

Original article

Medication Adherence among Diabetic Libyan Adults Patients Attending Diabetic Outpatient Departments in Primary Health Care Facilities, Tripoli, Libya

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Keywords.

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Excessive healthcare burdens and sociodemographic factors can both significantly impact a patient's ability to adhere to prescribed treatments, which may result in adverse health outcomes. This study aims to assess medication adherence in diabetic patients and identify factors contributing to non-adherence at primary healthcare facilities and the Golden Polyclinics. A cross-sectional quantitative design was employed for this study, conducted from May to September 2024 in some primary health centres in Tripoli. The target population comprised patients diagnosed with type 2 diabetes mellitus. Data were collected using the Probabilistic Medication Adherence Scale (ProMAS) questionnaire. The study included 341 diabetic patients (mean age: 65.88 ± 12.9 years), with majority being female (55.4%), and having an education level of elementary to middle school (56.3%). Most were married (76.8%), and 50.7% were employed. Over half (53.0%) used oral medication, with 56.8% taking it twice daily. Additionally, 74.8% covered treatment costs independently, and 85.0% managed medication without assistance. Regarding medication adherence, 32.6% of participants demonstrated moderate-to-high adherence based on the ProMAS questionnaire. While 26.1% exhibited partial adherence requiring improvement, 16.7% had low adherence, indicating a risk for poor glycaemic control. Notably, 24.6% achieved high adherence. A chi-square analysis showed significant associations between adherence and demographic factors ($P < 0.05$). Females had higher adherence than males ($P = 0.042$). Higher medication frequency and personal payment were linked to better adherence, while public sector coverage was associated with lower adherence. This study underscores the significant impact of sociodemographic factors on medication adherence among patients with diabetes mellitus. Gender, medication frequency, and drug acquisition sources were identified as key determinants of adherence. Female patients exhibited higher adherence rates than males, suggesting potential gender-related differences in treatment engagement. Additionally, patients with more frequent dosing regimens demonstrated greater adherence, highlighting the potential benefits of structured medication schedules. Furthermore, reliance on public sector coverage was associated with lower adherence compared to personal payment. These findings emphasize the need for targeted interventions to address sociodemographic barriers and improve adherence in diabetes management.

Introduction

Diabetes is a long-term metabolic disorder marked by elevated blood glucose levels. If left unmanaged, it can progressively lead to significant complications affecting the heart, blood vessels, eyes, kidneys, and nervous system. The most prevalent form of diabetes in adults is type 2, in which the body develops insulin resistance or insufficient insulin production [1]. In 2021, the prevalence of diabetes mellitus (DM) among individuals aged 20 to 79 in Libya was estimated at 8.7%, as reported by the World Bank's development indicators, based on officially recognized sources. Diabetes is recognized as a major contributor to disability and mortality, with approximately 12% of healthcare expenditures in several countries directed toward preventing its complications [2].

Patients with chronic health conditions face challenges not only from their illnesses but also from complex healthcare regimens, which may involve taking medications, attending medical appointments, monitoring their health, and maintaining a proper diet and exercise routine. Excessive healthcare burdens can have serious consequences, as overwhelmed patients may find it difficult to adhere to prescribed treatments. Nonadherence can lead to more frequent hospitalizations and increased mortality rates. In response to poor outcomes, physicians often intensify treatments, further increasing the burden on patients. This escalation can negatively affect patients' quality of life, as they are required to devote more time, energy, and resources to managing their health [3].

According to a report from the World Health Organization (WHO), the rate at which patients with chronic diseases adhere to their prescribed long-term treatments is significantly low, with only half of such patients

(50%) in developed nations maintaining consistent compliance. This issue is even more pronounced in developing countries, where adherence rates are reportedly lower. The lower adherence in both developed and developing countries can have critical implications for health outcomes, as chronic diseases often require sustained management through medication or other therapies. These findings highlight the need for strategies to improve patient adherence to long-term treatments globally, particularly in resource-limited settings [4].

Inadequate adherence to prescribed diabetes treatment regimens is associated with significantly worse clinical outcomes, including potential damage to critical organs such as the heart, kidneys, and eyes. When patients fail to adhere to their treatments, the therapeutic goals are not met, resulting in an absence of the expected health improvements. Moreover, this non-adherence contributes to increased healthcare costs, not only for the individuals affected but also for the broader community. The financial strain arises from the need for more intensive medical interventions and the management of complications that could have been avoided with proper adherence to treatment protocols [5].

Numerous factors have been identified as contributing to the issue of non-adherence in diabetes management. These include both individual patient characteristics, such as attitudes and beliefs about the treatment, and external factors like socioeconomic challenges and the complexity of the healthcare systems. Additionally, morbidity, or the presence of other chronic conditions, complicates the management of diabetes. A recent study has highlighted specific reasons behind the lack of adherence, revealing that many patients grow weary of the continuous, long-term use of medication. Factors such as the large number of medications prescribed, the size of the pills, and unpleasant side effects can lead to feelings of discouragement. Furthermore, patients often feel disillusioned, as they perceive that the treatment does not offer a cure, but merely manages the disease, which further reduces their motivation to adhere to the regimen [6].

The early identification of patients who do not adhere to their prescribed treatments is essential in outpatient care settings. Detecting non-adherence allows healthcare providers to intervene in a timely manner, adjusting treatment strategies as needed. By recognizing these patients, clinicians can address the underlying causes of non-adherence, such as misunderstandings about the therapy, side effects, or barriers related to cost or access. This enables the implementation of more effective and individualized treatment approaches, ultimately improving health outcomes and ensuring that therapeutic goals are met.

The objective of this research is to evaluate the extent to which patients with type 2 diabetes adhere to their prescribed medication regimens. Additionally, it aims to analyze the differences in adherence based on various sociodemographic factors, such as age, gender, education level, and income, which have been commonly examined in prior studies. By focusing on the specific patterns of antidiabetic drug use and adherence within the population of Tripoli, the study seeks to contribute to a deeper understanding of the factors that influence medication adherence among patients with diabetes mellitus in this region. This analysis is crucial for identifying at-risk groups and developing targeted interventions to improve adherence and, consequently, health outcomes.

Methods

Study design and sampling

A quantitative research methodology, using a cross-sectional design, was adopted for this study. The research was conducted over a four-month period, from May to September 2024, across multiple primary health centers in the city of Tripoli. These centers, including Khaled Iben Waleed health center, Abosleem Golden Polyclinic, Tarek Almatar Golden Polyclinic, Gout Alshaal Golden Polyclinic were selected as the main sites for data collection. The study's target population comprised patients who had received a diagnosis of type 2 diabetes mellitus. The choice of a cross-sectional design allows for the collection of data at a single point in time, facilitating the analysis of adherence behavior and its relationship to various sociodemographic factors in the specified population.

In this study, data collection was conducted using the Probabilistic Medication Adherence Scale (ProMAS) questionnaire, a standardized tool designed to assess the degree of medication adherence among patients [7]. The ProMAS, initially developed in English, underwent a thorough translation process into Arabic, employing both forward and backward translation techniques to ensure linguistic accuracy and cultural relevance. This translated version has been validated for use in a population of type 2 diabetes patients in Tripoli, ensuring that it reliably captures adherence behavior. The data collection involved structured interviews, during which doctors administered the questionnaire directly to the participants. This approach helped minimize response bias and ensure clarity. Prior to participation, patients were fully informed about the study and provided their consent, adhering to ethical research practices.

Study population and sampling

The inclusion criteria specified that participants must be aged between 18 and 65 years, have a confirmed diagnosis of type 2 diabetes mellitus, and have been on medication for a minimum of one year. A total of 341 individuals with type 2 diabetes were included in the study. To ensure the sample was representative of non-medical populations, respondents who were healthcare professionals or had any formal education in the medical field were excluded.

For this study, the respondents were selected using a convenience sampling technique, which involved choosing participants based on their accessibility and willingness to participate. The process was carried out by volunteer intern doctors under the supervision of the study's author to ensure the collection of a diverse and representative dataset. The selection method aimed to minimize bias and capture a wide range of variables relevant to the research objectives. To ensure the privacy and confidentiality of participants, all identifying information was anonymized, and strict data protection protocols were followed throughout the process.

Data analysis

The data analysis in this study was conducted through a scoring mechanism applied to the questionnaire responses. For each correct response, a score of 1 was awarded, while incorrect responses were given a score of 0. This binary scoring approach allowed for the classification of respondents' adherence behavior into distinct categories. The adherence levels were divided into four specific groups: individuals with scores ranging from 0 to 4 were classified as having low adherence, those scoring between 5 and 9 were considered to have moderate-low adherence, respondents with scores between 10 and 14 were categorized as moderate-high adherence, and participants who scored between 15 and 18 were deemed to exhibit high adherence. This scoring system provided a clear and structured way to quantify adherence behavior among patients [7]. Data coded, entry then analysis were performed by statistical package for social science (SPSS) software 25 version. Simple descriptive statistics were used (mean \pm standard deviation for quantitative variables, and frequency with percentage for categorized variables. inferential statistics used Chi square test with. $P < 0.05$ as statistically significant.

Results

A total of 341 diabetic patients were included in this study. Approximately two-thirds of the participants (54%) were under the age of 60, with a mean age of 56.88 ± 12.9 years. The sample consisted predominantly of females 189 (55.4%), while males accounted for 152 (44.6%). Among the participants with diabetes, 56.3% had an education level ranging from elementary to middle school. A significant proportion of participants (76.8%) were married, and nearly half (50.7%) were employed. A total of 179 respondents (53.0%) reported using tablets or capsules to manage DM in contrast to those who received insulin therapy. On average, the frequency of medication intake among the respondents was twice daily (56.8%). Most respondents (74.8%) covered the cost of their treatment independently. Furthermore, after prolonged treatment and adaptation to their medication routine, most respondents (85.0%) did not require assistance with administration. The detailed sociodemographic characteristics of the study population are summarized in table 1.

Table 1. Socio-demographic characteristics of respondents with diabetes mellitus (n=341)

Variable	Frequency	Percentage (%)
Age group (years old)		
- Mean	(56.88)	
- < 60	184	54.0
- \geq 60	157	46.0
Gender		
- Male	152	44.6
- Female	189	55.4
Education Level		
- Elementary/Middle School	192	56.3
- College	149	43.7
Marital Status		
- Single	48	14.1
- Married	262	76.8
- Widowed	31	9.1

Occupation		
- Employed	173	50.7
- Unemployed	168	49.3
Type of Medication		
- Tablet/Capsule	179	53.0
- Insulin	159	47.0
Medication frequency/day		
- One time a day	70	20.6
- Two times a day	193	56.8
- ≥ 3 times a day	77	22.6
Payment		
- Public sector	86	25.2
- Personal Payment	255	74.8
Caregiver assists the patient with medication		
- No	289	85.0
- Yes	51	15.0

Medication adherence

The overall prevalence of medication adherence, as assessed using the ProMAS questionnaire, indicates that 32.6% of diabetic respondents exhibited a moderate-to-high level of adherence. Furthermore, 26.1% of participants demonstrated some adherence but required further improvement, while 16.7% displayed low adherence, posing a considerable risk for poor glycaemic control. Notably, 24.6% ($n = 84$) of participants achieved a high level of adherence. The distribution of adherence levels among diabetic patients, as measured by ProMAS, is presented in (Table 2).

Table 2. Adherence Level of Diabetes Mellitus Medication

Adherence Level Category	Score Range	n (%)
Low	0-4	57 (16.7%)
Low-Medium	5-9	89 (26.1%)
Medium-High	10-14	111 (32.6%)
High	15-18	84 (24.6%)

Association between adherence scores and sociodemographic factors

The chi-square test was used to assess for the bivariate association between the study variables and adherence scores, with a significance level set at a P-value of less than 0.05. The results of this analysis are presented in Table 3. The analysis revealed a statistically significant association (P -value < 0.05) between medication adherence and specific patient characteristics, including gender, medication frequency, and drug acquisition source. These findings underscore the influence of demographic and treatment-related factors on adherence behavior. The analysis identified a statistically significant association between gender and medication adherence levels among patients with diabetes mellitus ($P=0.042$). Female participants exhibited a higher proportion of high adherence (29.6%) compared to males (18.4%), whereas male participants were more frequently represented in the low score category (19.7%). These findings suggest that females tend to demonstrate greater adherence to prescribed medication regimens.

Moreover, the analysis of both medication frequency and payment measures revealed a statistically significant association across categories (P -values ≤ 0.36). Participants taking medication three or more times daily exhibited the highest proportion of moderate to high adherence (45.5%). In contrast, those taking medication once daily demonstrated a higher proportion of moderate to high adherence (37.1%) compared to high adherence (24.3%). Regarding payment methods, public sector coverage was associated with a greater proportion of low adherence (25.6%) and a lower proportion of high adherence (16.3%). Conversely, personal payment was linked to a lower prevalence of low adherence (13.7%) and a higher proportion of high adherence (27.5%).

Table 3. Association between sociodemographic/clinical characteristics and Adherence Level of Diabetes Mellitus Medication

Variable	Low Level (%)	Low-Medium Level (%)	Medium-High Level (%)	High Level (%)	Total (N=241)	p-value
Age group (years old)						
- < 60	16.8%	26.1%	33.7%	23.4%	184	
- ≥ 60	16.6%	26.1%	31.2%	26.1%	157	0.935
Gender						
- Male	19.7%	24.3%	37.5%	18.4%	152	
- Female	14.3%	27.5%	28.6%	29.6%	189	0.042
Education Level						
- Elem./Sec. School	14.6%	28.6%	29.2%	27.6%	192	
- College	19.5%	22.8%	36.9%	20.8%	149	0.144
Marital Status						
- Single	10.4%	33.3%	22.9%	33.3%	48	
- Married	19.1%	24.0%	34.0%	22.9%	262	
- Widowed	6.5%	32.3%	35.5%	25.8%	31	0.161
Occupation						
- Employed	17.3%	24.3%	38.2%	20.2%	173	
- Unemployed	16.1%	28.0%	26.8%	29.2%	168	0.083
Type of Medication						
- Tablet/Capsule	15.6%	25.7%	30.7%	27.9%	179	
- Insulin	17.0%	27.0%	35.2%	20.8%	159	0.487
Medication frequency/day						
- One time a day	11.4%	27.1%	37.1%	24.3%	70	
- Two times a day	18.1%	30.1%	25.9%	25.9%	193	
- ≥ 3 times a day	18.2%	15.6%	45.5%	20.8%	77	0.036
Payment						
- Public sector	25.6%	29.1%	29.1%	16.3%	86	
- Personal Payment	13.7%	25.1%	33.7%	27.5%	255	0.024
Caregiver assistance						
- No	17.0%	28.0%	31.5%	23.5%	289	
- Yes	15.7%	13.7%	39.2%	31.4%	51	0.149

c: Chi-square test. P < 0.05 is statistically significant

Discussion

The present study found that a majority (57.81%) of the participants with type 2 diabetes exhibited moderate-to-high or high levels of medication adherence. In contrast, 42.82% of the patients reported low or low-to-moderate adherence to their prescribed medications. This finding aligns with a cross-sectional study conducted in Nepal, which indicated that more than half of the study population had high medication adherence [8].

The sociodemographic characteristics of the respondents in this study indicate that 55.4% (189 individual) are female, with an average age of 56.88 years. These finding is consistent with a previous study conducted in Libya [9]. In general, lifestyle changes that reduce physical activity and increase obesity contribute to a higher risk of diabetes. Females are potentially more likely to be affected due to lower levels of physical activity compared to males, as well as hormonal changes, especially those associated with premenstrual syndrome and post-menopause [10].

In the present study, gender was found to be significantly associated with the level of adherence (P=0.042). However, this finding contrasts with a study conducted in Al-Bayda, Libya [8], while it aligns with research conducted in Italy, with participants recruited from the Sapienza University of Rome and other study conducted in the United States [11,12]. The current study reveals that female participants demonstrate significantly higher adherence rates than their male counterparts. These studies suggest that women generally have a greater tendency to seek medical care, schedule regular check-ups, and follow healthcare

recommendations compared to men. Furthermore, women often take on caregiving roles, which may make them more responsible for maintaining their own health to care for others.

Our study found no significant differences between medication adherence and age, education level, marital status, or occupation. These findings are consistent with studies conducted in Libya and Indonesia, which also reported no significant association between patients' age, education level, and occupation ($P > 0.05$) [9,13]. Contrary to this finding, other studies found statistically significant associations between age, marital status, education, and occupation with medication adherence among patients with type 2 diabetes. The studies suggest that sociodemographic factors such as higher education levels likely improve medication literacy and understanding of treatment, leading to better adherence. Employment and stable income may reduce financial barriers to accessing medication, while older age could reflect greater experience with managing chronic conditions. Additionally, marital status may influence adherence through social support systems that encourage consistent medication use [14-16].

In this study, no significant association was found between medication adherence and the type of medication ($P=0.48$). These findings contrast with previous studies that have reported significant differences in adherence rates among various antidiabetic medication classes. Prior studies have indicated that medications with simpler dosing regimens and fewer side effects are associated with higher adherence rates, whereas insulin therapies tend to have lower adherence due to the burden of injections and associated adverse effects [17,18].

The findings of the present study indicate a significant association between medication adherence and medication frequency ($P=0.036$). The frequency of medication administration once or twice daily is associated with high level of adherence, whereas regimens requiring more than three doses per day are linked to lower adherence rates. This result aligns with numerous studies worldwide, which have consistently demonstrated that medication frequency plays a crucial role in adherence among diabetic patients. Higher dosing frequencies are linked to lower adherence rates, whereas simpler regimens with less frequent dosing have been shown to improve adherence and glycaemic control. These findings highlight the importance of optimizing medication schedules to enhance adherence and improve treatment outcomes in diabetes management [19-21].

The results reveal a significant correlation between medication adherence and the method of payment or drug acquisition ($P=0.024$). Individuals who personally finance their medication exhibit a higher adherence rate compared to those receiving treatment through public provisions. Similar findings have been reported in previous studies, which suggests that the method of payment plays a crucial role in adherence. Specifically, patients who receive fully subsidized or free medications tend to exhibit lower adherence rates, possibly due to a lack of perceived value or commitment to their treatment. In contrast, individuals who make financial contributions toward their medications often display higher levels of adherence [22].

Conclusion

This study highlights the significant association between sociodemographic factors and medication adherence among patients with diabetes mellitus. The findings reveal that gender, medication frequency, and the source of drug acquisition are critical determinants of adherence behaviours. Specifically, female patients exhibited higher adherence rates compared to males, suggesting potential gender-related differences in health-related behaviours and treatment engagement. Moreover, medication frequency emerged as a key factor influencing adherence, with patients taking medication three or more times daily demonstrating the highest levels of adherence. This suggests that structured and frequent dosing regimens may enhance patient compliance. Additionally, the mode of medication payment was found to significantly affect adherence, with patients relying on public sector coverage showing lower adherence rates than those who personally financed their medications. These findings highlight the necessity of targeted interventions that address sociodemographic barriers to enhance medication adherence in diabetes management.

Recommendations

This study underscores the importance of optimizing medication frequency of optimizing medication frequency to enhance adherence and improve treatment outcomes in diabetes management. Additionally, the findings highlight the necessity for policymakers to implement financial strategies that balance affordability with patient responsibility. By addressing these factors, healthcare systems can foster better adherence, ultimately leading to improve health outcomes and more effective disease management. Future research should explore the long-term impact such strategies on patient adherence and overall healthcare costs.

Ethical issue

Ethical approval for this study was obtained from the management of all primary health care facilities and the Golden Polyclinic facilities. Prior to participation, all patients provided informed consent after receiving a clear explanation of the study's objectives. To ensure confidentiality all collected data were anonymized.

Study limitation

The primary limitation of this study is the use of a non-probability sampling method, which restricts the generalizability of the findings. Additionally, the cross-sectional design of the analysis prevents the establishment of causal relationships or temporal association between medication adherence and diabetes in adult.

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Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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المستخلص

يمكن أن تؤثر الأعباء الصحية المفرطة والعوامل الاجتماعية والديموغرافية بشكل كبير على قدرة المريض على الالتزام بالعلاجات الموصوفة، مما قد يؤدي إلى نتائج صحية سلبية. تهدف هذه الدراسة إلى تقييم التزام المرضى المصابين بالسكري بالأدوية وتحديد العوامل التي تساهم في عدم الالتزام في مرافق الرعاية الصحية الأولية والعيادات الطبية الذهبية. تم استخدام تصميم كمي مقطعي لهذه الدراسة، التي أجريت من مايو إلى سبتمبر 2024 في بعض مراكز الرعاية الصحية الأولية في طرابلس. يتكون السكان المستهدفون من المرضى الذين تم تشخيصهم بمرض السكري من النوع 2. تم جمع البيانات باستخدام استبيان مقياس الالتزام بالأدوية الاحتمالية (ProMAS) شملت الدراسة 341 مريضًا مصابًا بالسكري (متوسط العمر: 65.88 ± 12.9 سنة)، وكانت الأغلبية من الإناث (55.4%). ومستوى تعليمي من الابتدائية إلى المتوسطة (56.3%). كان معظمهم متزوجين (76.8%)، وكان 50.7% منهم موظفين. استخدم أكثر من نصف المشاركين (53.0%) الأدوية عن طريق الفم، وتناولها 56.8% مرتين يوميًا. بالإضافة إلى ذلك، قام 74.8% بتغطية تكاليف العلاج بشكل مستقل، وتمكن 85.0% من إدارة الأدوية دون مساعدة. وفيما يتعلق بالالتزام بالأدوية، أظهر 32.6% من المشاركين التزامًا متوسطًا إلى مرتفعًا بناءً على استبيان ProMAS. بينما أظهر 26.1% التزامًا جزئيًا يتطلب تحسنًا، كان لدى 16.7% التزامًا منخفضًا، مما يشير إلى وجود خطر ضعف التحكم في نسبة السكر في الدم. والجدير بالذكر أن 24.6% حققوا التزامًا مرتفعًا. أظهر تحليل مربع كاي ارتباطات مهمة بين الالتزام والعوامل الديموغرافية ($P < 0.05$) كان لدى الإناث التزام أعلى من الذكور ($P = 0.042$). ارتبط ارتفاع وتيرة تناول الأدوية والدفع الشخصي بالالتزام الأفضل، في حين ارتبطت تغطية القطاع العام بانخفاض الالتزام. تؤكد هذه الدراسة على التأثير الكبير للعوامل الاجتماعية والديموغرافية على الالتزام بالأدوية بين مرضى السكري. تم تحديد الجنس وتواتر تناول الأدوية ومصادر الحصول على الأدوية كمحددات رئيسية للالتزام. أظهرت المريضات معدلات التزام أعلى من الذكور، مما يشير إلى وجود اختلافات محتملة مرتبطة بالجنس في المشاركة في العلاج. بالإضافة إلى ذلك، أظهر المرضى الذين لديهم أنظمة جرعات أكثر تكرارًا التزامًا أكبر، مما يسلط الضوء على الفوائد المحتملة لجداول الأدوية المنظمة. وعلاوة على ذلك، ارتبط الاعتماد على تغطية القطاع العام بانخفاض الالتزام مقارنة بالدفع الشخصي. تؤكد هذه النتائج على الحاجة إلى تدخلات مستهدفة لمعالجة الحواجز الاجتماعية والديموغرافية وتحسين الالتزام في إدارة مرض السكري.