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Risk Factors That Lead To Poor Glycemic Control In Type 2 Diabetic Patients Attending Al Diwaniya Diabetes Mellitus Center In 2023

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Abstract.*Background: Diabetes mellitus (DM) is the most common metabolic disorder worldwide. DM is the most common chronic illness in adults. It is estimated that 300 million people will have DM by 2025, and it will reach approximately 439 million and the prevalence is estimated to be 7.7% by 2030. The decrease of blood glucose levels in patients with DM decreases the mortality and morbidity rates significantly.Objective: To identify the potential risk factors of poor glycemic control among patients having type2 Diabetes mellitus in Al-diwaniya city. Methods: A total of 340 patients were included in the study. This was cross sectional study conducted in the Diabetes Center at Al-diwaniya city, Iraq, from period of 1st of February to the 1st September2023. Based on the cutoff point of Glycosylated hemoglobin of 7, the poor control were the patients with (Glycosylated hemoglobin is ≥ 7) and the good control were the diabetic patient with Glycosylated hemoglobin is <7. A questionnaire developed to gather the demographic, lipid profile, disease characteristics and lifestyles behaviors and filled by the researcher through direct interview. Results: The total number of poor controls was 221 and the good control was 119 patients. There was no significant difference between the two groups regarding sex, age, marital status and occupation. A significant association was observed between the control status and high education level (p=0.001) dyslipidemia (p=0.001), cholesterol level (P=0.002), high TG level (p<0.001), and LDL level (p=0.025). Smoking, Body Mass Index and HDL level were not significant factors (p>0.005). All disease characteristics including the duration, family history of DM, FBS, type of medication were significant factors (p<0.001). Lifestyle behaviors including self-monitoring, healthy diet, physical activity, and adherence were significant factors (p<0.001). Conclusion: The most important potential risk factors for poor control diabetes were dyslipidemia, poor adherence and longer duration of diabetes. Enhancement of education of the patients and their healthcare providers on these factors are great benefit in glycemic control.*

Keywords*: Risk Factors,Poor Glycemic Control,Type 2 Diabetes*

Abstrak. Latar Belakang: Diabetes melitus (DM) merupakan kelainan metabolik yang paling banyak terjadi di seluruh dunia. DM adalah penyakit kronis yang paling umum terjadi pada orang dewasa. Diperkirakan 300 juta orang akan menderita DM pada tahun 2025, dan akan mencapai sekitar 439 juta orang dan prevalensinya diperkirakan sebesar 7,7% pada tahun 2030. Penurunan kadar glukosa darah pada penderita DM menurunkan angka mortalitas dan morbiditas secara signifikan. Tujuan: Untuk mengidentifikasi potensi faktor risiko kontrol glikemik yang buruk pada pasien Diabetes Mellitus tipe 2 di kota Al-diwaniya. Metode: Sebanyak 340 pasien dilibatkan dalam penelitian ini. Penelitian ini merupakan studi cross sectional yang dilakukan di Pusat Diabetes di kota Al-diwaniya, Irak, dari periode 1 Februari hingga 1 September 2023. Berdasarkan titik potong Hemoglobin terglikosilasi 7, kontrol buruk adalah pasien dengan (Hemoglobin terglikosilasi ≥ 7) dan kontrol baik adalah pasien diabetes dengan hemoglobin terglikosilasi <7. Kuesioner yang dikembangkan untuk mengumpulkan demografi, profil lipid, karakteristik penyakit dan perilaku gaya hidup dan diisi oleh peneliti melalui wawancara langsung. Hasil: Jumlah kontrol buruk sebanyak 221 pasien dan kontrol baik sebanyak 119 pasien. Tidak ada perbedaan yang signifikan antara kedua kelompok mengenai jenis kelamin, usia, status perkawinan dan pekerjaan. Terdapat hubungan yang signifikan antara status kontrol dan tingkat pendidikan tinggi (p=0.001), dislipidemia (p=0.001), kadar kolesterol (P=0.002), kadar TG tinggi (p<0.001), dan kadar LDL (p=0.025) . Merokok, Indeks Massa Tubuh dan kadar HDL bukan merupakan faktor yang bermakna (p>0,005). Seluruh karakteristik penyakit termasuk durasi, riwayat keluarga DM, FBS, jenis pengobatan merupakan faktor yang signifikan (p<0,001). Perilaku gaya hidup termasuk pemantauan diri, pola makan sehat, aktivitas fisik, dan kepatuhan merupakan faktor yang signifikan (p<0,001). Kesimpulan: Faktor risiko potensial yang paling penting terhadap diabetes yang tidak

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terkontrol adalah dislipidemia, kepatuhan yang buruk, dan durasi diabetes yang lebih lama. Peningkatan edukasi pada pasien dan penyedia layanan kesehatan mengenai faktor-faktor ini merupakan manfaat besar dalam pengendalian glikemik.

Kata Kunci: Faktor Risiko, Kontrol Glikemik yang Buruk, Diabetes Tipe 2

1. INTRODUCTION

Diabetes mellitus (DM) is the most common metabolic disorder worldwide. It is characterized by chronic elevation of blood glucose caused by multiple etiologies including defects either in insulin secretion, action, or both [1]. Insulin resistance and glucose intolerance results in hyperglycemia and alterations in lipid and protein metabolism. In the long term, these metabolic abnormalities contribute to complications such as CVD, retinopathy, nephropathy, and neuropathy [2]. Globally it is one of the commonest non-communicable chronic degenerative diseases and it is estimated that between 5–10% of the population suffers from it and the prevalence is estimated to be continually rising across the globe with multiple implications on social, financial, and the health system [3]. Effective diabetes self-management (keeping the HbA1C level within normal range) could decrease the burden on the health system by decreasing diabetic complications, and hospital admissions which in turn decrease and minimize the finical strain on the health system [4]. Increasing confirmations on good control of diabetes have a major impact on patients and the health system. Although the availability of many primary studies that have investigated the factors associated with glycemic control among patients with type 1 or 2 diabetes, it must be documented in each population with etiological characteristics [5], [6].

a. Epidemiology and incidence of type 2 DM

Globally, an estimated 462 million individuals are affected by type 2 diabetes, corresponding to 6.28% of the world's population. More than 1 million deaths were attributed to this condition in 2017 alone, ranking it as the ninth leading cause of mortality [7]. This is an alarming rise when compared with 1990 when type 2 diabetes was ranked as the eighteenth leading cause of deaths. In terms of human suffering (DALYs), diabetes ranks as the seventh leading disease. The prevalence of type 2 diabetes shows a distribution pattern that matches socio-economic development. Developed regions, such as Western Europe, show considerably higher prevalence rates that continue to rise despite public health measures. In Iraq, the prevalence of DM demonstrated as high as 13.9% from STEP wise surveys that were conducted by Iraqi MOH in 2015 [8].

b. Pathogenesis of type 2 DM

The pathogenesis of type 2 diabetes ordinarily involves the development of insulin resistance associated with compensatory hyperinsulinemia, followed by progressive beta-cell impairment that results in decreasing insulin secretion and hyperglycemia. Hyperglycemia itself causes additional inhibition of insulin secretion and more insulin resistance (glucose toxicity), which further accentuates the hyperglycemia. Thus, the development of type 2 diabetes is usually characterized by 2 abnormalities: impaired insulin action and deficient insulin secretion. Both impairments are made worse by hyperglycemia. Normal beta cells can compensate for insulin resistance. Type 2 diabetes, therefore, cannot occur in the absence of beta-cell abnormalities [9].

Table 1. Criteria for testing diabetes or prediabetes in asymptomatic Adults.

1. Testing should be considered in overweight or obese (BMI ≥25 kg/m2 or ≥23 kg/m2 in Asian Americans) adults who have one or more of the following risk factors: • First-degree relative with diabetes • High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander) • History of CVD • Hypertension (≥140/90 mmHg or on therapy for hypertension) • HDL cholesterol level <35 mg/dL (0.90 mmol/L) and/or a triglyceride level >250 mg/dL (2.82 mmol/L) • Women with polycystic ovary syndrome • Physical inactivity • Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
2. Patients with prediabetes (A1C ≥5.7% [39 mmol/mol], IGT, or IFG) should be tested yearly.
3. Women who were diagnosed with GDM should have lifelong testing at least every 3 years.
4. For all other patients, testing should begin at age 45 years.
5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.

Types of DM

1. Type 1 DM is also called insulin-dependent diabetes or juvenile-onset diabetes because it often begins in childhood. Type 1 diabetes is an autoimmune condition in which the progressive decline of ß-cell function leads to permeant destruction with the inability to produce insulin [10].
2. Type 2 diabetes is a chronic disease. It is characterized by high levels of sugar in the blood. Type 2 diabetes is also called type 2 diabetes mellitus and adult-onset diabetes. That's because it used to start almost always in middle- and late-adulthood. However, more and more children and teens are developing this condition. Type 2 diabetes is much more common than type 1 diabetes, and is really a different disease. But it shares with type 1 diabetes high blood sugar levels, and the complications of high blood sugar [11].

3. Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes (such as neonatal diabetes and maturity-onset diabetes of the young), diseases of the exocrine pancreas (such as cystic fibrosis and pancreatitis), and drug- or chemical-induced diabetes (such as with glucocorticoid use, in the treatment of HIV/AIDS, or after organ transplantation) [12].
4. Gestational Diabetes Mellitus is first detected duringpregnancy. It complicates 7% of all pregnancies. Women with GDM and their offspring have an increased risk of developing type 2 diabetes mellitus in the future [13].

Diagnosis of DM type 2

Diabetes can be diagnosed either by the hemoglobin A1C criteria or plasma glucose concentration (fasting or 2-hour plasma glucose) .The American Diabetes Association (ADA) —Standards of Medical Care in Diabetesl includes ADA's current clinical practice recommendations, Diabetes can be diagnosed with any of the following criteria [14].

- Fasting plasma glucose (FPG) ≥ 126 mg/dL or
- Oral glucose tolerance test (OGTT) using 75 g of anhydrous glucose
- with FPG ≥ 126 mg/dL and/or 2-h plasma glucose ≥ 200 mg/dL or
- Glycated hemoglobin (A1C) ≥ 6.5% or
- Random plasma glucose ≥ 200 mg/dL in the presence of classical diabetes symptoms

In Iraq, there are no specific guidelines for the diagnosis of DM. In 2020, an expert panel of endocrinologists have issued the Iraqi Experts Consensus on the Management of Type 2 Diabetes/Prediabetes in Adults 17, The expert panel agreed that further screening for diabetes and pre-diabetes should be done across the various regions of Iraq. The expert panel noted that the—Finnish Diabetes Risk Scorel (FINDRISC) is an appropriate screening tool for T2DM and advised to be translated to Arabic and to be made available to all asymptomatic patients across Iraq. Diagnosis modalities of T2DM is an important matter that the panel wished to address through clear and simple practice recommendations in order to support new physicians, family medicine doctors, and other medical specialists in diabetes management. The key elements of diagnostic investigations and criteria, glycemic targets in the outpatient and in-patient settings, in addition to glycemic control monitoring; all these elements are summarized in table 2 [15].

Table 2. Iraqi consensus on the diagnosis of T2DM in symptomatic patients.

Necessary investigations	• Fasting plasma glucose (FPG) or, • Postprandial glucose • Renal function test
Indications for performing OGTT	• Impaired glucose tolerance (IGT) or, • FPG (100-125 mg/dL) (5.5-6.93 mmol/L) or, • Two-hour postprandial glucose ([140-199] mg/dL [7.7-11 mmol/L]) or • Gestational diabetes mellitus (GDM)
OGTT cut-off values	• Oral glucose tolerance test (OGTT) ⩾ 200 mg/dL (11.1 mmol/L), This test ought to be performed after 2 hours of taking 75 g oral glucose load in the morning post at least 8 hours of overnight fasting
HbA1c cut-off values	• ⩾6.5% (48 mmol/mol)

Monitoring of DM type 2

As with the glucose measures, several prospective studies that used HbA1C to predict the progression to diabetes as defined by A1C criteria demonstrated a strong, continuous association between A1C and subsequent diabetes. Zhang's systemic review from 16 cohort studies found that HbA1C between 5.5% – 6.0% have an increased risk for diabetes [16]. Several studies proved that increased HbA1c values are associated with increased risk of T2DM specific complications, and lowering HbA1c leads to a decreased risk for micro and macrovascular complications [17].

In Iraq, no standardization of HbA1c assay exists in laboratories; thus, the variability in results. Therefore, the expert panel privileged the use of fasting plasma glucose (FPG) and postprandial glucose for the diagnosis of T2DM. They recommended both tests to be repeated on two different days and the use of venous plasma for blood glucose measurement [16]. Certain conditions can affect the HbA1c level in blood; these conditions could range from anemia, asplenia, uremia, severe hypertriglyceridemia or hyperbilirubinemia, chronic salicylate or opioid or vitamin E or C ingestion, splenomegaly, pregnancy, and other conditions [18], [19]. Thus, in these conditions blood glucose levels should be evaluated for T2DM diagnosis.

The objective of the current research is to identify the potential risk factors of poor glycemic control among patients having type2 Diabetes mellitus in Al-diwaniya city.

2. PATIENTS AND METHODS

Study design and setting: This was cross sectional study carried out in Al diwaniya DM center Iraqi .

Study time and Sample size: from 1st of February to the 1st September 2023. About 340 patients participated in this study.

Sampling process The study was included patients who met the inclusion criteria in Al diwaniya DM center .Patients were divided into 2 groups according to the HbA1c level, either good control group (HbA1c ≤7% or ≤53mmol/mol) or poor control group (HbA1c >7% or >53mmol/mol).

Inclusion and Exclusion Criteria

The study population involve all patients with type 2 diabetes mellitus who Will present in Al diwaniya DM center who

met the following criteria:

1. diagnosed with DM for a minimum of one year.
2. Patients age is greater than 18 years.
3. Had at least 3months consecutive followed up.

Exclusion criteria:

1. Critically ill.
2. Mentally unstable.
3. Not able to respond.

Ethical and official approval

All patients were verbally informed about the study and they were asked permission to make them be part of the study. All personal information was kept anonymous. Data was exclusively used for the sake of this study. Official approval was granted from the Iraqi Council of Medical Specializations.

Data collection tools A questionnaire [20], [21] have been apply to all attendants to collect needed information; socio demographic , disease Characteristics , medication adherence, Lipid Profile , self-care management behaviours, barriers to adherence, the questionnaire was filled by the researcher through direct interview with the patients. The time taken with each patients nearly 15 minutes.

Socio demographic

Age, gender, level of education, marital status, occupation, Smoking status, alcohol status, income, and body mass index of the patients. For the age of the patients divided in to three categories, Less than 50; the youngest one was the age of 43,50-60, and more than 60 (because the patients in this study falls in one of these categories). BMI is BMI = Wight (kg) /(Height in Meter)2 [22].

BMI Categories [22]:

- Underweight = <18.5
- Normal weight = 18.5–24.9
- Overweight = 25–29.9
- Obesity = BMI of 30 or greater

Socioeconomic State

Socioeconomic state have been calculated based Al-Hadithi [23] publication of developing a socioeconomic index for health research in Iraq, which is based on educational level, occupation, employment status, and some additional factors, calculation of pointes per each category (SES= Education +Occupation +House ownership*0.5+ Car ownership*1+[(AGE-20)/100]- retired/unemployed/deceased) will have final score. The minimum score would be 0 and maximum 14.05. The calculated SES score can be divided into equal parts (3: high, middle and low socioeconomic levels).

Educational level

Educational level	Score
Illiterate	0
Primary school (read and write)	1
Intermediate school	2
Higher school or vocational	3
Diploma(institute)	4
Bachelor's degree(college)	5
Master's degree or equivalent (higher diploma)	6
PhD or equivalent	7

Occupation

Unskilled manual occupation	1
Cleaner, gardener, labourer, shoe mender, street vender	
Semiskilled manual occupation	2
Baker, barber, blacksmith, builder, butcher, carpenter, cook, driver, farmer, fitter, goldsmith, midwife, plumber, policeman, soldier, shop owner, tailor	
Skilled manual and non-manual occupation	3
Clerk, customer service employee, nurse, technician, electrical or mechanical technician	
Associate professional occupation	4
Accountant, actor, athlete, commissioned military and police officer, journalist, medical assistant, cleric, teacher, translator	
Skilled professional or senior managerial occupation	5
Company manager, dentist, engineer, high-level administrative official, IT professional, judge, lawyer, pharmacist, university lecturer, veterinarian	
Highly Skilled professional occupation	6
Medical doctor, university professor	

Lipid Profile

Each patient should in overnight fasting (if not, patient send for lipid profile on another day), each patient sent for lab to measure the lipid profile. The lipid profile includes [24]:

1. Total cholesterol: measures all the cholesterol in all the lipoprotein particles. Normal value< 200mg/dl.
2. Triglycerides: measures all the triglycerides in all the lipoprotein particles. Normal value <150 mg/dl.
3. Low-density lipoprotein cholesterol (LDL-C): measures the cholesterol in LDL particles. Normal value <100 mg/dl
4. High-density lipoprotein cholesterol (HDL-C): measures the cholesterol in HDL particles. Normal value higher than 40mg/dl in male, more than 50 mg /dl in female.

Disease Characteristics

1. Comorbidities: which included, hypertension, IHD, thyroid disease, and others (Rheumatoid arthritis, cancer, SLE, renal disease, stroke)
2. Family history of DM
3. Duration of DM (in years)
4. FBS: last visit FBS, the value of <130 mg/dl consider normal.
5. Medication type: which included OHA, insulin, OHA and Insulin.

Lifestyles factors

1. Physical activity: either sedentary, occasional, or regular physical activity. Regular activity: referred to exercise performed more than 30 min\day and more than 3 days\week. Occasional exercise; referred to exercise maintained to some extent but falls outside of the regular exercise criteria mentioned above . Sedentary life ;no exercise referred to scarce physical activity and no conscious of effort toward exercise maintenance.
2. Self-monitoring of blood sugar.
3. Following a healthy diet by the doctor.
4. Adherence to medication

Morisky Medication Adherence Scale-8 (MMAS-8) is used to assess the medication adherence. The tool consists of 8 questions, and scoring done according to an developed method, the total score is eight [25]. For questions one through seven, there was a score of zero for every —yes‖ response and one for every —no‖ response, while the eighth question was assessed on five-point scale from —never/rarely' to —all the time‖, a score of one was assigned

to —never/rarely' response and zero for all other responses. The total MMAS-8 score was calculated by adding all the eight individual question scores and patients were classified as a high, moderate, and low adherent.

SNO	MMAS–8 Adherence Questions	Patients Response
Q1_1	Do you sometimes forget to take your prescribed medicines?	☐ Yes[0] ☐ No[1]
Q1_2	Over the past 2 weeks, were there any days when you did not take your prescribed medicines?	☐ Yes[0] ☐ No[1]
Q1_3	Have you stopped taking medications because you feel worse when you took it?	☐ Yes[0] ☐ No[1]
Q1_4	When you travel or leave home, do you sometimes forget to bring along your meds?	☐ Yes[0] ☐ No[1]
Q1_5	Did you take your prescribed medicine yesterday?	☐ Yes[0] ☐ No[1]
Q1_6	When you feel like your health is under control, do you sometime stop taking your meds?	☐ Yes[0] ☐ No[1]
Q1_7	Do you feel hassled about sticking to your prescribed treatment plan?	☐ Yes[0] ☐ No[1]
Q1_8	How often do you have difficulty remembering to take all your prescribed medicine?	☐ Never/rarely[1] ☐ Once in a while[0] ☐ Sometimes[0] ☐ Usually[0] ☐ All the time[0]
	Total Score	

Statistical Analysis

The data analyzed using Statistical Package for Social Sciences (SPSS) version 22. Categorical data presented by frequencies and percentages. Pearson's Chi–square test was used to assess statistical association between categorical variables. Multivariate regression analysis was conducted to identify the significant unconfounded factors associated with the controlled status of DM.A level of P – value < 0.05 was considered significant.

3. RESULTS AND DISCUSSION

a. Socio–Demographic Characteristics

The total sample included in this study was 340 diabetic patients, of whom 56.5% were female and 43.5% were male, and the most prevalent age group was 50-60 years, at 45.5%. Regarding the educational status of the sample, the results showed that the primary and secondary levels were the highest in prevalence among the participants (40.6% and 39.4%, respectively), while the marital status of the participants showed that 97.9% were married, while 35% of the study sample They are self-employed (freelance) as shown in Table 3

Table 3: distribution of the study sample according to demographic characteristic.

N=340

sex	Frequency	Percent
male	148	43.5
female	192	56.5
age group	Frequency	Percent
<50years	98	28.8
50-60years	156	45.9
>60 years	86	25.3

Educational status	Frequency	Percent
primary	138	40.6
secondary	134	39.4
collage	68	20
marital status	Frequency	Percent
single	7	2.1
married	333	97.9
occupation	Frequency	Percent
employed	84	24.7
retired	47	13.8
freelance	120	35.3
housewife	89	26.2

In the results of the current study for a number of risk factors, we see that the most common among participants is not smoking and insufficient monthly money (74.1% and 59.4%, respectively). In contrast, most of the prevalent cases were obese (56.2%) with a body mass index (20-30 kg/cm3).

Table 4: Distribution of the study sample according to risk factors. N=340

smoking	Frequency	Percent
yes	88	25.9
no	252	74.1
income	Frequency	Percent
adequate	138	40.6
inadequate	202	59.4
BMI	Frequency	Percent
<25mgk	52	15.3
25-30k/cm	191	56.2
>30kg/cm	97	28.5

Dyslipidemia was presented in 64.7% of the patients. The TG was elevated in 43.8% of patients, While HDL was low in 55.3%. LDL was high in 28.8% of patients.

Table 5: Lipid profile characterization

Variable	N340	Percent
Dyslipidemia	220	64.7
Total Cholesterol <200 mg/dl ≥200 mg/dl	 229 111	 67.4 32.6
TG <150 mg/dl ≥150 mg/dl	 191 149	 56,2 43.8
LDL <100 mg/dl ≥100 mg/dl	 242 98	 71.2 28.8
HDL High Low	 152 188	 44.7 55.3

b. Disease Characteristics

The comorbidities were associated with 69.1% of DM patients, and hypertension was the most frequent (58.8%) comorbidity associated with DM patients. .The characteristics of diabetic patients in the current study were that 71.5% of participants had a positive family history of diabetes and 64.4% had diabetes for more than 7 years. In contrast, 75% of the study sample had a fasting blood sugar of more than 130 mg. /dL while it was closer to half of the participants, 43.5% of those receiving oral treatment for diabetics. As shown in table 6.

Table 6: Distribution of the study sample according to DM characteristics. N=340

Comorbidities – Yes	Frequency	Percent
	235	69.1
Hypertension	200	58.8
IHD	44	12.9
Thyroid disease	15	4.4
Others	65	19.1
duration of DM	Frequency	Percent
<7years	121	35.6
>7years	219	64.4
HA1C	Frequency	Percent
<7	119	35
>7	221	65
FBS	Frequency	Percent
<130mgldl	85	25
>130mgldl	255	75
medication type OF DM	Frequency	Percent
OHA	149	43.8
insulin	65	19.1
OHA+insulin	126	37.1

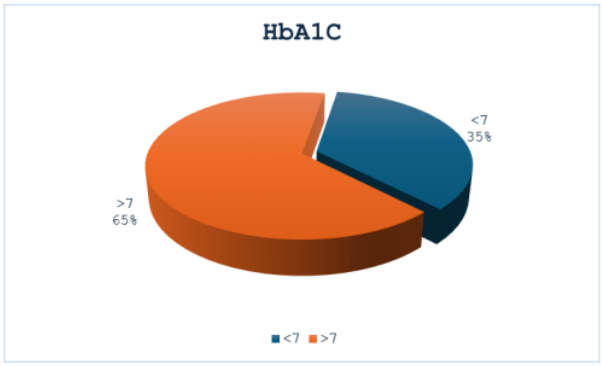

Figure 1: pie chart of HbA1c classification

c. Lifestyles factors

In terms of the study sample's lifestyle, the findings revealed that over 44% of participants engaged in sedentary physical activity, only 57.9% of participants self-monitored their diabetes, and 58% relied on a healthy diet; nevertheless, most participants (68%) had moderate medication adherence. As noted in Table 7

Table 7: Distribution of the study sample according to lifestyle factors. N=340

physical activity	Frequency	Percent
sedentary	152	44.7
occasional	119	35
regular	69	20.3
self-monitoring of DM	Frequency	Percent
yes	197	57.9
no	143	42.1
following heathy diet by doctor	Frequency	Percent
yes	141	41.5
no	198	58.2
System	1	0.3
adherence on medication	Frequency	Percent
low	108	31.8
moderate	232	68.2

d. Factor associated with poor control

Based on HbA1C, DM patients were classified as good (< 7) and poor glycemic control (≥7) patients. The association between the DM control and demographic variables was given in the below table. The current study's findings (p = 0.738) did not indicate a relationship between sex and Hb1AC levels. However, there is a statistically significant correlation (p= 0.017) between the age group of 50–60 years and an increase in Hb1AC greater than 7. Furthermore, our results show that individuals with primary education have a higher incidence of Hb1Ac levels exceeding 7, with a statistically significant correlation (p=0.001). Table 8

demonstrates that there was no statistically significant correlation between the individuals' level of Hb1Ac and their marital status or job categories (p= 0.791 and p=0.361, respectively).

Table 8: relationship between HbA1c test and socio demographic factors. N=340

sex	HbA1c=<7 (119)	HbA1c=>7 (221)	Total(340)
male	53(44.50%)	95 (44.50%)	148(43.50%)
female	66(55.50%)	126(57.00%)	192(56.50%)
Pearson Chi-Square= 0.076a	df= 1	p. value=0.738	
age group	HbA1c=<7	HbA1c=>7	Total
<50years	31	67	98
	26.10%	30.30%	28.80%
50-60years	47	109	156
	39.50%	49.30%	45.90%
>60 years	41	45	86
	34.50%	20.40%	25.30%
Pearson Chi-Square= 8.189a	df= 2	p. value=0.017* statically significant	
Educational status	HbA1c=<7	HbA1c=>7	Total
primary	21	117	138
	17.60%	52.90%	40.60%
secondary	42	92	134
	35.30%	41.60%	39.40%
collage	56	12	68
	47.10%	5.40%	20.00%
Pearson Chi-Square= 91.549a	df= 2	p. value=0.001* statically significant	
marital status	HbA1c=<7	HbA1c=>7	Total
single	2	5	7
	1.70%	2.30%	2.10%
married	117	216	333
	98.30%	97.70%	97.90%
Pearson Chi-Square= 1.30a	df= 1	p. value=0.791	
Occupation	HbA1c=<7	HbA1c=>7	Total
employed	29	55	84
	24.40%	24.90%	24.70%
retired	22	25	47
	18.50%	11.30%	13.80%
freelance	38	82	120
	31.90%	37.10%	35.30%
housewife	30	59	89
	25.20%	26.70%	26.20%
Pearson Chi-Square= 3.350a	df= 3	p. value=0.361	

Regarding the correlation between risk factors and the HbA1c level, the results indicate that smoking individuals have a high level of HbA1c in excess of 7 compared to non-smoking participants, with a significant statistical variation (p=0.01). However, there was no significant statistical relationship between the income of individuals and the BMI level with the high HbA1c level. (p=0.392 and p=0.593respectively).

Table 9: relationship between HbA1c test and risk factors. N=340

smoking	HbA1c=<7	HbA1c=>7	Total
yes	21	67	88
	17.60%	30.30%	25.90%
no	98	154	252
	82.40%	69.70%	74.10%
Total	119	221	340
Pearson Chi-Square= 6.472a	df=	p. value=0.011* statically significant	
BMI	HbA1c=<7	HbA1c=>7	Total
<25mgk	20	32	52
	16.80%	14.50%	15.30%
25-30k/cm	62	129	191
	52.10%	58.40%	56.20%
>30kg/cm	37	60	97
	31.10%	27.10%	28.50%
Total	119	221	340
Pearson Chi-Square= 1.237a	df= 2	p. value=0.539	
Income	HbA1c=<7	HbA1c=>7	Total
adequate	52	86	138
	43.70%	38.90%	40.60%
inadequate	67	135	202
	56.30%	61.10%	59.40%
	119	221	340
Pearson Chi-Square= 0.734a	df= 1	p. value=0.392	

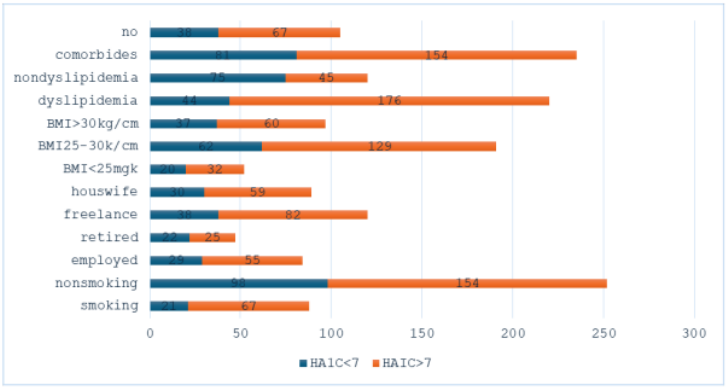

Figure 2: relationship between HbA1c test and risk factors. N=340

Dyslipidemia was associated with poor glycemic control (P-value < 0.001). The HDL did not show a significant association with DM control.

Table 9: relationship between HbA1c test and lipid profile N=340

dyslipidemia	HbA1c=<7(119)	HbA1c=>7(221)	Total
yes	44(37.00%)	176(79.60%)	220
no	75(63.00%)	45(20.40%)	120
Pearson Chi-Square= 61.648a	df= 1	p. value=0.001*	statically significant
Total. Ch <200 mg/dl ≥200 mg/dl	 95(79.8%) 24(20.2%)	 134(60.6%) 87(39.4%)	 229(67.4%) 111(32.6%)

p. value<0.001 statically significant			
TG <150 mg/dl ≥150 mg/dl	 97 (81.5%) 22(18.5%)	 94(42.5%) 127(57.5%)	 191(56,2%) 149(43.8%)
p. value=0.002 statically significant			
LDL <100 mg/dl ≥100 mg/dl	 104(87.4%) 15(12.6%)	 138(62.4%) 83(37.6%)	 242(71.2%) 98(28.8%)
p. value=0.024 statically significant			
HDL High Low	 55(46.2%) 64(53.8%)	 97(43.9%) 124(56.1%)	 152(44.7%) 188(55.3%)
p. value=0.52			

The current study's results demonstrated a statistically significant (p=0.002) positive history of diabetes mellitus in 76.90% of individuals with a HbA1c greater than 7. Additionally, 78% of those with a HbA1c > 7 had DM duration for more than 7 years, with a statistically significant association (p=0.001). Furthermore, all subjects with uncontrolled blood sugar levels >130 and those receiving combination therapy had higher HbA1c levels than 7 levels than others with statistically significant differences (p=0.001).as seen in Table

The association between the DM control and disease characterization was demonstrated in table 10

Table 10: relationship between HbA1c test and DM characteristics. N=340

Comorbidity	HbA1c=<7 (119)	HbA1c=>7 (221)	Total
yes	81(68.10%)	154(69.70%)	235(69.10%)
no	38(31.90%)	67(30.30%)	105(30.90%)
Pearson Chi-Square= 0.059a df= 1 p. value=0.02 statically significant			
positive family hx of DM	HbA1c=<7(119)	HbA1c=>7(221)	Total
yes	73(61.30%)	170(76.90%)	243(71.50%)
no	46(38.70%)	51(23.10%)	97(28.50)
Pearson Chi-Square= 9.206 df= 1 p. value=0.002* statically significant			
duration of DM	HbA1c=<7	HbA1c=>7	Total
<7years	73 (61.3%)	48(21.70%)	121(35.5%)
>7years	46(38.7%)	173(78.30%)	219(64.4%)
Pearson Chi-Square= 48.952a df= 1 p. value=<0.001* statically significant			
FBS	HbA1c=<7	HbA1c=>7	Total
<130 mg/dl	66(55.50%)	19(8.60%)	85(25.00%)
>130mg/dl	53(44.50%)	202(91.40%)	255(75.00%)
Pearson Chi-Square= 90.605a df= 1 p. value=0.001* statically significant			
medication type	HbA1c=<7	HbA1c=>7	Total
OHA	87(73.10%)	62(28.10%)	149(43.80%)
insulin	8(6.70%)	57(25.80%)	65(19.10%)
OHA+insulin	24(20.20%)	102(46.20%)	126(37.10%)
Pearson Chi-Square= 64.636a df= 2 p. value=0.001* statically significant			

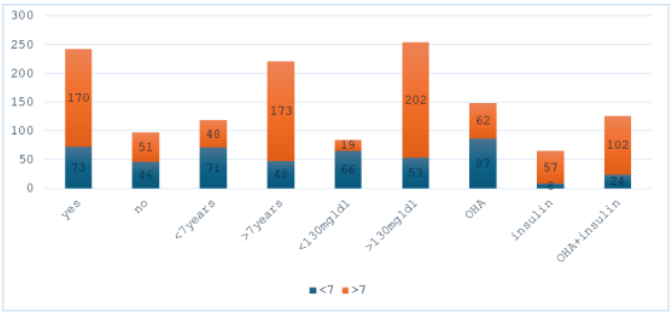

Figure 3: relationship between HbA1c test and DM characteristics. N=340

Relationship between HbA1c test and lifestyles factors

Concerning the degree of physical activity decline with Hb1Ac levels rise over 7 in a statistically significant way (p=0.001). 87.40% of people with a Hb1Ac level below 7 were found to be self-monitoring for diabetes mellitus, a statistically significant finding (p=0.001). Additionally, 80% of patients with high Hb1Ac > 7 levels did not consume a healthy diet, with statistically significant differences (p=0.001). On the other hand, there was a significant correlation (p=0.007) between the high prevalence of low adherence participants and those who had a Hb1Ac level greater than 7. as seen in Table 11.

Table 11: relationship between HbA1c test and lifestyles factors N=340

physical activity	HbA1c=<7	HbA1c=>7	Total
sedentary	30(25.20%)	122(55.20%)	152(44.70%)
occasional	44(37.00%)	75(33.90%)	119(35.00%)
regular	45(37.80%)	24(10.90%)	69(20.30%)
Pearson Chi-Square= 43.463a	df= 2	p. value=<0.001*	statically significant
self monitoring of DM	HbA1c=<7	HbA1c=>7	Total
yes	104(87.40%)	93(42.10%)	197(57.90%)
no	15(12.60%)	128(57.90%)	143(42.10%)
Pearson Chi-Square= 65.174a	df= 1	p. value=0.001*	statically significant
following heathy diet by doctor	HbA1c=<7	HbA1c=>7	Total
yes	98(83.10%)	43(19.50%)	141(41.60%)
no	20(16.90%)	178(80.50%)	198(58.40%)
Total	118	221	339
Pearson Chi-Square= 128.62a	df= 1	p. value=<0.001*	statically significant
adherence on medication	HbA1c=<7	HbA1c=>7	Total
low	13(10.90%)	95(43.00%)	108(31.80%)
moderate	106(89.10%)	126(57.00%)	232(68.20%)
Pearson Chi-Square= 36.685a	df= 1	p. value=0.007*	statically significant

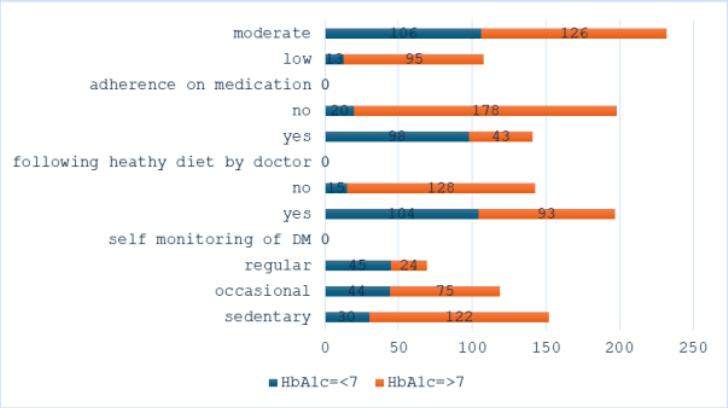

Figure 4: relationship between HbA1c and lifestyles factors N=340

4. DISCUSSION

Identify the risk factors for poor glycemic control among type 2 DM patients will help both physicians and patients to overcome those factors and trying to control them decrease the burden on patients as well as the health system. This study estimated the proportion of patients with Type 2 diabetes who did not achieve target level of HbA1c. Poor glycemic control (HbA1c >7%) was present in 65%of patients. In Zakho city ,Iraq 76.6%of the studied population had HbA1c ≥8% [26], Istanbul, Turkey 2017 only 32.5% of the patients reached target level of glycemic control 67.5% of the patients had poor glycemic control (HbA1c was found as ≥ 7%) [20]. IN South Indian (78.2%) patients had poor glycemic control [27]. DM patients in the United States have a better glycemic control rate (about 50%) than patients in other nations.56 The difference may be related to HbA1Cmeasurements which associated with variability and can vary further with race and ethnicity.

a. Socio – Demographic Characterization

The study demonstrated around 56.5% of patients were females and 45.9% were 50- 60 years. This result is in line with study conducted in Iraq by Abbas, which showed 54% of patients were female and the mean age was 51 years [28]. Another study in Mansoura Specialized Medical Hospital, Egypt the mean age was 54year, 66% were females, 66.8% [29]. Regarding the level of education, the results showed that the primary and secondary levels were the highest in prevalence among the participants (40.6% and 39.4%, respectively). This is comparable to general population of Iraq [30]. About 25.9% of the patients were smokers which is low in comparison to another study conducted in Iraq which showed the smoker

percentage exceeding 30% among Iraqis. Around 56.2% of patients were overweight is in line with the general Iraqi population [31], [32].

b. Lipid profile

The lipid profile characterization for the patients included in this study showed that dyslipidemia was seen in more than two thirds of the study population ,which is comparable to Abbas's [28] study as well as other global Studies. Similar results were found in other studies in Karbala (73%) [33]. It is proven that dyslipidemia prevalence is higher among DM.

This result is in line with study conducted in Qatar revealed that unachieved target glycemic control was more common among patients with diagnosed dyslipidemia than those without dyslipidemia [34]. This in in contrast to other studies in zakho Iraq hyperlipidemia Was not statistically associated with poor glycemic control [26].

In Tabuk, Saudi Arabia, as around two-thirds of its participants (66.5%) had dyslipidemia [35]. These differences in the prevalence of dyslipidemia might be due to lifestyle, dietary habits, and genetic predisposition. Strong association between dyslipidemia and glycemic control in type 2 diabetic patients was reported in this study with dyslipidemia being more frequently encountered in those with poorly controlled diabetes.

Elevated cholesterol was observed in111(32.6%) of our patients which is low in comparison to Iraqi STEPS report which report a high cholesterol in 34% [36]. Alzaheb's study found (47.8%) of DM patients had elevated cholesterol [35]. This discrepancy may be related to medication used for dyslipidemia, as previous study did not mention whether they included patients before medication or after.

The high TG level was observed in43.8% and LDL level was 28.8% comparable to study conducted in Iraq by Abbas's study [26]. Another study in National Diabetes Center, Baghdad 19.1% with high LDL, and 42.2% were with low HDL [37],while Shwan's62 study demonstrated a 60% of patients have high TG among DM patients in UAE [38].

c. Disease Characterization

Around 69.1% of patients included in this study had comorbidities, and hypertension was the most frequent comorbidity associated with DM patients (58.8%).This is in line with cohort study in UK in which 65% patients with DM had at least one comorbidity and hypertension was the most prevalent condition among all patients [39]. Also, Abbas's study demonstrated a high hypertension condition in 55% associated with DM [28]. In a study conducted in UAE comorbidities was demonstrated in 83% of patients and hypertension was also the most common comorbidity The multi ethnicity in UAE may contributed to this difference. In a study conducted in USA revealed that around 81% of DM patients have

hypertension [35], [40]. This is difficult to explain and more studies are needed with larger sample size to explore the role of these factors in controlling diabetes.

The majority of patients the DM duration was more than 7 years 64.4% which was in line with study conduct in Saudi Arabia found a 63% of DM patients had a duration more than 10 years [35]. The Positive family history of DM was observed in (71.5%) of patients and result was comparable to another study conducted in India [41].

About 43.8% of patients on OHA medication only and it was comparable to Abbas's study that show 45% of patients was on OHA [28]. The difference may be related to HbA1Cmeasurements which associated with variability and can vary further with race and ethnicity.

d. Factor associated with poor control

The association between the DM control and demographic variables showed a significant association between control and education level (college education), with a statistically significant correlation (p=0.001). This was comparable to recent study conducted in USA which concluded a diabetic control demonstrates a gradient from lowest to highest education level [42] and low educational level had a strong relation with higher HbA1C [43].

There was no significant statistical relationship between the income of individuals with the high HbA1c level (p=0.392) this in in contrast to many studies demonstrated that income may attribute to good quality of medication and in western countries the income will determine the type of insurance that may affect the glycemic control [44].

There is a statistically significant correlation (p= 0.017) between the age group of 50–60 years and an increase in Hb1AC greater than 7.Another observations found that there is an increasing prevalence of DM with poor glycemic control among middle-aged (40–50 years) and older adults (60–74 years) [45]. Despite of many reports that demonstrated the relationship between BMI with control of DM [46], [47] however, our results did not show the association (p-value=0.593).

For disease characteristics, all variables (comorbidities, family history, duration, FBS, medication) were associated with poor control. As duration of DM association with more insulin resistance that may contribute to its association with poor control [9]. Furthermore, patients who were newly diagnosed with type 2 DM were usually in denial, lacked acceptance, and refused to change their behaviors and lifestyle, which impeded successful glycemic control [48], [49].

The positive family history was associated with poor control, which was in line with other studies that demonstrated a strong association [41], however, there was a study that

showed there was no association found between family history and poor control [50]. This significant variability in this association remains inexplicable.

Those receiving combination therapy had poorer glycemic control than others with statistically significant differences (p=0.001). Patients with new onset DM given oral medication and increase the medications dose and pattern with increased resistance to medications, so patients with insulin or combined therapy expecting to have resistance to previous medications that could not control their DM. This is demonstrated in Abbbas's [28] study which found an insulin treatment is associated poor glycemic control. Also, poor self-management of insulin due to insufficient knowledge, abilities or skills, contribute to poorer glycemic control among patients on Insulin therapy [51], [52]. FBS directly affected by DM control, and patients with high HbA1C have a higher level of FBS than control ones.

The presence of comorbidities was associated with poor control, which had been approved in many studies to be associated with poor glycemic control [20]. There is strong evidence and increased challenges of managing diabetes with substantial comorbidities [53]. Remarkably, Abbas's study showed that the

presence of hypertension was associated with decreased risk of poor glycemic control [28]. This in in contrast to study in zakho Iraq hypertension Was not statistically associated with poor glycemic control [26].

Dyslipidemia was associated with poor control, including cholesterol level, TG level, and LDL level. The HDL did not show a significant association with DM control. About lifestyles factors (physical activity decline, did not consume a healthy diet and low adherence participants) all associated with poor glycemic control with a statistically significant finding(p=0.001, p=0.001, p=0.007 respectively). On the other hand, self-monitoring for diabetes mellitus is associated with good glycemic control with a statistically significant finding (p=0.001).

Studies indicated that poor diabetes-related knowledge leads to poor adherence to diabetes self-management steps, such as following medication protocols and self-monitoring blood glucose [54]. In Redmond study [55], nutrition and diabetes intervention improved several aspects of diabetes self-management activities and HbA1c knowledge. Therefore, all given information suggested that diabetes-related knowledge is significantly associated with glycemic control [56].

Healthy diet and adherence paly important role in DM control as health diet improvement through knowledge, attitude, and practices lead to better control of the disease

[20]. Overall HbA1c and fasting blood glucose improved among adults with type 2 DM with high self-efficacy who adhered to carbohydrate counting-based dietary regimens [57].

5. CONCLUSIONS

- The presence of dyslipidemia is a significant determinant of an increased risk of poor glycemic control.
- For disease characteristics (comorbidities, Duration of DM>7, combination medication, family history of DM) and lifestyles factors (unhealthy diet, physical inactivity, and poor adherence) were associated with poor control.

6. RECOMMENDATIONS

1. Increase awareness regarding the importance of managing to improve DM control and prevent complications.
2. Treatment and monitor guidelines for special DM population who had factors that associated with poor glycemic control.
3. Special attention should be considered for dyslipidemia, FBS, activity, and adherence as important factors for glycemic control among DM patients.

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