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Impact of diabetes-related knowledge, attitudes, and practices and other factors on glycemic control in type 2 diabetes patients in Southern Iraq

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ABSTRACT

Aims: The prevalence of type 2 diabetes (T2D) has increased significantly in Iraq, making it critical to understand knowledge, attitudes, and practices (KAP) to improve diabetes management and health outcomes. This study explores the impact of KAP and other factors on glycemic control among T2D patients in Southern Iraq.

Methods: A cross-sectional study was conducted among patients with T2D, aged 18-64 years, excluding those with type 1 diabetes, gestational diabetes, or severe conditions such as cancer or kidney failure. Their KAP was assessed using a validated and reliable questionnaire.

Results: 390 patients (163 males and 227 females), with a mean age of 48.5±13.0 years. The findings revealed moderate levels of knowledge (63.4%) and practices (58.2%), while attitudes towards diabetes management were notably negative (40.7%). Key predictors of glycated hemoglobin (HbA1c) included body mass index, diabetes knowledge, gender, marital status, family history, duration of diabetes, blood pressure, employment status, education level, and comorbidities, which collectively explained 37% of the variance in HbA1c levels [adjusted R2=0.37, F (11, 389)=17.645, p<0.001].

Conclusions: This study found that T2D patients in Southern Iraq have moderate knowledge and practices, but poor attitudes toward diabetes management. Sociodemographic and clinical factors significantly affect glycemic control, indicating a need for targeted education and improved diabetes care programs to enhance patient outcomes.

Introduction

Type 2 diabetes (T2D) has become a critical global health worry, affecting millions and contributing to a significant burden of morbidity and mortality (1). The prevalence of T2D in the Middle East and North Africa in 2021 and 2045 was 16.2% and 19.3%, respectively (2). Iraq is experiencing a diabetes mellitus epidemic, with a prevalence of around 20% (3). This figure has increased approximately fourfold over the past four decades and is expected to keep rising (4). Poor glycemic control (86.2%) was indicated in studies among T2D patients in Basrah, Iraq (5-7).

Healthcare providers provide medical care, but patients with diabetes are responsible for day-to-day diabetes management (8). Non-adherence to self-management practices is a significant cause of poor glycemic control among T2D patients (9). Most non-adherent individuals have inadequate knowledge, attitudes, and practices (KAP) regarding diabetes management (10). It is considered a significant obstacle in diabetes management (11). The outcomes of diabetes are influenced by patients' KAP and the effectiveness of their self-management (11). Most studies have used blood glucose levels and KAP measurements to evaluate diabetes management (12,13). Understanding KAP regarding glycemic control and diabetes management can provide valuable insights for developing effective preventive and treatment strategies for patients (13).

So far, only one study has examined KAP concerning hospital care and self-management among patients with T2D in Baghdad with a small sample size (14), and none has been conducted in Basrah. Only one tool was developed in Basrah, Iraq (15), and implemented in only one educational program in the same region (7). These studies lacked a valid and reliable questionnaire, which is crucial for a country of such size. Therefore, developing a valid and reliable questionnaire to explore KAP related to hospital care and self-management, and to assess their relationship to glycemic control, could help identify underlying barriers to poor glycemic control. This study investigates the impact of diabetes-related KAP and other factors, including anthropometric, sociodemographic, and medical factors, on glycemic control among T2D patients in Southern Iraq.

Methods

Study design, setting and participants

This descriptive-analytical cross-sectional study was conducted between February and August 2024 among patients with T2D at the Faiha Specialized Diabetes, Endocrine, and Metabolism Center (FDEMC) in Basrah, Southern Iraq. FDEMC receives patients with T2D from across the governorate on weekdays (Sunday-Thursday). FDEMC is recognized as the first major diabetes center in Basrah. It is a well-known medical center, distinguished by its primary laboratories and advanced equipment for essential investigations. These specifications made it suitable for this study. Patients aged 18 to 64 years with a confirmed diagnosis of T2D who attended FDEMC during the study period were eligible for inclusion. Patients were excluded if they had type 1 diabetes; had gestational diabetes or were pregnant; exhibited thyroid dysfunction; were receiving cortisol treatment; had severe conditions, such as cancer or renal failure; or were unable to provide informed consent.

Sample size and sampling procedure

The sample size was calculated using a formula from a cross-sectional study by Daniel (16), based on the prevalence of T2D in Basrah, reported at 19.7% among patients with T2D (17), as follows:

$$n = (Z1 - a/2)\ 2\ p\ (1 - p)/d^2$$

With a 95% confidence level and a 20% dropout rate (16), at least 390 patients were to be recruited for the study. Patients were selected from the hospital registry using systematic random sampling. Based on an average of 100 daily visits to the FDEMC, we recruited 10 patients per day during routine visits. To ensure randomness, we established a random starting point using SPSS version 25 and then selected every seventh patient from the daily visit list. This period was calculated by dividing the average daily patient count (100) by the required daily sample size.

Data collection

Data were collected using an adapted questionnaire to assess KAP related to diabetes management. Information was gathered from all patients attending routine visits at FDEMC. Data collection involved one-on-one interviews lasting approximately 10 minutes in a private room. The most recent anthropometric and biochemical data were obtained from the patient's medical records. Illiterate patients received assistance through verbal administration of the questionnaire, and their responses were recorded.

Study instrument and measurements

This study used a questionnaire that contained five sections: socio-demographic characteristics, medical characteristics, anthropometry, glycemic and biochemical data, and the KAP study scale. The socio-demographic data, encompassing age, gender, marital status, educational attainment, employment status, and monthly household income, were collected using a standardized questionnaire. Information on the duration of T2D, familial history, and comorbidities was extracted from medical records.

Patients' body weight and height were measured using a standardized method. Weight was measured using a calibrated digital scale (SECA, British Indicators, London, U.K.) and recorded to the nearest 0.1 kg. Patients were instructed to wear light clothing and to remove shoes, watches, wallets, jewelry, and other accessories that might affect measurement accuracy. Height was measured without footwear using a height scale (SECA; British Indicators Ltd., London, U.K.) and recorded to the nearest 0.1 cm. The patients positioned themselves upright on the audiometer's floorboard, aligning their backs with the vertical backboard. Body weight and height were used to compute body mass index (BMI). The patient's blood pressure readings and the most recent blood test results for glycated hemoglobin (HbA1c), total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein cholesterol, and triglycerides were collected from the patient's medical records. The guidelines provided by the American Diabetes Association (1) establish the ideal ranges.

The KAP study questionnaire is a key component of the study tool and was adapted from previous research (13,14).

The researcher implemented modifications in collaboration with endocrinologists at FDEMC. Permission to use the questionnaire was obtained from the corresponding author via email. Four dietitians and six endocrinologists reviewed the draft questionnaire for content validity. To address language barriers, a qualified bilingual translator translated the questionnaire from English into Arabic, and the Arabic version was used for data collection. The questionnaire was pilot-tested for face validity among fifteen diabetic patients who were not part of the study population. Three endocrinology consultants confirmed its validity.

The KAP study questionnaire has three main parts, as shown in Table 1.

Validity and reliability

The content validity ratio (CVR) is calculated as CVR=(n_e-N/2)/(N/2), where n_e is the number of experts who consider an item essential, and N is the total number of experts. This method entails subtracting half the number of experts from the total number of "essential" ratings for each item, then dividing the result by half the number of experts (18). The CVR is a suitable statistical method for assessing the validity of individual items in the instrument, using evaluations provided by a panel of content experts. The content validity index (CVI) quantifies the mean CVR across all items in the instrument. CVR and CVI provide researchers and consumers with a quantitative assessment of the validity of a simulation evaluation instrument (18).

In this study, the CVR values had a minimum of 0.92, indicating that more than half of the experts agreed on the essentiality of each item. Four dietitians and six endocrinologists assessed the questionnaire items for necessity, relevance, clarity, and simplicity and measured the CVR, R-CVI, C-CVI, and S-CVI. According to Lawshe's table, a significance level of 0.75 was used (19). All items exhibited CVR or CVI values equal to or exceeding 0.75. All items exhibited CVR and CVI values of at least 0.75.

Ethical considerations

The study was conducted in accordance with the Medical Research Ethics guidelines outlined in the Helsinki Declaration. The ethics committee for this study was approved by the Falha Specialized Diabetes Endocrine and Metabolism Center (approval no: FDEMC/56/35/22, date: 02.11.2023). Informed consent was obtained from the patients.

Statistical analysis

The data analyses were conducted using IBM SPSS Statistics (version 25), developed by IBM Corporation, based in Armonk, New York, USA. The significance level is established at $p<0.05$. Continuous variables are presented as means and standard deviations, whereas categorical variables are presented as percentages and frequencies. Data normality was assessed using the Kolmogorov-Smirnov test. Patients were categorized by sex, and mean differences for continuous variables were analyzed using one-way analysis of variance (ANOVA). Pearson's chi-square test or Fisher's exact test was used for categorical data, and Phi and Cramer's V were applied to nominal data. Tukey's post hoc test was used to examine differences among several groups. The Pearson correlation coefficient was employed to evaluate the relationship between continuous variables. Categorical variables were converted to dichotomous (0.1) values and subsequently used to compute Pearson correlation coefficients.

The relationship between diabetes knowledge, as measured by KAP scores, and glycemic control was analyzed using a stepwise multiple linear regression. Variables were included in the models if their p-values were <0.20 in the bivariate analysis. In the multiple linear regression analyses, variables were categorized to ensure that all relevant categories were included in the predictive models. Categorical variables with two categories were coded using dummy coding; for example, sex was coded as 1 for males and 0 for females. For variables with more than two levels, such as marital status, we created a dichotomous variable: 1 for married (the reference category) and 0 for all other statuses. A 95% confidence interval was established.

Results

Three hundred and ninety patients with T2D, with a mean age of 48.5±13.0 years, were evaluated (163 males and 227 females). More than 80% of them were married and lived in urban areas. Homemakers constituted the majority (53.6%), and 27.7% had a primary school education. About 55% of patients have both a family history of diabetes and comorbidities. The duration of T2D was 5-9 years in 41.3% of cases. Of the patients, 128 (32.8%) were classified as class 1 obese (BMI 30.0-34.9 kg/m^2), representing the largest subgroup. Regarding glycemic control, 312 patients (80.0%) had poor control (HbA1c >7.0%).

Table 1. Structure and scoring of the KAP questionnaire

Section	Number of items	Question format	Scoring range	Score calculation	Categorization (%)
Knowledge	10	Multiple choice, yes/no	0-20	(Score/20)×100%	Low: <50, moderate: 50-75, high: 76-100
Attitudes	10	Likert-like (-1, 0, +1)	-10 to +10	[(Score+10)/20]×100%	Negative: <50, neutral: 50-75, positive: 76-100
Practices	10	Multiple choice, yes/no	0-20	(Score/20)×100%	Poor: <50, moderate: 50-75, good: 76-100

KAP: Knowledge, attitudes, practices

Lipid profiles that include serum cholesterol, LDL, high-density lipoprotein, and triglycerides were 177.3±44.5, 119.5±73.7, 40.6±14.7, and 198.7±138.9 mg/dL, respectively. Systolic and diastolic pressures were within the normal range. All factors differed significantly between males and females ($p<0.05$), except comorbidities, body mass index, serum cholesterol, LDL, and systolic blood pressure (Table 2).

Table 3 shows highly significant differences in glycemic control by sex and by family history of T2D ($p<0.001$) ($t=-3.8$ and -5.7, respectively). The variance ratio between socio-demographic factors and HbA1c% was highly significant ($p<0.001$); the socio-demographic factors included marital status, education, and occupation ($F=10.0$, 4.4, and 5.7, respectively). Significant negative correlations were observed between HbA1c% and age, BMI, and systolic blood pressure ($r=-0.144$, -0.330, and -0.087, respectively; $p<0.05$). At the same time, LDL and triglycerides were positively and significantly correlated with HbA1c% ($r>0.152$ and $r>0.113$, respectively; $p<0.05$).

Table 4 shows that the mean scores for KAP were 63.4±8.9, 40.7±18.9, and 58.2±18.9, respectively, indicating that patients had moderate knowledge, negative attitudes, and moderate practices. A positive correlation between knowledge scores and HbA1c levels was observed ($r=0.214$, $p=0.032$), indicating that higher diabetes knowledge was associated with poorer glycemic control, which is counterintuitive. The attitude score was significantly negatively correlated with HbA1c ($r=-0.159$, $p=0.032$). In a one-way ANOVA, the F ratio shows significant differences between HbA1c and KAP scores ($p<0.001$).

Table 5 displays the factors (predictors) that significantly predicted the HbA1c levels, including BMI, knowledge, female, married, no family history of diabetes, long duration of diabetes (≥10 years), diastolic blood pressure, employed, university or above, preparatory school, and comorbidities (Adjusted $R^2=0.37$, $F(11, 389)=17.645$, $p<0.001$). These variables accounted for 37% of the variability in HbA1c in this study. In the model, BMI was positively associated with HbA1c levels. For every 1-unit increase in BMI, HbA1c increased by 0.25% ($\beta=0.25$, 95% confidence interval: 0.18-0.32, $p<0.001$), indicating that higher BMI is associated with poorer glycemic control.

Discussion

The finding that the average knowledge of diabetes management among Iraqi patients is 63.4% suggests that this population has a relatively good understanding of diabetes compared with many other countries. This level is significantly higher than those reported in studies in Jordan (53.3%) (20) and Saudi Arabia (37.6%) (21). Differences in diabetes knowledge may stem from factors such as healthcare quality, access to education, and cultural attitudes. In Iraq, higher educational attainment may result from improved healthcare services, better educational resources, and public health initiatives focused on diabetes awareness.

The comparability of Iraqi patients' knowledge to that of populations in Saudi Arabia (57%) (22) suggests a regional trend in which certain Middle Eastern and North African countries may be more proactive in diabetes education and management. It could reflect national health policies that prioritize non-communicable diseases, including diabetes, and invest in health promotion activities that empower patients with knowledge. A 2021 study (7) showed that patients in Iraq improved their diabetes knowledge from an average score of 50.3% before an educational program to 71.4% afterwards.

The results indicate a significant positive correlation between knowledge scores and HbA1c levels in this study, aligning with Saudi Arabia's findings (23). Although this may seem counterintuitive, it can be explained by several factors not covered by our model. First, patients with poor glycemic control may actively seek more information about diabetes, resulting in reverse causality. Second, factors such as health awareness (the ability to apply knowledge), depression, medication adherence, and access to healthcare resources, none of which were measured in this study, may mediate or confound the relationship between knowledge and glycemic control. Third, knowledge alone may not be sufficient to effect behavioral change without corresponding improvements in attitudes, self-efficacy, and practical skills. Future studies should incorporate these psychosocial and healthcare access variables to better understand the pathways linking knowledge to glycemic outcomes.

The results of this study indicate that 40.7% of patients exhibit negative attitudes toward diabetes management. This percentage is notably higher than that observed in studies from Saudi Arabia (30.9%) (21). One potential reason for this discrepancy could be differences in study settings. Attitudes toward diabetes as an incurable or inevitable condition can contribute to feelings of hopelessness regarding treatment. Furthermore, the burden of daily self-management tasks, including dietary restrictions, medication adherence, and blood sugar monitoring, can cause frustration and exhaustion, especially given the limited educational and support services available to people with diabetes in Iraq.

The overall diabetes management practices among patients in this study were 58.2%, indicating good practice. The 58.2% rate in Iraq is comparable to that of nearby countries, such as Iran (52.2%) (24). To understand diabetes management in a region, the following key points should be considered. Similar cultural and healthcare factors influence management. Improved access to diabetes education and healthcare can lead to more effective diabetes management. Programs that raise awareness and improve facilities help patients manage their condition.

Table 2. Socio-demographic, anthropometric, and medical characteristics of patients (n=390)				
Variables	**Males (n=163)**	**Females (n=227)**	**Total (n=390)**	**p-value**
Age (years), mean ± SD	52.3±11.609	45.6±13.2	48.5±13.0	**<0.001**[a]
Body mass index (kg/m²), mean ± SD	31.4±7.2	32.8±6.7	32.2±6.9	0.834[a]
HbA1c, %, (Mmol/mol), mean ± SD	8.7±2.0 (72.2±22.3)	9.6±2.2 (81.3±23.7)	9.2±2.2 (77.5±23.5)	**0.018**[a]
Cholesterol (mg/dL), mean ± SD	181.0±38.8	174.6±48.1	177.3±44.5	0.081[a]
LDL (mg/dL), mean ± SD	110.2±41.9	126.2±89.3	119.5±73.7	0.398[a]
HDL (mg/dL), mean ± SD	37.5±12.8	42.8±15.6	40.6±14.7	**<0.001**[a]
Triglyceride (mg/dL), mean ± SD	210.5±174.2	190.2±106.3	198.7±138.9	0.058[a]
Systolic blood pressure (mg/dL), mean ± SD	133.7±26.3	135.7±17.8	134.8±21.8	0.441[a]
Diastolic blood pressure (mg/dL), mean ± SD	81.8±11.1	79.3±9.5	80.3±10.3	**0.002**[a]
Monthly income (USD), mean ± SD	418.9±184.0	540.4±184.1	489.6±193.4	**<0.001**[a]
Residence, n (%)				**<0.001**[b]
Urban	158 (40.5)	188 (48.2)	346 (88.7)	
Rural	5 (1.3)	39 (10.0)	44 (11.3)	
Marital status, n (%)				**<0.001**[b]
Single	20 (5.1)	30 (7.7)	50 (12.8)	
Married	128 (32.8)	187 (47.9)	315 (80.8)	
Divorced	15 (3.8)	0 (0.0)	15 (3.8)	
Widowed (widower)	0 (0.0)	10 (100.0)	10 (100.0)	
Education, n (%)				**<0.001**[b]
Illiterate	10 (2.6)	60 (15.4)	70 (17.9)	
Read and write	50 (12.8)	27 (6.9)	77 (19.7)	
Primary	44 (11.3)	64 (16.4)	108 (27.7)	
Intermediate	30 (7.7)	52 (13.3)	82 (21.0)	
Preparatory	10 (2.6)	19 (4.9)	29 (7.4)	
University or above	19 (4.9)	5 (1.3)	24 (6.2)	
Occupation, n (%)				**<0.001**[b]
Employed	35 (9.0)	9 (2.3)	44 (11.3)	
Retired	25 (6.4)	5 (1.3)	30 (7.7)	
Free job	93(23.8)	14 (3.6)	107 (27.4)	
House wife	10 (2.6)	199 (51.0)	209 (53.6)	
Family history of diabetes, n (%)				**0.001**[b]
Yes	78 (20.0)	139 (35.6)	217 (55.6)	
No	80 (20.5)	88 (22.6)	168 (43.1)	
Time since diagnosis in years, n (%)				**0.033**[b]
0-4	54 (13.8)	49 (12.6)	103 (26.4)	
5-9	59 (15.1)	102 (26.2)	161 (41.3)	
10 and above	50 (12.8)	76 (19.5)	126 (32.3)	
Comorbidities, n (%)				0.469[b]
Yes	95 (24.4)	123 (31.5)	218 (55.9)	
No	68 (17.4)	104 (26.7)	172 (44.1)	

[a]: Independent samples test, [b]: Pearson chi-square, N (%): Data are presented as number and percentage, the p-value is significant at the 0.05 level
SD: standard deviation, HbA1c: glycated hemoglobin, mmol/mol: millimoles per mole, LDL: low-density lipoprotein, USD: United states dollar, HDL: High-density lipoprotein

Table 3. Socio-demographic and medical characteristics associated with HbA1c (n=390)

Variables	HbA1c, mean ± SD%, (mmol/mol)	t-test	p-value
Sex		-3.8	**<0.001**
Males	8.7±2.0 (72.2±22.3)		
Females	9.6±2.2 (81.3±23.7)		
Residence		0.682	0.496
Urban	9.2±2.3 (77.7±24.5)		
Rural	9.0±1.2 (75.4±13.7)		
Family history of DM		-5.7	**<0.001**
Yes	8.7±2.0 (71.7±22.7)		
No	9.9±2.2 (85.1±22.8)		
Comorbidities		-1.4	0.142
Yes	9.1±2.0 (76.1±22.1)		
No	9.4±2.4 (79.2±25.2)		
Variables	**HbA1c, mean ± SD %, (mmol/mol)**	**F-ratio**	**p-value**
Marital status		10.0	**<0.001**
Single	10.6±1.8 (92.7±20.1)		
Married	8.9±2.2 (74.5±23.2)		
Divorced	9.2±2.2 (77.7±24.1)		
Widowed (widower)	10.8±1.2 (94.5±13.8)		
Education		4.4	**<0.001**
İlliterate	9.6±2.2 (80.4±20.0)		
Read and write	9.0±2.1 (75.7±23.2)		
Primary	8.6±2.1 (71.4±22.1)		
İntermediate	10.0±1.6 (86.3±25.9)		
Preparatory	9.2±2.2 (77.8±17.7)		
University or above	8.6±2.6 (71.4±29.4)		
Occupation		5.7	**<0.001**
Employed	9.0±1.7 (74.9±19.4)		
Retired	8.8±2.3 (73.2±25.8)		
Free job	8.6±2.0 (71.2±22.9)		
Housewife	9.6±2.0 (81.8±23.6)		
Time since diagnosis		1.6	0.196
0-4 years	9.0±2.5 (75.1±27.9)		
5-9 years	9.2±2.1 (76.4±20.7)		
10 years and above	9.5±2.1 (80.8±22.9)		
Variables	**Mean ± SD**	**r**	**p-value**
Age (years)	48.5±13.0	-0.144	**0.004**
Monthly income (USD)	489.6±193.4	-0.086	0.090
Body mass index (kg/m^2)	32.2±6.9	-0.330	**<0.001**
Low-density lipoprotein (mg/dL)	119.5±73.7	0.152	**0.003**
Triglyceride (mg/dL)	198.7±138.9	0.113	**0.025**
Systolic blood pressure (mmHg)	134.8±21.8	-0.121	**0.017**
Diastolic blood pressure (mmHg)	80.3±10.3	0.087	0.086

t: t-test, f: statistics of ANOVA (variance ratio test), r: Pearson correlation coefficients with HbA1c, All biochemistry tests were measured in mg/dL. The p-value is significant at the 0.05 level
HbA1c: Glycated hemoglobin, SD: Standard deviation, USD: United states dollar

This study examines key predictors identified, which explain 37% of the variability in HbA1c. This finding contrasts with a study conducted by Kowsar and Mansouri (25) in Iraq, which identified a positive correlation between elevated BMI and increased HbA1c levels. The discrepancies between these studies highlight the complexity of the relationship between BMI and glycemic control and suggest that factors such as lifestyle, diet, and genetic predispositions may significantly influence these readings.

Gender disparities in diabetes outcomes are significant, with studies revealing that female patients in Iraq face unique challenges in diabetes management. A study by Ahmed et al. (26), conducted in Sudan found that women had higher HbA1c levels than men. In contrast, another recent study in Libya (27) reported different results. Elevated HbA1c levels in female patients result from biological, socioeconomic, psychosocial, and healthcare factors. Marital status has been recognized as a predictor of glycemic control, particularly given its role in social support. A study by Ford and Robitaille (28) supports this finding, showing that married individuals tend to have lower HbA1c levels than their unmarried counterparts.

A study by Lee et al. (29) found that individuals without a family history of diabetes tend to be less proactive in managing their health, which results in higher HbA1c levels. It proposes

Table 4. **Patients' knowledge, attitudes, practices, and correlation with HbA1c (n=390)**

Variables	Total score (mean ± SD)	Total score, n (%)	r	p-value[a]
Total knowledge score	63.4±8.9		0.214	**0.032**
Poor knowledge		25 (6.4)		
Good knowledge		306 (78.5)		
Excellent knowledge		59 (15.1)		
Total attitude score	40.7±18.9		-0.159	0.045
Negative attitude		303 (77.7)		
Neutral attitude		73 (18.7)		
Positive attitude		14 (3.6)		
Total practice score	58.2±18.9		0.163	0.089
Poor practice		146 (37.4)		
Good practice		160 (41.0)		
Excellent practice		84 (21.5)		

[a]: Independent samples test, the p-value is significant at the 0.05 level, r: Pearson correlation coefficient, the p-value is significant at the 0.05 level, all KAP scores are out of 100
SD: Standard deviation, HbA1c: Glycated hemoglobin

Table 5. **Predictive factors for HbA1c percentages (n=390)**

Variables	B (95% CI)	β	R^2	Adjusted R^2	t	p-value
Constant	7.391	-	-	-	6.999	**<0.001**
Body mass index	0.082	0.256	0.081	0.079	5.259	**<0.001**
Knowledge	0.062	0.250	0.156	0.151	5.312	**<0.001**
Female	1.302	0.288	0.220	0.214	6.383	**<0.001**
Married	-1.383	-0.244	0.259	0.251	-5.592	**<0.001**
No family history of DM	0.885	0.196	0.280	0.270	4.039	**<0.001**
Long duration of DM	0.992	0.208	0.294	0.283	4.653	**<0.001**
Diastolic blood pressure	0.043	0.197	0.309	0.297	3.898	**<0.001**
Employed	1.809	0.257	0.320	0.306	5.204	**<0.001**
University or above	-1.489	-0.160	0.375	0.355	-3.590	**<0.001**
Preparatory school	-1.021	-0.120	0.388	0.367	-2.864	**0.004**
Comorbidities	0.483	0.108	0.397	0.375	2.359	**0.019**

Reference categories =1. Variables: sex: 1 if male, zero if female; marital status: 1 if married, while 0 for others; family history: 1 if yes, zero if no; duration of DM; 1 if 0-4 years, 0 for others; employment: 1 if employed, 0 for others; education: 1 for illiterate, 0 for others; and comorbidities: 1 if yes, zero if no. The p-value is significant at the ≤0.05 level
B: Unstandardized coefficients, β: Standardized coefficients, CI: Confidence interval, -: Standardized coefficients, R^2: The proportion of variance in the criterion, t: t-statistic, DM: Diabetes mellitus, HbA1c: Glycated hemoglobin

that the absence of a family history of diabetes can affect an individual's perception of risk and management practices. The duration of diabetes is closely linked to glycemic control, as Sheleme et al. (30), noted in Ethiopia, where longer diabetes duration correlated with higher HbA1c levels. Comorbidities such as hypertension complicate diabetes management and often lead to poorer glycemic control.

A 2018 study by Bijlsma-Rutte et al. (31) found that employed individuals had lower HbA1c levels than the unemployed, whereas the current study showed the opposite. These discrepancies highlight the complexity of diabetes management and the various factors influencing blood sugar control. Lower levels of education are associated with poor glycemic control. A study by Liao et al. (32) found that individuals who had completed university or preparatory school had significantly lower HbA1c levels than those with less education. Higher educational attainment likely improves glycemic control by enhancing health literacy, improving comprehension of self-management instructions, enabling better navigation of the healthcare system, and increasing the capacity to process and apply complex diabetes information.

Study Limitations

This study has several limitations that should be considered when interpreting the results. First, the cross-sectional design prevents establishing causal relationships among KAP, and glycemic control. Second, the study was conducted at a single tertiary healthcare center in Basra, which may limit the generalizability of the findings to primary healthcare centers or other areas in Iraq. Third, KAP were assessed using a questionnaire administered during a single interview, and responses may be subject to recall and social desirability bias. Fourth, several potentially important confounding factors were not measured, including medication adherence, diet, physical activity levels, depression, social support, and access to healthcare, which may have influenced the observed associations. The study sample was limited to patients aged 18-64 years, excluding older adults, who may experience different challenges and outcomes in diabetes management.

Clinical implications

These findings have several implications for clinical practice in Iraq and similar contexts. First, the average level of knowledge and negative attitudes suggest that diabetes education programs should go beyond simply providing information and should address beliefs, feelings, and self-confidence. Cognitive-behavioral techniques and motivational interviewing may be more effective than theoretical instruction alone. Second, identifying high-risk groups, including women, unmarried individuals, those with limited education, and the unemployed, can help guide awareness efforts and resource allocation. Third, given that 37% of the variance in HbA1c levels is attributable to modifiable factors, structured diabetes self-management education programs should be implemented and evaluated. Fourth, healthcare providers should periodically assess patients' KAP using concise screening tools to identify those who require additional support. Policymakers should consider investing in community-based diabetes support programs, particularly for the most vulnerable groups, and should ensure that diabetes education is available to patients with limited literacy.

Conclusion

The majority of patients have good knowledge of and practices in diabetes management but hold negative attitudes. Several predictors influence glycemic control, including BMI, diabetes management knowledge, female sex, marital status, family history of diabetes, duration of diabetes, blood pressure, employment status, level of education, and comorbidities. These factors account for 37% of the variation in HbA1c levels. The relationship between BMI and glycemic control is complex and may be influenced by lifestyle factors. Improving diabetes-related knowledge and practices is essential for reducing negative attitudes and enhancing health outcomes, especially among women who face unique challenges. A comprehensive approach is needed to improve diabetes care in Iraq, and further research is required to better understand this condition.

Ethics

Ethics Committee Approval: The ethics committee for this study was approved by the Falha Specialized Diabetes Endocrine and Metabolism Center (approval no: FDEMC/56/35/22, date: 02.11.2023).

Informed Consent: Informed consent was obtained from the patients.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: S.A.H., F.F.G., H.A.A., Concept: S.A.H., Design: S.A.H., F.F.G., Data Collection or Processing: S.A.H., F.F.G., Analysis or Interpretation: S.A.H., H.A.A., Literature Search: F.F.G., Writing: S.A.H.

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References

1. American Diabetes Association. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes-2024. *Diabetes Care.* 2023;47(Supplement_1):S20-S42.
2. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022;183:109119. Erratum in: Diabetes Res Clin Pract. 2023;204:110945.
3. Mikhael E, Hassali M, Saad A. Need for self-management education for Iraki diabetic patients. *J Soc Health Diabetes.* 2020;8(3).
4. Mansour A, Douri F. Diabetes in Iraq: facing the epidemic. A systematic review. *Wulfenia.* 2015;22(3):258.
5. Mansour AA, Alibrahim NTY, Alidrisi HA, Alhamza AH, Almomin AM, Zaboon IA, et al. Prevalence and correlation of glycemic control achievement in patients with type 2 diabetes in Irak: a retrospective analysis of a tertiary care database over 9 years. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews.* 2020;14(3):265-272.
6. Hashim SA, Barakatun-Nisak MY, Abu Saad H, Ismail S, Hamdy O, Mansour AA. Association of health literacy and nutritional status assessment with glycemic control in adults with type 2 diabetes mellitus. *Nutrients.* 2020;12(10):3152.
7. Hashim SA, Mohd Yusof BN, Abu Saad H, Ismail S, Hamdy O, Mansour AA. Effectiveness of simplified diabetes nutrition education on glycemic control and other diabetes-related outcomes in patients with type 2 diabetes mellitus. *Clin Nutr ESPEN.* 2021;45:141-149.
8. Sørensen M, Groven KS, Gjelsvik B, Almendingen K, Garnweidner-Holme L. The roles of healthcare professionals in diabetes care: a qualitative study in Norwegian general practice. *Scand J Prim Health Care.* 2020;38(1):12-23.
9. Rahmatullah, Qutubuddin M, Abdul Rahman R, Ghafoor E, Riaz M. Assessment of factors associated with non-compliance to self-management practices in people with type 2 diabetes. *Cureus.* 2021;13(10):e18918.
10. Zhu W, Liang D, Petersen JD, Zhang W, Huang J, Dong Y. Relationship between diabetic knowledge, attitudes, and practices among patients with diabetes in China: a structural equation model. *BMJ Open.* 2023;13(11):e076464.
11. Ferreira PL, Morais C, Pimenta R, Ribeiro I, Amorim I, Alves SM, et al. Knowledge about type 2 diabetes: its impact on future management. *Front Public Health.* 2024;12:1328001.
12. Ghannadi S, Amouzegar A, Amiri P, Karbalaeifar R, Tahmasebinejad Z, Kazempour-Ardebili S. Evaluating the effect of knowledge, attitude, and practice on self-management in type 2 diabetic patients on dialysis. *J Diabetes Res.* 2016;2016:3730875.
13. Asmelash D, Abdu N, Tefera S, Baynes HW, Derbew C. Knowledge, attitude, and practice towards glycemic control and its associated factors among diabetes mellitus patients. *J Diabetes Res.* 2019;2019:2593684.
14. Mikhael EM, Hassali MA, Hussain SA, Shawky N. Self-management knowledge and practice of type 2 diabetes mellitus patients in Baghdad, Iraq: a qualitative study. *Diabetes Metab Syndr Obes.* 2018;12:1-17.
15. Hashim SA, Al Jassim NH, Mansour AA. Development of simplified diabetes nutrition education tools for patients with type 2 diabetes mellitus in Basrah, Iraq. *Int J Nutr Sci.* 2025;10(2):314-324.
16. Daniel WW. *Biostatistics: a foundation for analysis in the health sciences.* 9th edition. Wiley, John Wiley & Sons, INC.; 2009. p. 956.
17. Mansour AA, Al-Maliky AA, Kasem B, Jabar A, Mosbeh KA. Prevalence of diagnosed and undiagnosed diabetes mellitus in adults aged 19 years and older in Basrah, Iraq. *Diabetes Metab Syndr Obes.* 2014;7:139-144.
18. Gilbert GE, Prion S. Making sense of methods and measurement: Lawshe's Content Validity Index. *Clinical Simulation In Nursing.* 2016;12(12):530-531.
19. Lawshe CH. A quantitative approach to content validity. *Personnel Psychology.* 2006;28:563-575.
20. Alsous M, Abdel Jalil M, Odeh M, Al Kurdi R, Alnan M. Public knowledge, attitudes, and practices toward diabetes mellitus: a cross-sectional study from Jordan. *PLoS One.* 2019;14(3):e0214479.
21. Mansy W, Wajid S, Alwhaibi A, Alghadeer SM, Alhossan A, Babelghaith S, et al. Assessing outpatients' knowledge, attitude, and practice toward managing diabetes in Saudi Arabia. *Inquiry.* 2022;59:469580221082781.
22. Aldossari K, Abdelrazik M, Kamal S, Al Zahrani J, Al Ghamdi S, Altamimi I, et al. Assessment of levels of knowledge, attitude and practice about diabetes mellitus (DM), its complications and self-management of diabetic patients in AlKharj city, Saudi Arabia. *International Journal of Advanced Research*. 2015;3:23-32.
23. AlShayban DM, Naqvi AA, Alhumaid O, AlQahtani AS, Islam MA, Ghori SA, et al. Association of disease knowledge and medication adherence among outpatients with type 2 diabetes mellitus in Khobar, Saudi Arabia. Front Pharmacol. 2020;11:60.
24. Niroomand M, Ghasemi SN, Karimi-Sari H, Kazempour-Ardebili S, Amiri P, Khosravi MH. Diabetes knowledge, attitude and practice (KAP) study among Iranian in-patients with type-2 diabetes: a cross-sectional study. *Diabetes Metab Syndr.* 2016;10(Suppl 1):S114-S119.
25. Kowsar R, Mansouri A. Multi-level analysis reveals the association between diabetes, body mass index, and HbA1c in an Iraqi population. *Sci Rep.* 2022;12(1):21135.
26. Ahmed SF, Hassan AA, Eltayeb MM, Omar SM, Adam I. Ethnicity, age, and gender differences in glycated hemoglobin (HbA1c) levels among adults in northern and eastern sudan: a community-based cross-sectional study. *Life (Basel).* 2023;13(10):2017.
27. Zaidi A, Elmghirbi W, El-Rwegi W, Algdar A, Saleh H. Impact of gender and age in HbA1c levels among libyan adults without known diabetes in Zeletin City, Libya: a cross-sectional study. *Alq J Med App Sci.* 2024;7(3):464-469.
28. Ford KJ, Robitaille A. How sweet is your love? Disentangling the role of marital status and quality on average glycemic levels among adults 50 years and older in the English Longitudinal Study of Aging. *BMJ Open Diabetes Res Care.* 2023;11(1):e003080.

29. Lee YH, Shin MH, Nam HS, Park KS, Choi SW, Ryu SY, et al. Effect of family history of diabetes on hemoglobin A1c levels among individuals with and without diabetes: the dong-gu study. *Yonsei Med J.* 2018;59(1):92-100.

30. Sheleme T, Mamo G, Melaku T, Sahilu T. Glycemic control and its predictors among adult diabetic patients attending Mettu Karl Referral Hospital, Southwest Ethiopia: a prospective observational study. *Diabetes Ther.* 2020;11(8):1775-1794.

31. Bijlsma-Rutte A, Rutters F, Elders PJM, Bot SDM, Nijpels G. Socio-economic status and HbA_{1c} in type 2 diabetes: a systematic review and meta-analysis. *Diabetes Metab Res Rev.* 2018;34(6):e3008.

32. Liao Y-S, Tsai W-C, Chiu L-T, Kung P-T. Educational attainment affects diagnostic time for type 2 diabetes mellitus and mortality risk among those enrolled in the diabetes pay-for-performance program. *Health Policy.* 2023;138:104917.