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Research Article

Assessment of Glycemic Control and Associated Factors Among Iraqi Patients with Type 2 Diabetes

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Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a growing health problem worldwide, including in Iraq. Poor glycemic control is a major determinant of diabetes-related complications. Identifying factors associated with poor glycemic control is essential for improving diabetes management.

Objective: To assess glycemic control and identify factors associated with poor glycemic control among Iraqi patients with type 2 diabetes.

B A cross-sectional study was conducted among 384 adult patients with T2DM attending an outpatient diabetes clinic in Al-Taj Private Hospital, Baghdad, Iraq. Data on socio-demographic, clinical, and lifestyle factors were collected via interview and medical records. HbA1c, fasting plasma glucose, and lipid profile were measured. Medication Adherence (MMAS-8), dietary adherence (3-day food recall), diabetes knowledge (Michigan Diabetes Knowledge Test), and depression (PHQ-9) were assessed. Glycemic control was defined as HbA1c <7.0%. Multivariate logistic regression identified independent predictors of poor glycemic control.

Results: The mean age was 54.3±9.8 years, and 55.7% were female. The mean HbA1c was 8.4±1.7%. Only 94 patients (24.5%) achieved good glycemic control, while 290 (75.5%) had poor control. Independent predictors of poor glycemic control were longer diabetes duration (aOR 1.10 per year, 95% CI 1.04–1.16, p<0.001), insulin use (aOR 2.45, 95% CI 1.33–4.51, p = 0.004), presence of dyslipidemia (aOR 1.89, 95% CI 1.10–3.25, p = 0.021), and low physical activity (aOR 2.08, 95% CI 1.24–3.48, p = 0.005). Poor medication adherence (89.7% vs. 70.1%, p < 0.001), poor dietary adherence (82.9% vs. 64.1%, p < 0.001), low diabetes knowledge (84.1% vs. 68.9%, p = 0.001), and depression (87.6% vs. 70.0%, p < 0.001) were also associated with poor control.

Conclusion: Poor glycemic control is highly prevalent (75.5%) among Iraqi patients with type 2 diabetes. Longer duration of diabetes, insulin use, dyslipidemia, and low physical activity are independent predictors. Comprehensive interventions targeting these modifiable risk factors are urgently needed.

Keywords: Glycemic control, type 2 diabetes, HbA1c, predictors, Iraq, dyslipidemia

Introduction

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterised by insulin resistance and progressive pancreatic β-cell dysfunction, leading to persistent hyperglycemia [6]. Globally, the prevalence of T2DM has risen dramatically, with the International Diabetes Federation estimating that 537 million adults were living with diabetes in 2021. Poor glycemic control is a major determinant of diabetes-related complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy [21]. In Iraq, the burden of T2DM is substantial and growing. Recent estimates indicate a diabetes prevalence of approximately 12-15% among Iraqi adults, placing the country among those with a high disease burden in the Middle East and North Africa region [18,23]. Despite the availability of glucose-lowering medications and clinical guidelines, many Iraqi patients with T2DM fail to achieve optimal glycemic targets, often defined as Haemoglobin A1c (HbA1c) <7% (53 mmol/mol) [5,10]. Several factors influence glycemic control in T2DM, which can be categorized into patient-related, disease-related, and healthcare system factors. Patient-related factors include medication adherence, dietary habits, physical activity, diabetes knowledge, and socioeconomic status [14,20].

Disease-related factors encompass diabetes duration, obesity, comorbidities such as hypertension and dyslipidemia, and the presence of diabetes complications [7,15]. Healthcare system factors include access to diabetes education, regular follow-up, and medication availability [3,8]. In the Iraqi context, additional unique challenges may affect glycemic control, including political instability, economic sanctions, healthcare resource limitations, medication shortages, and cultural dietary practices [4,13]. Moreover, there is a scarcity of recent, large-scale studies specifically examining the determinants of poor glycemic control among Iraqi patients with T2DM [1,11]. Understanding the status of glycemic control and identifying its associated risk factors are essential steps toward developing targeted interventions to improve diabetes management in Iraq. Therefore, this study aims to assess the level of glycemic control and identify factors associated with poor glycemic control among Iraqi patients with type 2 diabetes.

Patients and Methods

Study Design and Setting: A cross-sectional study was conducted at Taj Private Hospital in Baghdad, Iraq, over a 6-month period.

Study Population

A total of 384 adult patients with type 2 Diabetes Mellitus (T2DM) attending the outpatient diabetes clinic were enrolled.

Inclusion Criteria

Age≥18 years; T2DM diagnosed for ≥1 year [6] Stable antidiabetic therapy for≥3 months; Provided informed consent.

Exclusion Criteria

Type 1 or gestational diabetes; Acute diabetic complications or major illness within 4 weeks; Pregnancy or lactation; and Severe chronic kidney disease (eGFR < 30 mL/min/1.73m^2) [17].

Data Collection

Socio-Demographic and Clinical Data (age, sex, education, income, diabetes duration, medications, comorbidities, smoking, physical activity) were collected via interview and medical records [6,24].

Anthropometric Measurements: included weight, height, body mass index (BMI) (WHO, 2000), and waist circumference.

Biochemical Measurements (fasting plasma glucose, HbA1c, lipid profile) were obtained after an 8-hour fast. HbA1c was measured using HPLC.

Definitions

Good Glycemic Control: HbA1c<7.0% (53 mmol/mol)

Poor Glycemic Control: HbA1c≥7.0% [6].

Associated Factors Assessed

a. **Medication Adherence**: Morisky Medication Adherence Scale (MMAS-8) [19].

b. **Dietary Adherence**: 3-day food recall [22].

c. **Diabetes Knowledge**: Michigan Diabetes Knowledge Test [9].

d. **Depression**: Patient Health Questionnaire-9 (PHQ-9) [16].

Statistical Analysis

Data were analyzed using SPSS. Continuous variables were expressed as mean±SD or median (IQR), and categorical variables as frequencies (%). Univariate and multivariate logistic regression identified independent predictors of poor glycemic control (Adjusted Odds Ratios [aORs] with 95% CIs). The p-value < 0.05 was significant.

Ethical Considerations

Approval was obtained from the Institutional Review Board. Written informed consent was obtained from all participants. The study followed the Declaration of Helsinki [25].

Results

Baseline Characteristics of Study Participants

A total of 384 patients with type 2 Diabetes Mellitus (T2DM) were enrolled. The mean age was 54.3±9.8 years, and 214 (55.7%) were female. The mean duration of diabetes was 8.6±5.4 years. Regarding treatment, 248 (64.6%) were on oral hypoglycemic agents alone, 96 (25.0%) on insulin alone, and 40 (10.4%) on combination therapy. Hypertension was the most common

comorbidity (52.1%), followed by dyslipidemia (45.8%) and diabetic neuropathy (22.9%). A total of 142 (37.0%) were current smokers, and 168 (43.8%) reported regular physical activity. Mean Body Mass Index (BMI) was 28.9±4.6 kg/m^2, with 51.6% overweight and 28.1% obese. Baseline characteristics are summarised in Table 1.

Prevalence of Glycemic Control

The mean HbA1c level was 8.4±1.7% (68 mmol/mol). Overall, 94 patients (24.5%) achieved good glycemic control (HbA1c < 7.0%), while 290 patients (75.5%) had poor glycemic control (HbA1c ≥ 7.0%) (Table 1).

Table 1: Baseline characteristics of study participants (N = 384)

Characteristic	Value
Age (years), mean±SD	54.3±9.8
Female sex, No. (%)	214 (55.7)
Diabetes duration (years), mean±SD	8.6±5.4
Treatment type, No. (%) – OHA only	248 (64.6)
– Insulin only	96 (25.0)
– Combination	40 (10.4)
Hypertension, No. (%)	200 (52.1)
Dyslipidemia, No. (%)	176 (45.8)
Diabetic neuropathy, No. (%)	88 (22.9)
Current smoker, No. (%)	142 (37.0)
Regular physical activity, No. (%)	168 (43.8)
BMI (kg/m^2), mean±SD	28.9±4.6
Overweight (25–29.9), No. (%)	198 (51.6)
Obese (≥30), No. (%)	108 (28.1)

***Note:** OHA: Oral Hypoglycemic Agents; SD: Standard Deviation.

Comparison of Characteristics Between Good and Poor Glycemic Control Groups

Patients with poor glycemic control were significantly older (55.1±9.9 vs. 51.8±9.2 years, p = 0.004), had longer diabetes duration (9.2±5.6 vs. 6.5±4.1 years, p < 0.001), and had higher BMI (29.4±4.7 vs. 27.6±4.1 kg/m^2, p = 0.001) compared to those with good control. Use of insulin (alone or in combination) was more frequent in the poorly controlled group (39.7% vs 19.1%, p<0.001). Hypertension, dyslipidemia, and neuropathy were also significantly more common among patients with poor glycemic control (all p<0.05). Physical activity was less frequent in the poor control group (38.6% vs. 59.6%, p<0.001). No significant difference was observed regarding sex or smoking status (Table 2).

Table 2: Comparison of characteristics by glycemic control status.

Variable	Good control (No.=94)	Poor control (No.=290)	p-value
Age (years)	51.8±9.2	55.1±9.9	0.004
Female sex, No. (%)	50 (53.2)	164 (56.6)	0.567
Diabetes duration (years)	6.5±4.1	9.2±5.6	<0.001
Insulin use (any), No. (%)	18 (19.1)	115 (39.7)	<0.001
Hypertension, No. (%)	38 (40.4)	162 (55.9)	0.009

Dyslipidemia, No. (%)	30 (31.9)	146 (50.3)	0.002
Neuropathy, No. (%)	12 (12.8)	76 (26.2)	0.008
Current smoker, No. (%)	32 (34.0)	110 (37.9)	0.496
Physical activity, No. (%)	56 (59.6)	112 (38.6)	<0.001
BMI (kg/m^2)	27.6±4.1	29.4±4.7	0.001

Factors Associated with Poor Glycemic Control-Univariate Analysis

Univariate logistic regression identified several factors significantly associated with poor glycemic control: older age (OR 1.04, 95% CI 1.01–1.07, p = 0.005), longer diabetes duration (OR 1.12, 95% CI 1.06–1.18, p < 0.001), insulin use (OR 2.78, 95% CI 1.60–4.83, p < 0.001), hypertension (OR 1.86, 95% CI 1.16–2.98, p = 0.010), dyslipidemia (OR 2.17, 95% CI 1.33–3.53, p = 0.002), neuropathy (OR 2.42, 95% CI 1.25–4.69, p = 0.009), higher BMI (OR 1.10, 95% CI 1.04–1.16, p = 0.001), and low physical activity (OR 2.35, 95% CI 1.45–3.81, p<0.001). Sex and smoking were not significant (Table 3).

Table 3: Univariate logistic regression for factors associated with poor glycemic control.

Factor	OR	95% CI	p-value
Age (per year)	1.04	1.01–1.07	0.005
Diabetes duration (per year)	1.12	1.06–1.18	<0.001
Insulin use (vs. OHA only)	2.78	1.60–4.83	<0.001
Hypertension (yes vs. no)	1.86	1.16–2.98	0.010
Dyslipidemia (yes vs. no)	2.17	1.33–3.53	0.002
Neuropathy (yes vs. no)	2.42	1.25–4.69	0.009
BMI (per kg/m^2)	1.10	1.04–1.16	0.001
Physical activity (low vs. regular)	2.35	1.45–3.81	<0.001
Smoking (current vs. never/former)	1.19	0.73–1.93	0.496

Independent Predictors of Poor Glycemic Control – Multivariate Analysis

Multivariate logistic regression (including variables with p<0.2 in univariate analysis) revealed four independent predictors of poor glycemic control: longer diabetes duration (aOR 1.10, 95% CI 1.04–1.16, p < 0.001), insulin use (aOR 2.45, 95% CI 1.33–4.51, p = 0.004), presence of dyslipidemia (aOR 1.89, 95% CI 1.10–3.25, p = 0.021), and low physical activity (aOR 2.08, 95% CI 1.24–3.48, p = 0.005). Age, hypertension, neuropathy, and BMI were not independent predictors after adjustment (Table 4).

Table 4: Multivariate logistic regression – independent predictors of poor glycemic control.

Factor	aOR	95% CI	p-value
Diabetes duration (per year)	1.10	1.04–1.16	<0.001
Insulin use (vs. OHA only)	2.45	1.33–4.51	0.004
Dyslipidemia (yes vs. no)	1.89	1.10–3.25	0.021
Low physical activity (vs. regular)	2.08	1.24–3.48	0.005

Assessment of Associated Factors

Among all patients, 48.2% had high Medication Adherence (MMAS-8 score of 8), 31.5% had medium adherence, and 20.3% had low adherence. Poor glycemic control was significantly more common among patients with low adherence (89.7% vs. 70.1%, p<0.001). Regarding dietary adherence, only 34.1% reported good adherence to dietary recommendations, and poor control was associated with poor dietary adherence (82.9% vs. 64.1%, p < 0.001). Diabetes knowledge was adequate in 56.8% of patients;

poor knowledge was associated with poor glycemic control (84.1% vs. 68.9%, p = 0.001). Depression (PHQ-9 ≥ 10) was present in 31.5% of patients and was significantly associated with poor control (87.6% vs. 70.0%, p < 0.001).

Discussion

The present study aimed to assess glycemic control and identify associated factors among Iraqi patients with type 2 Diabetes Mellitus (T2DM). The key findings revealed that 75.5% of patients had poor glycemic control (HbA1c≥7.0%), with only 24.5% achieving target levels. Independent predictors of poor control included longer diabetes duration, insulin use, presence of dyslipidemia, and low physical activity. Additionally, poor medication adherence, inadequate dietary adherence, low diabetes knowledge, and depression were significantly associated with poor glycemic control in unadjusted analyses.

Prevalence of Poor Glycemic Control

The prevalence of poor glycemic control (75.5%) observed in this study is alarmingly high but consistent with previous reports from the Middle East and developing countries. Similar findings were reported by Al-*Shammari et al.,* [5] in Saudi Arabia (78.3%) and by *Khattab et al.,* [15] in Jordan (72.1%). In Iraq, comparable rates were documented by Hasan & Al-Hassan [10] in Baghdad (74.2%) and by *Hussein et al.,* [11] in Basrah (76.5%). However, the rate is considerably higher than that reported in developed countries, such as the United Kingdom, where approximately 35–40% of T2DM patients have poor control [2,21]. This disparity likely reflects differences in healthcare infrastructure, access to diabetes education, medication availability, and socioeconomic factors [12,23].

Factors Associated with Poor Glycemic Control

Diabetes Duration: Longer diabetes duration was a strong independent predictor of poor glycemic control (aOR 1.10 per year; 95% CI 1.04–1.16). This finding is consistent with multiple studies [15,20]. Progressive β-cell dysfunction and insulin resistance over time necessitate treatment intensification, yet many patients fail to achieve or maintain glycemic targets American Diabetes Association [6] *Khan et al.,* [14] similarly reported that each additional year of diabetes increased the odds of poor control by 8–12%. Delayed treatment escalation and patient fatigue with long-term self-management may contribute to this association [8].

Insulin Use: Insulin use was independently associated with poor glycemic control (aOR 2.45). Although this may appear counterintuitive, it is a well-recognised phenomenon in diabetes epidemiology. Patients requiring insulin typically have longer disease duration, greater β-cell failure, and more severe hyperglycemia than those managed on oral agents alone (Asif, 2014). Moreover, insulin therapy is often initiated late, after years of suboptimal control, and is associated with challenges including fear of hypoglycemia, weight gain, injection phobia, and poor adherence [3,13]. Similar findings were reported by *Khattab et al.,* [15] and Abbood & Kadhim [1] in the Iraqi population.

Dyslipidemia

The presence of dyslipidemia independently predicted poor glycemic control (aOR 1.89). Dyslipidemia and hyperglycemia share common pathophysiological mechanisms, including insulin resistance, inflammation, and oxidative stress [21]. Patients with dyslipidemia may have more profound metabolic dysregulation and may be less likely to adhere to comprehensive lifestyle modifications [4,7]. This association underscores the importance of integrated management of both glycemia and lipid profiles. Our findings align with those of *Mansour et al.,* [18] and *Bukhsh et al.,* [8].

Physical Activity

Low physical activity was a strong independent predictor of poor glycemic control (aOR 2.08). Regular physical activity improves insulin sensitivity, enhances glucose uptake by skeletal muscle, and contributes to weight management [24]. Patients who reported regular physical activity (≥150 minutes/week) were twice as likely to achieve good glycemic control compared to inactive patients. This finding is consistent with *Sanal et al.,* [20] and Khan et al., [14]. In the Iraqi context, cultural factors, urban sedentary lifestyles, and lack of safe recreational facilities may limit physical activity [11,13].

Other Associated Factors (Not Independent Predictors)

Although age, hypertension, neuropathy, and BMI were significant in univariate analysis, they did not remain independent predictors after multivariate adjustment. This suggests that their effects are mediated through other variables such as diabetes duration, insulin use, or physical activity. For example, older age and higher BMI are often associated with longer diabetes duration and lower physical activity levels [6,24].

Medication Adherence, Diet, Knowledge, and Depression

Medication adherence was suboptimal, with only 48.2% of patients showing high adherence [19]. Poor adherence was strongly associated with poor glycemic control, consistent with studies from Malaysia *Bukhsh et al.,* [8] and India *Sanal et al.,* [20]. Dietary adherence was poor in nearly two-thirds of patients, reflecting cultural dietary habits high in refined carbohydrates and saturated fats [4]. Diabetes knowledge was adequate in only 56.8%, and poor knowledge correlated with worse control [9]. Depression, present in 31.5% of patients, was significantly associated with poor control, consistent with *Kroenke et al.* [16] and *Al-Shammari et al.* [5].

Limitations

Include the single-centre setting, which may limit generalizability to other regions of Iraq. The cross-sectional design precludes causal inference. Social desirability bias may have affected self-

reported adherence and physical activity. HbA1c measurement was a single point and may not reflect long-term patterns. Additionally, unmeasured confounders such as medication cost, health literacy, and family support were not assessed.

Conclusion

In conclusion, poor glycemic control is highly prevalent among Iraqi patients with type 2 diabetes, affecting three-quarters of the study population. Longer duration of diabetes, insulin use, dyslipidemia, and low physical activity are independent predictors. Suboptimal medication adherence, poor diet, inadequate diabetes knowledge, and depression are also significant contributing factors. Comprehensive, patient-centred interventions addressing these modifiable risk factors are urgently needed to improve diabetes outcomes in Iraq.

Acknowledgement

None.

Conflict of Interest

None.

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