Predictors of adherence to diabetes medication: multicentre study from the Eastern Province, Saudi Arabia

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INTRODUCTION

Diabetes mellitus (DM) is a highly disseminated, chronic disease resulting from insufficient insulin production from pancreatic cells or underutilization of insulin. The American Diabetes Association (ADA) in 1997 classified DM as type 1, type 2, gestational, and other types. In 2014, WHO estimated that 422 million people above 18 years have diabetes and expected to reach 642 million by 2040. Al Dawish et al., 2015 reported that 25% of the adult population has diabetes, and the percentage is projected to double by 2030. This alarming rise in DM prevalence and its associated complications render DM as an emerging global health concern. The WHO states that the prevalence of diabetes in the Kingdom of Saudi Arabia is the second highest among Middle Eastern countries.

DM dramatically enhances the risk of developing microvascular (e.g., retinopathy, nephropathy, and neuropathy) and macrovascular diseases (e.g., cardiovascular diseases and cerebrovascular disease), which are fatal and increase the risk of mortality. Morbidity & mortality related to diabetes is creating challenges on economic, social, and other aspects that seriously affect the lives of individuals, families, businesses, and the entire society.

Adherence can be defined as the patient's behavior in sticking to the medical advice. Adherence in terms of taking medication, making lifestyle changes, undergoing medical examinations, and keeping appointments with physicians can help achieve the treatment's therapeutic goals.
barriers can affect patients’ adherence and lead to non-adherence status. Some of them are patient-centered, like demographic and psychological factors.\textsuperscript{10,11} Others can be either therapy-related factors like complex treatment regimens or medication side effects, or healthcare system-related factors such as insufficient or confusing information provided by their healthcare providers.\textsuperscript{12,13}

Patients’ adherence tends to reduce with time. Patients with chronic diseases adhere less to their long-term medications than those on short-term medications.\textsuperscript{10,14} Type 2 diabetes patients show low adherence rates to their drug regimens; however, this varies widely between populations.\textsuperscript{15} Poor adherence to anti-diabetes medications alters the effectiveness of treatment and contributes to suboptimal glycemic control. This adversely affects the patient condition, and severe health complications arise, compromising patients’ quality of life with an escalation in mortality.\textsuperscript{16} Effective patient counselling regarding their disease and treatment regimens can improve patient adherence.\textsuperscript{17} Our study aimed to assess the impact of socio-demographic and clinical characteristics on medication adherence of type 2 DM patients in the Eastern Province, KSA. Knowing the predictors might help policymakers to determine the appropriate interventions to enhance adherence to type 2 diabetes medications.

**METHODOLOGY**

**Study setting and subjects**

A questionnaire-based cross-sectional study was designed. The questionnaire’s Arabic and English versions were made available offline and online. Participants, who visited the outpatient clinics at two major hospitals in the Eastern Province of Saudi Arabia, were approached through systematic sampling. A number of fifth-year graduate students who were trained for data collection using a structured questionnaire visited the clinics once weekly from November 2017 to April 2018. Systematically selected eligible patients were explained the purpose of the study, requested to provide their consent to participate in the study and invited to fill out the questionnaire either offline or online. Any T2DM patients were eligible if they had T2DM for at least one year, were residents of Saudi Arabia, aged 18 years or older, and could respond to the questionnaire in Arabic or English with minimal support. Ethical approval was obtained from the Institutional Review Board at Imam Abdulrahman bin Faisal University (IRB-2019-05-391).

Sample size calculation was carried out assuming that a minimum of 50% of T2DM patients are expected to show a moderate-high level of medication adherence. The study required a sample size of 385 participants to detect the prevalence with a 95% confidence level and a 5% margin of error. During the study period, 490 eligible patients were approached, and 376 (response rate = 77%) completed the questionnaire.

**Data Collection**

The data collection was carried out using a structured questionnaire with two parts. The first part consists of participants’ socio-demographic and clinical characteristics, including age, gender, academic qualification, monthly income level, the number of diabetes-related complications, type of diabetes medications, and history of hospitalization due to diabetes. The second part used a standardized and validated questionnaire called the ‘General Medication Adherence Scale (GMAS)’ to assess adherence towards anti-diabetic drugs.\textsuperscript{16} The GMAS is a validated questionnaire in Saudi patients with chronic disease and showed a good reliability index (Cronbach’s $\alpha$ = 0.865).\textsuperscript{16} The tool consists of 11 items over three dimensions: patient’s intentional or unintentional behavior-related non-adherence (five items), disease and pills burden-related non-adherence (four items), and cost-related non-adherence (two items). Participants were asked to rate these items on a 4-point Likert scale from 0 (=always) to 3 (=never). The sum scores 0-33 represent an overall medication adherence, with the higher score indicating a higher adherence level. An overall score of 30–33, 27–29, 17–26, 11–16, and less than 11 were regarded as high, good, partial, low, and poor overall medication adherence, respectively.

**Statistical analysis**

Data were summarised using descriptive statistics – mean and standard deviation (SD) for continuous variables and frequency and percentage for categorical variables. Participants’ characteristics were summarized using frequencies and percentages. The mean and SD of the GMAS overall score were provided, in addition to the percentage of patients in each level of adherence. Chi-square test and multiple regression models were used to assess socio-demographic and clinical factors’ association with adherence. The outcome variable for the chi-square test and multiple logistic regression was a binary variable indicating ‘partial or lower adherence level’ or ‘not.’ The logistic regression model reported the adjusted odds ratio (AOR) and 95% confidence interval (CI). As a sensitivity analysis, a multiple linear regression with the overall GMAS score as the outcome variable. Least-square estimate of mean difference and 95% CI were reported from the linear regression model. The normality of the outcome variable was examined through a Q-Q plot and Shapiro-Wilk test of standardized residuals. Statistical significance was assessed against a 5.
average overall adherence score was 27.3 (SD:5.6) on a 0–33 scale. Figure 2 shows the degree of overall adherence among diabetes patients. Importantly, 37% (138/376) of participants were reported partial or lower adherence level, and only 42% (160/376) of participants reported high level of adherence.

Predictors of partial or lower adherence level

The difference in adherence level between patients’ characteristics was reported in Table 1. The univariate analysis showed that significantly lower level of adherence among aged less than 50 years compared to patients older than 50 years (p-value=0.011). In addition, the degree of adherence was also lower among participants who had RBG of 200 mg/dl or more compared to participants with RBG of 200 mg/dl or lower (p-value<0.001).

Table 2 (column 3) presents the AOR and 95% CI from a logistic regression model where the outcome variable indicates ‘partial or lower adherence level’ or ‘not.’ Table 2 (column 4) presents the least-square estimate (95% CI) from the linear regression model, where the overall GMAS score was the outcome variable. The estimate quantified the adjusted mean difference in adherence score between a group and the corresponding reference group. The negative difference indicates lower adherence for a group compared to the reference group, whereas the positive difference indicates a higher adherence for the group. The results from both regression models showed that patients older than 50 years were more likely to adhere to their medications. The AOR (95% CI) for the age group >50 years was 1.76 (1.01, 3.04). The adjusted mean difference in GMAS score (95% CI) for the age group >50 years in reference to aged < 50 years was -1.96 (-3.36, -0.56). In addition, the odds of having low adherence among the patients with RBG in between 200-300 mg/dl and >300 mg/dl were more than

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Table 2. Predictors of low medication adherence – regression modelling

<table>
<thead>
<tr>
<th></th>
<th>Logistic modelling(a)</th>
<th>Continuous modelling(a)</th>
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<tbody>
<tr>
<td></td>
<td>Adjusted odds ratio (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50 years</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>&gt;50 years</td>
<td>1.76 (1.01, 3.04)</td>
<td>0.044</td>
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<tr>
<td><strong>Anti-diabetic medication type</strong></td>
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<tr>
<td>Insulin injection or combination</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Only oral medication</td>
<td>1.68 (0.98, 2.87)</td>
<td>0.060</td>
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<tr>
<td><strong>Random blood glucose level (mg/dl)</strong></td>
<td></td>
<td></td>
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<tr>
<td>&lt; 200</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>200 to 299</td>
<td>3.42 (2.01, 5.83)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>7.28 (3.38, 15.72)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
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\(a\)outcome was defined as partial or lower adherence level (i.e. GMAS score26); \(b\)outcome was the GMAS overall score; LS – least square; CI – confidence interval
them more committed to their medications. Several studies have reported that adherence increases with age, supporting the idea that older patients have better adherence. However, more than a third of patients had partial-to-poor adherence. Previous studies for satisfactory medication adherence were reported to be 23% and 32.1% in Jazan and AlHassa regions of Saudi Arabia, respectively. However, both studies did not use a validated measure to document medication adherence. Our study used a novel medication adherence measuring tool validated in the Saudi population, which is a strength of our study.

The present study showed that some patient demographic and other factors were linked with changes in adherence to diabetes treatments. Gender, age, education level, monthly income, type of medications, and RBG were some of these factors. Only the age factor was statistically significantly associated with higher adherence, as older patients had higher treatment adherence. These results may be explained by the fact that the older population usually has more severe diseases, which makes them more committed to their medications. Several studies have reported that adherence increases with age, supporting our results. In contrast, other studies found that younger patients were more likely to be adherent than older patients.

One of the notable occurrences in our study was the significant association of adherence score with random blood glucose levels. It was observed that patients with elevated random blood glucose levels seem to have lower adherence scores which were found consistently in several studies. This is logical as non-adherence to antidiabetic medicines would cause blood glucose to rise, resulting in a hyperglycaemic state.

Similarly, patients on oral hypoglycaemic medicines appeared more adherent than those on combined oral and injectable insulins or insulin alone. Available literature suggests that gender acted as an independent predictor of adherence in Saudi patients; however, there was no significant association of gender with adherence in our study. In our study, it was observed that most patients with better adherence scores had no diabetes-related hospital admission in the last year.

While this research provided several essential points regarding the predictors of the level of adherence, it has some limitations. The first limitation was that we could not obtain information about the patient’s hemoglobin A1c (HbA1c) because many patients could not recall it while collecting the data. HbA1c is considered a critical predictor for long-term glycaemic control and might provide strong evidence for patient adherence to medications for the past three months. The second limitation is that our data were collected only from hospitals in the Eastern province, which might indicate that the sample population cannot represent the Saudi population. Therefore, the findings of our study cannot be generalized to larger populations.

CONCLUSION

Our study highlighted that less than half of Saudi patients with type 2 diabetes mellitus adhered highly to their medication regimen. Moreover, our study identified the predictors for adherence to type 2 diabetes medications. The age of patients acted as an independent predictor of adherence, while no such association was seen in the patient’s education level. Patients with better adherence scores had better treatment outcomes. The study’s findings suggest that educating patients about the importance of adherence and the repercussions of non-adherence could promote better adherence in this population.

References


