

# Risk Factors Associated with Poor Glycemic Control in Patients with Type Two Diabetes Mellitus in Zakho City

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## Abstract

**Objectives:** The aim of this study was to investigate the prevalence of poor glycemic control in Zakho city and to explore the modifiable risk factors that may help controlling the disease.

**Methods:** We recruited patients with known history of diabetes receiving oral anti-diabetic medications. Those patients were registered in Zakho Diabetes center with regular visits. The measurement of anthropometric indices was conducted by trained personnel. Plasma glucose was determined using colorimetric enzymatic method with glucose oxidase. HbA1c concentrations were measured in whole blood samples using high performance liquid chromatography.

**Results:** In this study, 520 patients were recruited. The average age of the patients was  $56.92 \pm 9.62$ . Among those, 190 were male. The blood sugar was controlled in 122 (23.4%) patients. We found a significant association between sex and HbA1C level ( $p = 0.000$ ; OR = 0.4796; CI = 0.3175–0.7243). In addition, waist circumference was significantly associated with HbA1C levels ( $p = 0.018$ ; OR = 1.02; CI = 1.0031–1.0373).

**Conclusions:** The vast majority of the patients had uncontrolled diabetes. We found that sex and waist circumference were risk factors for uncontrolled diabetes. Any diabetes controlling program should focus on those two factors.

**Keywords:** Risk factors, Diabetes mellitus, poor glycaemic control, Zakho city

## Introduction

DM is a chronic condition caused by relative lack of insulin due to impaired insulin secretion or insulin resistance.<sup>1</sup>

DM is the ninth major cause of death and with obesity, they represent the biggest epidemics in human history.<sup>2,3</sup> The burden of DM is represented by its enormous breadth as DM has been quadrupled in the past three decades.<sup>2</sup> Diabetes was seriously underrated as a global public health issue; it was proposed that the total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030.<sup>4</sup> However, in 2015, there were already 415 million people with diabetes, far above what was predicted in 2000 for 30 years later according to International Diabetes federation.<sup>5</sup> A better understanding of the traditional drivers “risk factors” of the diabetes is required in order to combat the disease.<sup>3</sup> There are considerable number of risk factors associated with poor glycemic control including age; sex; family history; smoking history; hypertension; chronic diseases such as Ischemic heart disease, bronchial asthma and thyroid diseases; raised body mass index and raised waist circumference.<sup>6-10</sup> Few studies have been conducted in neighboring countries to Iraq to assess the risk factors associated with poor glycemic control.<sup>11-13</sup> The aim of this study was to investigate the prevalence of poor glycemic control in Zakho city in Kurdistan Region of Iraq and to explore the modifiable risk factors that may help controlling the disease.

## Materials and Methods

### Study design and setting

This retrospective observational study was conducted in Zakho City, Kurdistan Region of Iraq. In the city, diabetes

center was established in 2010. All patients with diabetes who receive treatment from governmental hospitals were registered in the center.

### Patients

In this study, we recruited patients with known history of type 2 diabetes (T2DM) receiving oral anti-diabetic medications. Those patients were registered in Zakho Diabetes center with regular visits. Demographic data were collected via face-to-face interview. All patients who were 18 years or older, with type 2 diabetes, registered in the center for at least 12 months, and agreed to participate were included in the study. Controlled diabetes was defined as HbA1C below 7%.<sup>14</sup>

### Anthropometric assessment

The measurement of anthropometric indices was conducted by trained personnel. The measurement of participants weight was conducted by a balance while the height of the participants was measured by a wall-fixed tape measure. Then, the waist circumference was measured by a plastic tape measure. The waist circumference was considered at the narrowest level between the lowest rib and iliac crest.

### Lab measurements

Plasma glucose was determined using colorimetric enzymatic method with glucose oxidase. HbA1c concentrations were measured in whole blood samples using high performance liquid chromatography. Hyperlipidemia was confirmed by history taking. Uncontrolled diabetes was defined as HbA1c of 7% or more.

## Ethics

The study protocol and informed consent were approved by the Research and Ethics Committee of the College of Medicine, Zakho University, Kurdistan Region of Iraq. Informed consent was obtained from all recruited subjects.

## Statistical analysis

Statistical analysis was conducted using Minitab 18. Linear regression was used to investigate the relationship between variables and outcomes when the variables were continuous while chi square test was used for categorical data. *P* value of <0.05 value was considered as significant.

## Results

### Patients

In this study, 520 patients with T2DM were recruited. The average age of the patients was  $56.92 \pm 9.62$ . Among those, 190 were male. The blood sugar was controlled in 122 patients (Table 1). Amongst our patients, 65.96% had a family history of T2DM. Hypertension (HT) was found in 53.07% of our recruited samples. Out of 520 patients, 13.46% were smokers.

### Factor affecting sugar level

Then, we studied the factors affecting blood sugar levels. We found a significant association between sex and HbA1C

level. Our results showed that males were at higher risk of uncontrolled diabetes ( $p = 0.000$ ; OR = 0.4796; CI = 0.3175–0.7243) (Table 2). Additionally, waist circumference was significantly associated with HbA1C levels ( $p = 0.018$ ; OR = 1.02; CI = 1.0031–1.0373). Other variables did not show significant influence on HbA1C levels (Table 2). Other risk factors did not show any significant impact on HbA1C levels.

## Discussion

To prevent organ damage and other complication of diabetes, glycemic control remains the main therapeutic objective.<sup>15</sup> It was previously shown that diabetic patients who control their HbA1C below 7% will have less microvascular diabetic complications.<sup>14</sup> Age, sex, waist circumference, smoking history, family history, body mass index and hypertension were shown to play role in the control of HbA1C.<sup>6,9,10,16,17</sup> Studying risk factors associated with poor glycemic control is crucial for the control of diabetes in any society. Therefore; this study was conducted to check the rate of T2DM with good glycemic control and risk factors associated with poor glycemic control. In this study, the mean HbA1C was  $8.19 \pm 1.6$  which was comparable to what was found by Marilia et al.<sup>18</sup> In this study, 50.19%, 23.65% and 26.15% of recruited patients had HbA1c < 8.0%,  $\geq 8.0$  to < 9.0%, and  $\geq 9.0\%$ , respectively. Again these results were comparable to Marilia et al., results.<sup>18</sup> Additionally, 23.46% of the patients were having their HbA1C being controlled which was comparable to a study performed in Saudi Arabia.<sup>19</sup> In studies conducted in Turkey, Sudan and Tanzania, 32.5%, 28% and 30% of the patients showed good glycemic control, respectively.<sup>20-22</sup> This discrepancy in HbA1C control may be related to cultural and genetic variations. In this study, male to female ratio was 0.57 [male 36.5%, female 63.5%]. This is in contrast to a study that was conducted in The USA and Tanzania where the male to female ratios were 1.15, and 1.5, respectively.<sup>23</sup> In contrast to a previous study from Iraq,<sup>13</sup> in our study, males were at a statistically significant increased risk of suboptimal T2DM control in comparison to females with, which was also noticed in a study conducted in The USA,<sup>23</sup> while in a study conducted in India, male were predominant and a significantly higher risk of poor

Table 1. Characteristics of patients recruited in the study

Variable	No	%
Sex (female)	330	63.46%
IHD	69	13.26%
Asthma	11	0.021%
Thyroid	14	0.026%
Hyperlipidemia	193	37.11%
Family history	343	65.96%
Smoking	70	13.46%
HT	276	53.07%

Table 2. Factor affecting HbA1C levels

Factors	Controlled	Uncontrolled	<i>P</i> value	OR	CI 95%
Age (average $\pm$ Std)	55.36 $\pm$ 10.52	57.25 $\pm$ 9.29	0.057	1.0208	0.9992–1.0428
BMI (average $\pm$ Std)	30.59 $\pm$ 5.49	31.51 $\pm$ 5.57	0.102	1.0319	0.9931–1.0723
Waist circumference (average $\pm$ Std)	104.4 $\pm$ 12.98	107.42 $\pm$ 12.58	0.018	1.0200	1.0031–1.0373
Sex (female)	61/122 (50.00%)	269/398 (67.58%)	0.000	0.4796	0.3175–0.7243
IHD	11/122 (9.01%)	58/398 (14.57%)	0.100	1.7214	0.8728–3.3952
Asthma	2/122 (1.63%)	9/398 (2.26%)	0.667	1.3882	0.2959–6.5128
Thyroid dysfunction	3/122 (2.45%)	11/398 (2.76%)	0.854	1.1275	0.3094–4.1083
Hyperlipidemia	39/122 (31.96%)	154/398 (38.69%)	0.175	1.3432	0.8732–2.0662
Family history	75/122 (61.47%)	268/398 (67.33%)	0.235	1.2919	0.8484–1.9672
Smoking	22/122 (18.03%)	48/398 (12.06%)	0.090	0.6097	0.3482–1.0677
HT	60/122 (49.18%)	216/398 (54.27%)	0.325	1.2264	0.8171–1.8406

glycemic control was associated with females.<sup>6</sup> These variations may be in part related to genetic variation and discrepancy of the predominant sex in one study upon the other. Other risk factor which was at statistically significant association with raised HbA1c% was the central obesity represented by waist circumference, while body mass index was statistically not associated with poor glycemic control, this was consistent to a study done in India by Rohit et al.,<sup>24</sup> to explain the variation between BMI and waist circumference, it has been suggested that age-related increases in total body fat and visceral adiposity compromise the reliability of BMI as a sensitive marker of adiposity in older age groups<sup>25</sup>. In another study, Kayar et al., study<sup>20</sup> found that both BMI and waist circumference were statistically associated with poor glycemic control. In contrast to a previous study in Iraq where younger age was associated with an increased risk of poor glycemic control,<sup>13</sup> in our study there was a trend that age increases the chance of uncontrolled diabetes, though this was not statistically significant. In our study, Hypertension, Thyroid dysfunction, asthma and ischemic heart disease, hyperlipidemia and family history and smoking history were not statistically associated with poor glycemic control. This in contrast to other studies where these factors were found to play an important role in controlling diabetes.<sup>6, 13, 21, 22</sup> This is difficult to explain and more studies are needed with larger sample size to explore the role of these factors in controlling diabetes.

To conclude, out of 520 patients, 377 (72.5%) patients were having HbA1c% of equal or more than 7% reflecting uncontrolled diabetes. We found that sex and waist circumference are risk factors for uncontrolled diabetes. Any diabetes controlling program should focus on those two factors.

## Conflicts of Interest

The authors declare that there is no conflicts of interest.

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## Authors' Contribution

All authors equally contributed to designing the study, analyzing data, and writing the paper. Further, all authors approved the final draft and the authors' order. ■

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