

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

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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 to 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

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Declaration of Conflicting Interests

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