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Research Article

Medication Adherence of Diabetic Patients in Erbil City: A Cross-Sectional Study

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a major health problem in Iraq. In Erbil, differences in access to healthcare, socioeconomic level, and taking medications as directed made treatment much harder. Few studies are conducted on these dynamics outside of clinical settings, where selection bias might hide problems that happen in the real world. ***Objectives***: To find out how socioeconomic and clinical characteristics, as well as the rate of medication adherence, affect glycemic control in people with T2DM. ***Methods***: Community-based cross-sectional research was undertaken on 400 T2DM patients in Erbil, purposefully sampled from mosques, salary-collecting places, public parks, the Ministry of Education, and retirement offices. Data were obtained by standardized questionnaires, encompassing demographics, occupation, medication adherence, and health-seeking behavior. Glycemic control was categorized using HbA1c values. ***Results***: Out of 400 participants, 38 had controlled diabetes, while 90.5% had uncontrolled T2DM. Only 40.8% adhered to their suggested regimen. 28.3% were obese, 45.8% overweight, and 26.5% had normal BMI. The primary adherence challenges were financial restrictions, lack of regular follow-up, and insufficient health literacy. Obesity and being overweight were highly connected with poor diabetic control. ***Conclusions***: Uncontrolled diabetes is dangerously common in Erbil's society, driven by medication non-adherence and obesity. Public health policies must focus on pharmaceutical preparation costs, weight control measures, and community diabetes education, especially targeting jobless and low-income groups—to improve results.

Keywords: Advice seeking behavior, Glycemic control, Sociodemographic factors, T2DM, Treatment adherence.

الالتزام الدوائي لمرضى السكري في مدينة أربيل: دراسة مقطعية

الخلاصة

الخلفية: داء السكري من النوع 2 (T2DM) هو مشكلة صحية رئيسية في العراق. في أربيل، جعلت الاختلافات في الوصول إلى الرعاية الصحية والمستوى الاجتماعي والاقتصادي وتناول الأدوية حسب التوجيهات العلاج أكثر صعوبة. تم إجراء عدد قليل من الدراسات حول هذه الديناميكيات خارج الإعدادات السريرية، حيث قد يخفي تحيز الاختيار المشكلات التي تحدث في العالم الحقيقي. **الأهداف**: معرفة كيفية تأثير الخصائص الاجتماعية والاقتصادية والسريرية، وكذلك معدل الالتزام بالأدوية، على التحكم في نسبة السكر في الدم لدى الأشخاص المصابين بمرض السكري من النوع 2. **الطرائق**: أجريت أبحاث مقطعية مجتمعية على 400 مريض بمرض السكري من المرض في أربيل، تم أخذ عينات منها بشكل هادف من المساجد وأماكن جمع الرواتب والحدائق العامة ووزارة التربية ومكاتب التقاعد. تم الحصول على البيانات من خلال استبيانات موحدة ، تشمل التركيبة السكانية والمهنة والالتزام بالأدوية وسلوك البحث عن الصحة. تم تصنيف التحكم في نسبة السكر في الدم باستخدام قيم HbA1c. **النتائج**: من بين 400 مشارك، كان 38 شخصا يعانون من مرض السكري المتحكم فيه، بينما كان 90.5٪ يعانون من T2DM غير المنضبط. التزم 40.8٪ فقط بنظامهم المقترح. 28.3٪ كانوا يعانون من السمنة المفرطة، و 45.8٪ يعانون من زيادة الوزن، و 26.5٪ لديهم مؤشر كتلة جسم طبيعي. كانت تحديات الالتزام الرئيسية هي القيود المالية، وعدم المتابعة المنتظمة، وعدم كفاية محو الأمية الصحية. كانت السمنة وزيادة الوزن مرتبطة ارتباطا وثيقا بضعف السيطرة على مرضى السكري. **الاستنتاجات**: مرض السكري غير المنضبط شائع بشكل خطير في مجتمع أربيل، مدفوعا بعدم الالتزام بالأدوية والسمنة. يجب أن تركز سياسات الصحة العامة على تكاليف إعداد الأدوية، وتدابير التحكم في الوزن، والتثقيف المجتمعي لمرض السكري، لا سيما استهداف فئات العاطلين عن العمل وذوي الدخل المنخفض - لتحسين النتائج.

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INTRODUCTION

Globally, type 2 diabetes mellitus (T2DM) has grown to be a serious public health concern. People of all ages and demographics are affected by it, making it a leading cause of death and disability globally [1]. Diabetes mellitus has been becoming more common at an alarming rate. Approximately 529 million people worldwide received a diabetes diagnosis in 2021, making up 6.1% of the adult population. Notably, over 90% of these individuals have type 2 diabetes, underscoring the disease's dominance in the overall diabetes burden [2]. With over a million deaths annually, type 2 diabetes mellitus (T2DM) is now the tenth leading cause of death globally [2]. T2DM contributes significantly to morbidity and a worse quality of life in addition to death. It is one of the main causes of major long-term consequences, including retinopathy, neuropathy, chronic renal disease, stroke, and cardiovascular disease [2-5]. These issues might result in severe medical expenses and disability (such as blindness or limb amputations). Rapid urbanization, sedentary lifestyles, dietary changes (such as a rise in the use of processed foods high in

calories), and growing obesity rates have all contributed to an increase in diabetes prevalence in numerous Middle East and North Africa (MENA) nations over the last few decades. For example, it has been noted that these lifestyle modifications have caused the prevalence of diabetes to skyrocket in the majority of the region's nations [6]. The growing prevalence of T2DM in the area is best shown by Iraq. The frequency of diabetes has dramatically increased in Iraq during the last several decades. According to one comprehensive analysis, the incidence of diabetes in Iraq increased by almost four times, from around 5% in 1978 to approximately 19.7% in 2012 [7]. According to reports, the overall rate of type 2 diabetes in Iraq ranges from 8.5% to 13.9%. Certain research suggests that the prevalence is much greater in certain areas, such as Basrah, where it reaches 19.7% when undiagnosed cases are taken into account. This finding reflects the influence of risk factors and changing lifestyles [8]. According to research, a significant number of patients had complications from diabetes mellitus, including diabetic neuropathy (98%), diabetic retinopathy (96%), stroke (60%), diabetic nephropathy (36%), hypertension (63%), and foot issues (60%) [9]. In addition to pharmacological therapies, patient behaviors—particularly prompt health care seeking and regular medication adherence—are crucial for successful treatment of type 2 diabetes [10]. The term "health-seeking behavior" (HSB) describes how people identify health issues and promptly seek out expert healthcare treatments. Good HSB in the setting of diabetes may include getting routine blood sugar checks, seeing doctors as soon as problems or uncontrolled blood sugar occur, and going to checkups on time [11]. Medication adherence, also known as drug adherence, is the practice of taking anti-diabetic drugs (such as insulin or oral hypoglycemic medicines) precisely as directed, in the specified dosages, and on a regular basis [12]. In order to achieve and sustain glycemic control in T2DM and avert complications, HSB and adherence to drugs are essential. Diabetes results are significantly improved by prior and suitable health seeking along with rigorous adherence to treatment, according to the literature [13]. Patients may postpone or prevent the advancement of illness and its consequences by seeking care as soon as possible and according to medical guidance. This allows for early detection and therapy intensification [13]. On the other hand, poor adherence and postponed treatment predispose to long-term hyperglycemia, which results in preventable consequences [14]. Individuals with diabetes wait until their symptoms worsen or problems arise before seeking medical attention. Early glycemic control possibilities are lost as a result of these delays in requesting medical assistance. Research indicates that worse glycemic management and increased incidence of complications are linked to late detection and infrequent healthcare contact [10]. Patients who actively participate in healthcare systems, such as by routinely visiting diabetic clinics, often have improved glycemic indices and prompt treatment regimen modifications, hence avoiding chronic problems. Perhaps the most significant patient-driven factor in effective diabetes management, even after diagnosis, is medication adherence. By keeping glucose levels in the blood within the desired range, regular use of insulin and anti-diabetic drugs helps avoid the organ damage that results from chronic hyperglycemia. Non-adherence raises HbA1c levels and raises the risk of consequences from diabetes, including cardiovascular events, according to studies [15]. Conversely, individuals who adhere to their treatment plan have noticeably greater results. According to a meta-analysis of type 2 diabetes outcomes, patients who took at least 80% of their prescription drugs as directed had a 28% reduced chance of dying from any cause than those who did not take their drugs as directed. Better glycemic control explains this biologically because long-term pharmaceutical usage avoids blood glucose spikes that harm organs and blood arteries [16]. The benefits are further enhanced by the fact that adherence often coincides with compliance to other self-care practices (exercise, nutrition) [20].

METHODS

Study design and setting

A descriptive cross-sectional study was conducted among type 2 diabetic patients in Erbil city, Kurdistan-Iraq, between December 2024 and February 2025. The study assessed health-seeking behavior (HSB), drug adherence, and diabetic control in relation to sociodemographic and socioeconomic factors.

Sample selection

The target population is type 2 diabetic patients residing in Erbil. The sample size is 400 participants, calculated using a 5% level of significance and a 5% margin of precision, based on prior prevalence estimates. The sampling technique was a multi-site convenience sampling employed across salary distribution sites, general parks, mosques, Ministry of Education offices, general markets, and the Hawler Citadel vicinity.

Inclusion and exclusion criteria

The study included participants who had been diagnosed with type 2 diabetes mellitus (T2DM), were aged 18 years or older, and were willing to participate in the study by completing the questionnaire and providing blood samples for both HbA1c and random glucose testing. Individuals were excluded from the study if they had type 1 or gestational diabetes or if they were under 18 years of age. This selection criterion ensured the study population specifically represented adults with T2DM while eliminating potential confounding factors from other diabetes types or pediatric cases.

Study variables and data collection approach

This comprehensive study examined multiple dimensions influencing diabetes management through an integrated assessment of socioeconomic, clinical, behavioral, and lifestyle factors. The research employed a structured approach to evaluate how these interrelated variables affect health-seeking behavior, medication adherence, and glycemic control among type 2 diabetic patients in Erbil. The study collected detailed socioeconomic data, including participants' income levels categorized as low, middle, or high based on local wage standards, along with employment status (high-level occupations, non-manual workers, skilled manual workers, unskilled manual workers, or unemployed). Educational attainment was documented across four tiers, from illiteracy through university education. Housing and transportation status served as wealth indicators, with specific recordings of home and vehicle ownership. Health insurance coverage was additionally noted as it significantly impacts healthcare accessibility in the region. The study thoroughly evaluated health-seeking patterns by documenting participants' primary care sources, distinguishing between formal medical facilities and informal alternatives like traditional healers or unregulated pharmacies. Visit frequency to healthcare providers was categorized to identify engagement levels, while annual screening habits revealed preventive care adherence. Information sources about diabetes management were cataloged to understand knowledge acquisition channels, ranging from medical professionals to digital media and community networks. A validated MARS-5 adherence scale implementation enabled precise measurement of medication compliance, capturing dose timing accuracy, self-adjusted dosing behaviors, and treatment persistence. The study specifically investigated barriers to adherence through direct questioning about financial constraints, side effect experiences, forgetfulness patterns, and alternative medicine preferences. Detailed lifestyle analysis included exercise regimen documentation, noting both frequency and modality of physical activity. Dietary modifications were assessed through reported sugar intake reduction and adoption of diabetes-specific nutrition plans. The study also recorded usage of complementary therapies, including herbal preparations and spiritual healing practices, to evaluate their role in disease management. Cultural belief systems were examined for their influence on treatment preferences and healthcare decisions. This multidimensional assessment framework was specifically designed to capture the complex interplay of factors influencing diabetes outcomes in the Kurdish population. By simultaneously evaluating medical, economic, social, and behavioral elements, the study provides unique insights into the barriers and facilitators of effective diabetes management within this distinct cultural and healthcare context.

Data collection and outcomes measurement

Data were collected through a structured interviewer-administered questionnaire assessing sociodemographic characteristics (age, gender, education, employment), socioeconomic status (income, household assets), health-seeking behavior (utilization of formal versus informal healthcare services), and drug adherence (measured using the MARC-5 Medication Adherence Scale). To objectively evaluate diabetic control, biochemical assessments were performed, including HbA1c testing to reflect three-month glycemic control and random blood glucose testing for point-in-time glucose levels. Trained personnel collected capillary or fasting blood samples using standardized glucometers to ensure consistency in measurements.

Ethical approval

The project is approved by the Research Community of Hawler Medical University, College of Medicine (certificate number 25 on December 4, 2024).

Statistical analysis

For data analysis, SPSS (version 26) was utilized to perform both descriptive and inferential statistics. Descriptive analyses included frequencies and percentages for categorical variables (e.g., poor/good HbA1c control) and mean ± standard deviation for continuous variables (e.g., blood glucose levels). Inferential analyses involved chi-square tests to examine associations between variables (e.g., HbA1c control versus adherence) and logistic regression to identify significant predictors of poor glycemic control. A *p*-value of less than 0.5 was considered significant for differences.

RESULTS

The research looked at 400 people with Type 2 Diabetes Mellitus (T2DM), who were split into two groups: managed (9.5%) and uncontrolled (90.5%). Of the people, 59.25% were male and 7.59% had managed diabetes. Of the people, 40.75% were female and 12.27% had controlled diabetes, with a p-value of 0.117. Of the 29 widowed patients, all of them (7.25%) had uncontrolled diabetes. Of 91.25% of married patients, 10.14% had managed diabetes. The age distribution was almost equal across groups: 23.75% were under 50, 30.75% were 50–59, 30.25% were 60–69, and 15.25% were 70 or over. The control rates were between 8.27% and 11.38% for all age groups (p=0.167). There were different levels of education: 38.5% had a college degree or above, 9.74% had a high school diploma or less, and 10.5% were illiterate, with 9.52% controlled, with a p-value of 0.835. Occupation data showed that 45.75% of patients were jobless, 9.29% of whom were managed, while 162 (40.5%) were non-manual workers, with 11.11% controlled (p= 0.738). Income levels indicated

that 66.25% of patients made more than their daily requirements, and 11.32% of those were managed. On the other hand, 28.5% of patients didn't have enough money, and only 6.14% of them were controlled (p= 0.216). BMI categories were (41.0%) overweight patients, (12.81%) controlled, and (28.25%) obese patients, (9.73%) controlled (p= 0.283) (Table 1).

Table 1: Association of glycemic control with patient's characteristics

Variables	Controlled T2DM (n=38)	Uncontrolled T2DM (n=362)	Total (n=400)	*p-value
Gender				
Male	18(7.59)	219(92.41)	237(59.25)	0.117
Female	20(12.27)	143(86.5)	163(40.75)	
Marital status				
Single	1(16.67)	5(83.3)	6(1.5)	
Married	37(10.14)	328(89.86)	365 (91.25)	0.167
Widowed	0(0.0)	29(100)	29 (7.25)	
Age (year)				
< 50	8(8.42)	87(91.58)	95(23.75)	
50-59	14(11.38)	109(88.62)	123(30.75)	0.835
60-69	10(8.27)	111(91.74)	121(30.25)	
≥70	6(9.83)	55(90.16)	61(15.25)	
Educational level				
Illiterate	4(9.52)	38(90.48)	42(10.5)	
Read & Write and Primary	5(12.2)	36(87.8)	41(10.25)	
Intermediate	4(7.55)	49(92.45)	53(13.25)	0.962
Secondary	10(9.1)	100(90.91)	110(27.5)	
College and above	15(9.74)	139(90.26)	154(38.5)	
Occupation				
Unemployed	17(9.29)	166(90.71)	183(45.75)	
Unskilled manual workers	2(7.7)	24(92.3)	26(6.5)	
Skilled manual workers	1(4.76)	20(95.24)	21(5.25)	0.738
Non-manual workers	18(11.11)	144(88.89)	162(40.5)	
High level of occupation	0(0.0)	8(100)	8(2)	
Income				
Not sufficient or marginally Sufficient	7(6.14)	107(93.86)	114(28.5)	
Exceeds daily needs	30(11.32)	235(88.68)	265(66.25)	0.216
Sufficient	1(4.76)	20(95.24)	21(5.25)	
BMI categories				
Normal	6(5.77)	98(94.23)	104(26)	
Over-weight	21(12.81)	162(87.2)	164(41)	0.283
Obese	11(9.73)	102(90.27)	113 (28.25)	
Total			400(100)	

Values were expressed as frequency and percentage. *Statistical analysis is performed using Chi-square test at p<0.05.

The employment profile of the participant cohort represented different employment histories, with almost half (45.8%, n=183) jobless owing to retirement or economic issues. A considerable number were working in non-manual government tasks (40.5%, n=162), whereas manual laborers (unskilled: 6.5%, skilled: 5.3%) and high-level professionals (2.0%) represented smaller categories. Education and economic status varied; 38.5% (n=154) possessed college or higher degrees, followed by secondary education (27.5%) and intermediate-level schooling (13.3%). Notably, 20.8% (n= 83) had limited literacy (illiterate or read/write only). Economically, most participants owned their houses (81.0%, n=324) and automobiles (67.8%, n= 271). Income adequacy was stated by 66.3% (n= 265); however, 28.5% (n= 114) suffered budgetary restrictions (Table 2). The research population revealed a significant frequency of diabetes familial predisposition, with 65.5% (n= 262) having a family history of the illness. Nearly half of the patients (47.5%, n= 190) had at least one extra comorbidity, with hypertension (42.8%) being the most dominant. Other clinically relevant diseases were hyperthyroidism (5.0%), rheumatoid arthritis (3.0%), cancer (2.5%), and renal failure (1.8%).

Table 2: Socioeconomic status of the participants (n=400)

Variables	n(%)
Occupation	
Unemployed	183(45.7)
Unskilled manual workers	26(6.5)
Skilled manual workers	21(5.3)
Non-manual workers	162(40.5)
High level of occupation	8(2)
Educational level	
Illiterate	42(10.4)
Read & Write and Primary	41(10.3)
Intermediate	53(13.3)
Secondary	110(27.5)
College and above	154(38.5)
House ownership	
Rented and others	75(18.7)
Partially owned	1(0.3)
Owned	324(81)
Car ownership	
No	129(32.3)
Yes	271(67.7)
Income	
Not sufficient or marginally sufficient	114(28.4)
Exceeds daily needs	265(66.3)
Sufficient	21(5.3)
Total	400(100)

Additionally, uncommon but noteworthy comorbidities—such as Down syndrome, familial hyperprolactinemia, Alzheimer's disease, liver

cirrhosis, and PBH (benign prostatic hyperplasia) were described in lower percentages (Table 3).

Table 3: Family history of diabetes and co-morbidities (n=400)

Variables	n(%)
Family history of diabetes	262(65.5)
Have other chronic diseases	190(47.5)
Hypertension	171(42.8)
Hyperthyroidism	20(5)
Cancer	10(2.5)
Renal failure	7(1.8)
Rheumatoid arthritis	12(3)
Benign prostatic hyperplasia	11(2.7)
Liver cirrhosis	1(0.3)
Hepatitis B virus	1(0.3)
Asthma	5(1.3)
Alzheimer's disease	1(0.3)
Familial hyperprolactinemia	1(0.3)
Down syndrome	1(0.3)
Total	400(100.0)

The research found complicated healthcare consumption patterns among individuals. Private hospitals and clinics emerged as the most often utilized healthcare providers, with 355 participants (88.8%) obtaining treatment at these institutions. Public hospitals were also commonly used, treating 318 individuals (79.5%). Pharmacies demonstrated the greatest use rate, accessed by 374 participants (93.5%), showing their significant role in healthcare service. Supportive healthcare workers were contacted by 189 participants (47.3%), whereas traditional healers had low participation, with just 11 participants (2.8%) requesting their services. These data suggest that participants regularly mix different healthcare providers, with the majority depending on both private and public medical facilities alongside pharmacies but indicating low usage of traditional healing approaches (Table 4).

Table 4: Setting of medical advice and health information requests (n=400)

Variables	n (%)
Public hospitals	318(79.5)
Private Hospitals	355(88.89)
Supportive health care staff	189(47.3)
Pharmacies	374(93.5)
Traditional healers	11(2.80)
Total	400(100)

The research studied the association between medication adherence and the number of medicines taken daily, and the findings indicated a striking trend. Adherence rates vary based on the daily medication load. Among those taking only one medicine per day, only 14 patients (27.5%) were adherent, while 37 (72.5%) were non-adherent. The pattern was comparable for people using two medicines daily, with 22 adherent (32.4%) compared to 46 non-adherent (67.6%). As the number of prescriptions climbed to three per day, adherence marginally improved but remained low: 34 patients (28.7%) followed their regimen properly, whereas 82 (71.3%) did not. Notably, the group taking more than three medications per day had the greatest adherence count (93 patients, 47.2%), albeit non-adherence was still frequent (104 patients, 52.8%). Interestingly, with increasing the number of medications taken each day, the adherence to the treatment reduced. A chi-square test demonstrated a statistically significant link between the number of daily medicines and adherence (p= 0.02), demonstrating that medication load affects adherence behavior (Table 5).

Table 5: Impact of the number of prescribed medications on daily treatment adherence

Variables	Adherence	No adherence	Total	p-value*
No. of medications				
One	14(27.5)	37(72.5)	51(12.75)	
Two	22(32.4)	46(67.6)	68(17)	
Three	34(40.5)	50(59.5)	84(21)	0.028
More than three	93(47.2)	104(52.8)	19 (49.25)	
Total	163(40.8)	237(59.3)	400(100)	

Values were expressed as frequency and percentage. *Calculated by the chi-square test.

The table indicates a statistically significant correlation (p< 0.0001) between medication adherence and diabetes control. Among adherent individuals, only 4 (2.50%) attained glycemic control, and 97.50% remained uncontrolled. In comparison, non-adherent patients demonstrated a control rate of 13.30%, and 85.70% stayed uncontrolled. Overall, just 38 individuals (9.50%) had controlled diabetes, while the great majority, 362 (90.50%), were uncontrolled (Table 6).

Table 6: Impact of adherence to treatment on glycemic control in diabetic patients

Variables	Controlled	Not controlled	Total	p-value*
Adherence	4(2.5)	159(97.5)	163(40.75)	<0.0001
Non-adherence	34(13.3)	203(85.7)	237(59.25)	
Total	38(9.5)	362(90.5)	400(100)	

Values were expressed as frequency and percentage. *Calculated by the chi-square test.

In the connection between obedience to therapy procedures and clients characteristics, age doesn't appear to have a crucial effect on whether clients take their prescriptions regularly. Younger clients under 50 were somewhat more likely to skip doses (64.21% non-adherent versus 35.79% adherent), but individuals in their 50s and 60s exhibited essentially comparable adherence rates across both groups. Even our oldest clients, aged 70+, maintained equal adherence rates at roughly 42.62% of each group. The data demonstrates the distribution of consumers by BMI categories and adherence level. Among 114 normal-weight patients, 38 (36.53%) showed high adherence and 66 (63.46%) had non-adherence. Among 183 overweight people, 74 (40.44%) were adherent and 109 (59.56%) were not adherent. For 113 obese individuals, 51 (45.13%) demonstrated adherence, whereas 62 (54.87%) were non-adherent (p= 0.433). Married patients dominated both categories, while widowed people were almost twice as prevalent among those who took their medications consistently. 144 (39.45%) married individuals were adherent to their prescribed medications, whereas 221 (60.55%) were non-adherent. The research shows that

of 42 diabetic illiterate individuals, 17 (40.48%) were adherent, whereas 25 (59.52%) were non-adherent. In the basic literacy group, 15 (36.59%) exhibited adherence *vs*. 26 (63.42%) non-adherences. Patients with intermediate education (n= 53) exhibited 22 (41.51%) adherents and 31 (58.49%) non-adherents. The secondary education group (n= 110) exhibited similar adherence and non-adherence rates (55 each, 50.0%). Among college-educated patients (n= 154), 54 (35.07%) were adherent compared to 100 (64.94%) non-adherents (Table 7).

Table 7: Impact of patient's characteristics on daily treatment adherence

Variables	Adherence	Non-adherence	Total (n= 400)	*p-value
Age categories				
< 50	34(35.79)	61(64.21)	95(100)	
50-59	53(43.09)	70(56.91)	123(100)	0.716
60-69	50(41.32)	71(58.68)	121(100)	
≥ 70	26(42.62)	35(57.38)	61(100)	
BMI categories				
Normal	38(36.53)	66(63.46)	104(100)	
Over-weight	74(40.44)	109(59.56)	183(100)	0.434
Obese	51(45.13)	62(54.87)	113(100)	
Gender				
Male	104(43.88)	133(56.12)	237(100)	0.124
Female	59(36.2)	104(63.8)	163(100)	
Marital status				
Single	3(50)	3(50)	6(100)	
Married	144(39.45)	221(60.55)	365(100)	0.227
Widowed	16 (55.17)	13 (44.83)	29 (100)	
Educational level				
Illiterate	17(40.48)	25(59.52)	42(100)	
Read & Write and Primary	15(36.59)	26(63.42)	41(100)	
Intermediate	22(41.51)	31(58.49)	53(100)	0.180
Secondary	55(50)	55(50)	110(100)	
College and above	54(35.07)	100(64.94)	154(100)	
Occupation categories				
Unemployed	76(41.53)	107(58.47)	183(100)	
Unskilled manual workers	15(57.69)	11(42.31)	26(100)	
Skilled manual workers	9(42.86)	12(57.14)	21(100)	0.170
Non-manual workers	58(35.8)	104(64.2)	162(100)	
High level of occupation	5(62.5)	3(37.5)	8(100)	
Income categories				
Not sufficient or marginally sufficient	53(46.49)	61(53.51)	114(100)	
Exceeds daily needs	101(38.11)	164(61.89)	265(100)	0.308
Sufficient	9(42.86)	12(57.14)	21(100)	
Total	163(40.75)	237(59.25)	400(100)	

Values were expressed as frequency and percentage. *Calculated by the Chi-square test.

The research studied socioeconomic status (SES) disparities between individuals with managed and uncontrolled type 2 diabetes. The study indicated no statistically significant difference in SES distribution between the two groups (p= 0.724), indicating socioeconomic considerations may not be the key driver of glycemic control in this cohort. Looking at the breakdown, individuals with lower SES scores (≤5) constituted 34.21% of the managed diabetic group compared to 40.06% of uncontrolled cases. The intermediate SES group (6-8) revealed a slightly larger prevalence among treated diabetics (28.95%) compared to uncontrolled diabetics (24.03%). Interestingly, the highest SES bracket (9-12) comprised virtually identical numbers in both groups (36.84% controlled vs. 35.91% uncontrolled) (Table 8).

DISCUSSION

The results of this study provide insight into important trends in medication adherence, health-seeking behavior, and diabetes control among a cohort of 400 people in Erbil City who have T2DM. Our findings show that glycemic control is still far from ideal, with only 9.5% of patients reaching target glycemic levels, despite notable regional and worldwide advancements in diabetes education and treatment.

Table 8: Impact of socioeconomic status on daily treatment adherence

Variables	Controlled T2DM	Uncontrolled T2DM	Total	*p-value
SES categories				
≤ 5	13(8.23)	145(91.77)	158(39.5)	
6-8	11(11.23)	87(88.78)	98(24.5)	0.724
9-12	14(9.72)	130(90.28)	144(36)	
Total	38(9.5)	362(90.5)	400(100)	

Values were expressed as frequency and percentage. *Calculated by Chi square test.

Similar results are found in low- and middle-income environments, where research continuously shows that more than 60% to 80% of T2DM patients have poor glycemic control [1]. This concerning number seems to be the result of several structural and personal factors. Sex, age, and marital status were among the demographic differences that had no discernible impact on diabetes control in this sample. Glycemic control rates were marginally higher in females (12.27% vs. 7.59%) than in males, but this difference was not statistically significant (p= 0.117). Women frequently practice more preventive health behaviors and may follow treatment plans more closely than men, according to well-documented gender differences in diabetes outcomes [18]. Social and cultural norms, however, have the power to buck these trends, especially in traditional communities where women may encounter obstacles to independent access to healthcare. It is remarkable how completely widowed participants lack glycemic control. One known factor that influences the success of diabetes treatment is social support [19]. This finding may be explained by the fact that widowhood is frequently associated with loneliness, financial difficulties, and a diminished desire to maintain intricate self-care practices. For patients who are widowed or socially isolated, it emphasizes the necessity of specialized psychosocial interventions and community support systems. There was no statistically significant impact on diabetes control, according to the age distribution (p= 0.167). This is consistent with research showing that although age is a strong predictor of diabetes risk, it does not always determine control once the condition has been diagnosed [20]. Rather, comorbidities, functional status, and family support might be more important factors in older adults' capacity to effectively manage their conditions. Glycemic control did not significantly correlate with occupation or educational attainment (p= 0.738 and p= 0.835, respectively). Higher levels of education are generally thought to enhance treatment adherence and health literacy. Nevertheless, glycemic control was low across all educational levels in our study, even though more than one-third of participants had college degrees. This could imply that the protective function of formal education may be overshadowed by systemic healthcare barriers, a lack of individualized care plans, and a lack of diabetes education in practice. Participants with sufficient income exhibited a slight but non-significant trend towards improved control. In particular, only 6.14% of those with inadequate income attained control, compared to 11.32% of those who met their daily needs (p= 0.216). Adequate income can facilitate improved access to wholesome food, prescription drugs, and medical care [21]. Additionally, the Ministry of Health's drug distribution strategies from the community diabetic centers may contribute to the reduction in the influence of income on diabetic control. This study's lack of a significant correlation might be due to cultural or local factors that limit the impact of financial advantage, or it could be the mitigating effect of universal or inexpensive healthcare services. Although the trend was anticipated—overweight patients had marginally better control over their diabetes than obese ones—the BMI distribution also did not demonstrate a significant impact on diabetes control (p= 0.283). It is commonly known that obesity accelerates the development of type 2 diabetes; being overweight worsens glycemic outcomes and increases insulin resistance [22]. Small subgroup sizes and the prevalence of uncontrolled cases across all BMI categories may be the cause of the lack of significance. The employment profile sheds light on this population's broader socioeconomic difficulties. Due to retirement or financial limitations, nearly half of participants did not have a job. These socioeconomic factors can have a detrimental effect on diabetes self-management by limiting daily activity, decreasing social engagement, and raising the risk of depression. The genetic foundations of T2DM are consistent with the high prevalence of family history of diabetes (65.5%). Similarly, other comorbidities, primarily hypertension (42.8%), affected almost half of the cohort. According to worldwide observations, the coexistence of these conditions raises the risk of cardiovascular events and complicates the management of the disease. Patterns of healthcare utilization show a diverse range of service providers. 88.8% of participants used private clinics and hospitals, 79.5% went to public hospitals, and 93.5% most frequently visited pharmacies. This illustrates how important community pharmacies are to the treatment of diabetes in environments with limited resources [23]. Given that diabetes counseling and adherence support have been shown to improve outcomes, the high pharmacy utilization suggests that pharmacists could take on a more formal role in these areas [24]. Analyzing medication adherence provides important information. Patients taking more than three medications experienced a peak in adherence, which improved slightly as the daily medication load increased. In patients with complicated regimens, this finding (p= 0.02) might be due to more frequent follow-ups and a higher perceived severity of the disease. Overall adherence was low, though, and ironically, only 2.5 percent of adherents met their goals, indicating poor glycemic control. This could imply that patients are frequently given less-than-ideal treatment plans or that clinical inertia delays prompt treatment intensification, both of which have been observed in primary care [25]. Medication adherence is a complex, multi-factorial behavior, as evidenced by the weak relationships found between it and factors such as age, BMI, marital status, and education. Static demographics have less of an impact than relationships between patients and providers, health beliefs, and system-level factors [26]. This highlights the necessity of specialized interventions that address the logistical, cultural, and psychological obstacles to adherence. Lastly, there was no significant correlation between diabetes control and socioeconomic status (SES) (p= 0.724). This finding is consistent with studies that demonstrate that although low socioeconomic status is a known risk factor for the

onset of diabetes, other factors like healthcare access, cultural norms, and the efficacy of patient education may have a greater direct impact on control. When combined, these results show how urgently multifaceted interventions that involve more than just medication prescriptions are needed. Evidence-based tactics that could aid in bridging these gaps include pharmacist-led interventions, better access to diabetes educators, community-based education, and improved patient-provider relationships. To significantly improve diabetes outcomes in Erbil City and comparable contexts, it is also imperative to address structural barriers and cultural attitudes towards self-care.

Conclusion

Most of the participants have problems taking their medications as directed and are encouraged to get medical help. The study also revealed that adherence to medications as prescribed greatly decreases the chance of complications and comorbidities. Better glycemic control, shorter hospital admissions, and a lower risk of diabetes-related mortality are all observed by patients who follow their recommended treatment programs.

Conflict of interests

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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