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*Original Research Article*

# The Adequateness of Glycemic Control in Type 2 Diabetes Mellitus

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**Abstract**

A survey study of 166 patients with type 2 diabetes on medical treatment was investigated for inadequate glycemic control. The study carried out at the outpatient clinic in Al–Hindeya general hospitalover a period of five months. The study aims to find the proportion of glycemic control in type 2 diabetes patients and the factors associated with inadequate control. Fasting blood glucose and glycosylated hemoglobin were used to assess glycemic control**.** Patients' socio-demographic characters were collected to evaluate the factors related to inadequate control. An HbA1c level of 7% and more was used as an indicator of inadequate control. We found 78.3% of the patients had HbA1c level ≥7%. In the multivariate analysis, female gender (P≤ 0.042), overweight (P≤ 0.005), illiterate (P≤ 0.002), and treatment with insulin (P≤ 0.03) were significantly associated with poor glycemic control.

**Key words :**Type 2 diabetes mellitus, glycosylated hemoglobin**,** glycemic control.

**الخلاصة**

دراسة مسحية تشمل ١٦٦ مريضا يعانون من مرض السكري من النوع الثاني و مستمرين على العلاج الطبي. أجريت الدراسة في العيادة الخارجية في مستشفى الهندية العام على مدى خمسة أشهر. أهداف الدراسة هي العثور على نسبة السيطرة على السكر والعوامل المرتبطة بعدم كفاية تنظيم السكر. استخدم فحص سكر الصوم في الدم والهيموغلوبين الغليكوزيلاتي لتقييم مراقبة نسبة السكر في الدم واعتبرت نسبة ٧٪ و أكثر كمؤشرعلىضعفالسيطرة على داء السكري.بينت الدراسة أن نسبة ٧٨.٣٪ من المرضى لديهم أرتفاع مزمن بنسبة السكر بالدم وضعف في السيطرة على سكر الدم رغم تناولهم العقاقير الطبية.لدى أجراء التحليل متعدد المتغيرات تبين أن الجنس الأنثوي و زيادة الوزن و الأمية و العلاج بعقار الأنسولين مرتبطين بشكل كبير مع ضعف السيطرة على نسبة السكر في الدم.

## Introduction

Diabetes mellitus (DM) is a chronic metabolicdisorder associated with hyperglycemia due to either a deficiency of insulin secretion or insulin resistance and inappropriate insulin secretion to compensate[1]. Type 2 diabetes is the commonest form of DM constituting about 90 to 95 %, and around one in four of these patients is unaware of the diagnosis[2].

The Diabetes Control and Complications Trial found a direct relationship regarding good glycemic control and reduced microvascular complications [3], while the UK Prospective Diabetes Study noticed a 35% decrease in microvascularcomplications and a 7% reduction in all-cause mortality with each one point percentage reduction in glycosylated hemoglobin (HbA1c) in patients with type 2 DM [4].

HbA1c assay is the preferred test to assess glycemic control in patient with DM because no specific time or special preparations is needed for the test[5]. A proper glycemic control in DM is defined as keeping the HbA1c <7% [6].

This study attempted to assess the degree of glycemic control, as measured by

HbA1c level, in patients with type 2 diabetes receiving anti-diabetic medications and to find the most common factors associated with inadequate control.

## Materials and Methods

This survey study of 166 patients (78 Males and 88 females) with type 2 DM was conducted at the outpatient clinic in Al-Hindeya general hospital from August 2014 to December 2014.

All the participantshad history oftype 2 DM more than five yearsand theywere above the age of 30 years. They were on medical treatment whether oral anti-diabetic agents, insulin or both at least for three months before starting the study.

The patients underwent a list of questionnaire about their disease history including sociodemographic character-istics of patients' age, sex, education, residence, family history, and duration of disease.

The patients screened for glycemic control using fasting blood glucose (FBG) and HbA1c assay. An additional evaluation including renal function test, blood pressure measurement, weight, and height were done for the patients.

The body mass index (BMI) was calculated for each patient using the formula of weight in kilograms divided by the height in meter squared and according to the world health organization BMI classification the patients divided into normal (BMI <24.9kg/$m^2$), overweight (BMI 25-29.9kg/$m^2$), and obese (BMI >30kg/$m^2$)[7].

Depending on the level of HbA1c the patients were categorized in to two groups. Patients with HbA1c less than 7% were regarded as properly controlled, while those with HbA1c of 7% and more were considered as poorly controlled DM patients. Then a multivariate analysis was done between the patients' age, sex, duration of disease, BMI, education, and medication with HbA1c level to detect which factor of the above mentioned adversely affects glycemic control.

Pregnant women with DM and women with gestational diabetes were excluded from the study.Patients with heart failure, diabetic nephropathy and hemoglobinopathies were excluded from the study.

Verbal consent was taken from each patient to use their medical records in the study.

Data analysis carried out using *SPSS* software version 22. Chi-square test was used in this study to determinestatistical significance between various proportions indicated by the *P*-value. The tests regarded significant when the *P*-value <0.05.

## Results

The socio-demographic features (Table 1) of the patients show an age range from 37 to 69 years with a mean of 53.3 ± 8.7 years and more than two thirds of the patients were beyond the age of 50 years. There is a relative female preponderance constituting 53% of the patients (88 females and 78 males). The disease duration ranges from 5 years to 24.9 years with a mean of 9.4 ± 4.5 years and about 83.1% of the patients had disease duration less than 15 years, while those with disease duration more than 20 years represents only 4.8%. The majority of the patients were illiterate (66.3%) who did not attend even primary school and the rest at different levels of education. 63.9% of the patients were of urban origin and lived in areas served by primary health centers. Positive family history of DM was reported in 77.1% and some of the patients had more than one member of the family with DM.

**Table 1 :**Socio-demographic features of the studied group

| Variables | No. | % |
|---|---|---|
| **Age, y** | | |
| 30-39 | 14 | 8.4 |
| 40-49 | 36 | 21.7 |
| 50-59 | 70 | 42.2 |
| 60-69 | 46 | 27.7 |
| Total | 166 | 100 |
| **Gender** | | |
| Male | 78 | 47 |
| Female | 88 | 53 |
| Total | 166 | 100 |
| **Education** | | |
| Educated | 56 | 33.7 |
| Illiterate | 110 | 66.3 |
| Total | 166 | 100 |
| **Residence** | | |
| Rural | 60 | 36.1 |
| Urban | 106 | 63.9 |
| Total | 166 | 100 |
| **Family history** | | |
| Positive | 128 | 77.1 |
| Negative | 38 | 22.9 |
| Total | 166 | 100 |
| **Duration of disease, y** | | |
| 5-9.9 | 80 | 48.2 |
| 10-14.9 | 58 | 34.9 |
| 15-19.9 | 20 | 12.1 |
| 20-24.9 | 8 | 4.8 |
| Total | 166 | 100 |

Figure 1 classify the patients according to type of treatment whether oral anti-diabetic, insulin or mixed treatment. Oral anti-diabetic was the commonest modality of treatment in 104 patients (50 females and 54 males) 62.7%. Insulin therapy reported in 12 females only. The combination of oral anti-diabetic treatment and insulin were registered in 26 females and 24 males constituting about 31.2% of the total number of patients.

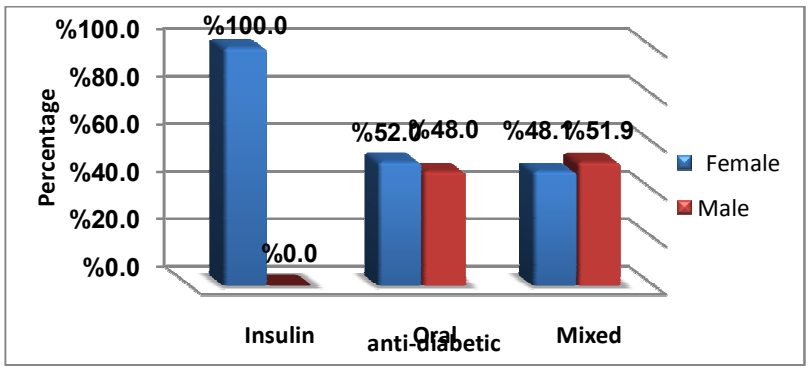


**Figure 1 :**Treatment modalities of the studied group

The patients' FBS ranges from 4-25 mmol/L with a mean of 11.4 ± 3.8mmol/L, while the range of HbA1cwas from 5.4-14.7 % with a mean of 9.2 ± 2.3 %. Thepatients' BMI ranges from 19-42kg/$m^2$ with a mean of 30.3±5.3kg/$m^2$ for females and 28.8 ±4.4kg/$m^2$ for males.

Of the 166 patients, 78.3% had poor glycemic control (HbA1c ≥7%) as shown in table 2. In the multivariate analysis, HbA1c significantly affected by female gender(P≤ 0.042), overweight (P≤ 0.005), illiterate (P≤ 0.002), and treatment with insulin (P≤ 0.03) (Table 2).

**Table 2:**Proportions of patients with inadequate glycemic control in relation to clinical features

| Variables | Total | HbA1c <7% No. (%) | HbA1c ≥7% No. (%) | P- value |
|---|---|---|---|---|
| **Age, y** | | | | |
| 30-39 | 14 | 0(0%) | 14(100%) | 0.076 |
| 40-49 | 36 | 12(33.3%) | 24(66.7%) | |
| 50-59 | 70 | 14(20.0%) | 56(80.0%) | |
| 60-69 | 46 | 10(21.7%) | 36(78.3%) | |
| **Gender** | | | | |
| Male | 78 | 22(28.2%) | 56(71.8%) | 0.042* |
| Female | 88 | 14(15.9%) | 74(84.1%) | |
| **Duration of disease, y** | | | | |
| 5-9.9 | 80 | 14(17.5%) | 66(82.5%) | 0.552 |
| 10-14.9 | 58 | 16(27.6%) | 42(72.4%) | |
| 15-19.9 | 20 | 4(20.0%) | 16(80.0%) | |
| 20-24.9 | 8 | 2(25.0%) | 6(75.0%) | |
| **Body mass index, kg/m$^2$** | | | | |
| 18.5-24.9 | 20 | 10(50%) | 10(50%) | 0.005** |
| 25-29.9 | 82 | 14(17.1%) | 68(82.9%) | |
| >30 | 64 | 12(18.8%) | 52(81.3%) | |
| **Education** | | | | |
| Educated | 56 | 20(35.7%) | 36(65.3%) | 0.002** |
| Illiterate | 110 | 16(14.5%) | 94(85.5%) | |
| **Anti-diabetic medication** | | | | |
| OAD | 104 | 20(19.2%) | 84(80.8%) | 0.03* |
| Insulin | 12 | 0(0%) | 12(100%) | |
| Mixed | 50 | 16(32.0%) | 34(68.0%) | |

(OAD= oral antidiabetic medication)

## Discussion

This study designed to assess the glycemic control in T2DM patients and to explore the factors associated with inadequate control. Inadequate glycemic control was found in 78.3% of patients. The result was consistent with a similar study done in India[8]. Such a high proportion of inadequate glycemic control related to many factors, some of them includebad dietary habits that comprise foods rich in fat and carbohydrates, unsatisfactory adherence to medications and the use of impropermedicines ofherbal origin. The proportions of inadequate glycemic control in the nearby Arab countries including Jordon [9], Kuwait [10], and Saudi Arabia[11] are 65.1%, 66.7%, and 73%, respectively.

In our study, we found female gender (P= 0.042) significantly correlates with inadequate glycemic control. A similar finding was reported by T.S. Sana et al[12].Along with our findings, females were found to have inadequate glycemic control than malesin Saudi Arabia [11]. This result is due to the social standards of women in traditional Arab communities which reducetheir ability to engage in an exercise programand limit their hospital visits for regular follow up. Moreover, an increased incidence of abdominal obesity was noted in women participated in the study is another factor for poor glycemic control as insulin resistance is aggravated by this condition.This is in comparison to another study which correlate male gender with inadequate glycemic control [8].

Overweight (P= 0.005) significantly associated with inadequate glycemic control in our study. The result was consistent with other studies which describe the adverse effect of high BMI on glycemic control[13,14]. Bad dietary habits and increase insulin resistance accompanying high BMI may explain this finding.

This study showed a highly significant relationship between Illiterate (P= 0.002) and inadequate glycemic control. The concept of education and glycemic control was studied in Al-Madina[15] and the result was consistent with ours. This issue defines the importance of education in the management of DM.

Anti-diabetic medication is another factor affecting glycemic control. Insulin therapy (P= 0.03) was significantly associated with inadequate glycemic control in our study. The relationship between insulin and glycemic control was the subject of many studies[13, 16, 17]. This finding reflects the fact of worsening of diabetes over time and the increased demand for potent therapy like insulin to control high blood sugar. Therefore, patients who were treated by insulin had more progressivedisease which required further violent treatment to provide glycemic control . Furthermore, in spite of insulin therapy the patients did not found to use the properdose and type of insulinat the appropriate time in order to achieve the desired response. In addition,the use of insulin allow the patient to neglect dietary therapy is a misconception observed in most of the patients in this group. All the aforementioned factors were responsible for inadequate glycemic control despite insulin therapy.

In this study the majority of patients with inadequateglycemic control were elderly >50 years but there was no significant correlation (P= 0.076) between age and glycemic control. Such a finding was reported by other studies[8, 9]. However, in contradiction studies had shown that younger age is associated withinadequate glycemic control[18, 19].

Longer duration of diabetes is identified to be linked toinadequatecontrol, possibly because of continuing impairment of insulin secretion with time asa result of B-cell failure. In the present study, although a greaternumber of patients with inadequateglycemic control were having longerdisease duration, diabetesduration was not significantly (P= 0.552) associated with inadequateglycemic

status. This finding is consistent with that reported by a study done in India[8].

## Conclusion

In this study, female gender, overweight, illiterate, and insulin therapy were significantly associated with inadequate glycemic control in patients with type 2 diabetes. Patients' age and duration of disease, although positively correlated with type 2 diabetes, were not significantly associated with inadequateglycemic control statistically.

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