented our participants from taking their medications as prescribed.

Interestingly, our study showed that there is no difference in medication adherence by gender. Different studies showed a similar finding or less adherence in male (17, 25). However, our study showed that those single and living with family appeared to be more adherent, probably because of the social and psychological support (25). Education (postgraduate degree) and employment were not associated with medication adherence. However, in France, patients with professional activity forgot more often to take their medications (25).

Logistic regression analysis showed that gender, and housing status were statistically significant, whereas educational level, duration of the disease, and education had a high contribution in predicting adherence, despite their statistical insignificance. Those who used herbal medicines for the treatment of their diabetes were 3.3 times more likely to be

nonadherent to anti-diabetic medications, although this was insignificant. Many predictors of adherence have been reported including having taken medication for more than 3 years, availability of antidiabetic drugs, ever had diabetic education (16) and age >60 years (9). Several sociodemographic factors that significantly associated with poor adherence were age 45 years, non-European geographical origin, financial difficulties, and being professionally active. Disease and therapy-related factors that significantly associated with poor adherence were $HbA_{1c} 8\%$, existing diabetes complications (25), comorbidities, and medication knowledge (13). Several factors have been associated with poor adherence including diabetes duration, inadequate patient education, side effects, the complexity of treatment regimen, unavailability of medicines, the high cost of medications, forgetfulness, and irregularity of follow up (14-17).

This study is not without limitations. The cross-sectional design of the study may not allow generalization of the study findings to all population in Sudan. Further research may be needed in rural areas of Sudan to assess adherence to diabetes medication. Despite these limitations, our study is novel and provide the first study to evaluate the adherence of diabetes medication in Sudan. Physicians, diabetologists, public health physician, and pharmacists are needed to work together to increase the level of adherence to diabetes medication.

Conclusion

Level of adherence to diabetes medication was unsatisfactory as only 15% showed high adherence. Predictors of non-adherence were gender, and housing status. Effective interventions should be implemented to improve medication adherence, like appropriate patient education and involvement in the treatment plan.

Authors' Note

The authors participated in the conception, design, and implementation of the study, statistical analysis and interpretation of the data, and the drafting of the manuscript. All authors have seen and approved the final version of the manuscript. The data sets used and analyzed during the current study are available from the corresponding author on reasonable request. The author degree SCE for Mohamed H Ahmed stands for Speciliaty certificate examination in Diabetes & Endocrinology and Geriatric Medicine of the Royal College of Physician, UK

Acknowledgments

We are grateful to the management team of Jabir Abu Eliz diabetes centre.


Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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References

- World Health Organization. Global report on diabetes. 2016. Available from: http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf?ua=12016, Retrieved 1 October 2018.
- World Health Organization. Country and regional data on diabetes. 2018. Available from: http://www.who.int/diabetes/facts/world_figures/en/index2.html2018, Retrieved 1 October 2018.
- Elmadhoun WM, Noor SK, Ibrahim AA, Bushara SO, Ahmed MH. Prevalence of diabetes mellitus and its risk factors in urban communities of north sudan: population-based study. *J Diabetes*. 2016;8:839-46.
- World Health Organization. Adherence to long-term therapies: evidence for action. 2003. Available from: <http://apps.who.int/medicinedocs/en/d/Js4883e/6.html2003>, Retrieved 1 October 2018.
- Awadalla H, Noor SK, Elmadhoun WM, Almobarak AO, Elmak NE, Abdelaziz SI, et al. Diabetes complications in Sudanese individuals with type 2 diabetes: Overlooked problems in sub-Saharan Africa? *Diabetes Metab Syndr*. 2017;11:S1047-51.
- Almobarak AO, Awadalla H, Osman M, Ahmed MH. Prevalence of diabetic foot ulceration and associated risk factors: an old and still major public health problem in Khartoum, Sudan? *Ann Transl Med*. 2017;5:340.
- Elwali ES, Almobarak AO, Hassan MA, Mahmouod AA, Awadalla H, Ahmed MH. Frequency of diabetic retinopathy and associated risk factors in Khartoum, Sudan: population based study. *Int J Ophthalmol*. 2017;10:948-54.
- Rwegerera GM. Adherence to anti-diabetic drugs among patients with Type 2 diabetes mellitus at Muhimbili National Hospital, Dar es Salaam, Tanzania- A cross-sectional study. *Pan Afr Med J*. 2014;17:252.
- Pihau-Tulo ST, Parsons RW, Hughes JD. An evaluation of patients' adherence with hypoglycemic medications among Papua New Guineans with type 2 diabetes: influencing factors. *Patient Prefer Adherence*. 2014;8:1229-37.
- Gimenes HT, Zanetti ML, Haas VJ. Factors related to patient adherence to antidiabetic drug therapy. *Rev Lat Am Enfermagem*. 2009;17:46-51.
- Bruce SP, Acheampong F, Kretchy I. Adherence to oral anti-diabetic drugs among patients attending a Ghanaian teaching hospital. *Pharm Pract*. 2015;13:533.
- Divya S, Nadig P. Factors contributing to non-adherence to medication among type 2 diabetes mellitus in patients attending tertiary care hospital in South India. *Asian J Pharm Clin Res*. 2015;8:274-6.
- Ahmad NS, Ramli A, Islahudin F, Paraidathathu T. Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. *Patient Prefer Adherence*. 2013;7:525-30.
- Abebaw M, Messele A, Hailu M, Zewdu F. Adherence and associated factors towards antidiabetic medication among type II diabetic patients on follow-up at University of Gondar Hospital, Northwest Ethiopia. *Adv Nurs*. 2016;2016:7.
- Arifulla M, John LJ, Sreedharan J, Muttappallymalil J, Basha SA. Patients' adherence to anti-diabetic medications in a hospital at Ajman, UAE. *Malays J Med Sci MJMS*. 2014;21:44-9.
- Bagonza J, Rutebemberwa E, Bazeyo W. Adherence to anti diabetic medication among patients with diabetes in eastern Uganda; a cross sectional study. *BMC Health Serv Res*. 2015;15:168.
- Khan AR, Al-Abdul Lateef ZN, Al Aithan MA, Bu-Khamseen MA, Ibrahim IA, Khan SA. Factors contributing to non-compliance among diabetics attending primary health centers in the Al Hasa district of Saudi Arabia. *J Family Community Med*. 2012;19:26-32.
- Awad A, Osman N, Altayib S. Medication adherence among cardiac patients in Khartoum State, Sudan: a cross-sectional study. *Cardiovasc J Afr*. 2017;28:350-5.
- Dafalla M, Abdalla IG. Evaluation of adherence to medications among hypertensive and diabetic patients in Fadasi ElHalimab Village, Gezira State, Sudan. *Sudan Med J*. 2013;49:83-88.
- Ahmed AD, Elnour AA, Yousif MAE, Farah FH, Osman HAAA, Abasaeed A. Improving adherence to prescribed anti-diabetics and cardiovascular medications in Primary Health Care Centers in Nyala City, South Darfur State-Sudan. *Pharmacol Amp; Pharmacy*. 2013;4:9.
- IndexMundi. Sudan - Diabetes prevalence. Available from: <https://www.indexmundi.com/facts/sudan/diabetes-prevalence2014>, Retrieved 17 May 2016.
- Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24:67-74.
- Grant RW, Devita NG, Singer DE, Meigs JB. Polypharmacy and medication adherence in patients with type 2 diabetes. *Diabetes Care*. 2003;26:1408-12.
- Sajith M, Pankaj M, Pawar A, Modi A, Sumariya R. Medication adherence to anti-diabetic therapy in patients with type 2 diabetes mellitus. *Int J Pharm Pharm Sci*. 2014;62:564-70.
- Tiv M, Viel JF, Mauny F, Eschwege E, Weill A, Fournier C, et al. Medication adherence in type 2 diabetes: the ENTRED study 2007, a French Population-Based Study. *PloS One*. 2012;7:e32412.
- Almobarak A, Noor S, Elmadhoun W, Bushara SO, Salim RS, Forawi SA. Metabolic control targets in sudanese adults with type 1 diabetes: a population-based study. *J Family Med Prim Care*. 2017;6:374-9.
- Omar SM, Musa IR, Osman OE, Adam I. Assessment of glycemic control in type 2 diabetes in the Eastern Sudan. *BMC Res Notes*. 2018;11:373.

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