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Uncontrolled Blood Glucose Level: Characteristics among Adult Patients with Type 2 Diabetes Mellitus in Aden, Yemen

Samira A. Mahmood[1], Shuhd S. Mohammed[1], Amal A. Abdullah[1], Mahmoud S. Bahmesh[2], Samer K. Al-Sallmi[2], Mohammed K. Obad[2], Bassel N. Muthanna[2], Monia M. Abdu[2], Sonia S. Saleh[2], Mohammed A. Mohammed[3], Dheiya M. Mohammed[2], Hiba A. Saeed[2], Mohammed M. Al-Douani[2], Hanin T. Saif[2], Fatima S. Bin Break[2], Nawal R. Hilal[2], Farooq A. Guman[4], Abdul-Raoof Y. Bahaker[2]

Abstract

Introduction: The study was conducted to find out the frequency and characteristics of uncontrolled blood glucose levels among type 2 diabetic patients.

Methods: This is a cross-sectional study conducted in 16 public and private medical outpatients' clinics including Aden Diabetes Center at Al-Gamhouria Modern General Hospital in Aden, in the period from 10 April to 10 June 2019. Patients diagnosed with type 2 diabetes mellitus aged ≥ 18 years and treated for more than one year were included. Data were collected through directly interviewing the patients using a structured questionnaire that included patients, medical and medication characteristics.

Result: A total of 180 patients with type 2 diabetes participated in the present study. Just above half (52.8%) were males and 47.2% females. The mean age was 55.4±10.93 years. Fifty-four percent of the patients have family history of diabetes mellitus. Poor glycemic control was found in 77.2% of the patients whereas irregular exercise was found in 63.3%. A total of 109 patients (60.6%) used antidiabetic medications only while 71 patients (39.4%) used antidiabetic and medications for cardiovascular diseases. Metformin was less frequently used (alone or in combination) in poorly controlled patients, while insulin (alone or in combination with oral drugs) was more utilized.

Conclusion: A higher frequency of poorly controlled type 2 diabetic patients is observed in this study. Type of medications, insufficient exercise, unemployment, duration and family history of diabetes are factors related to uncontrolled diabetes.

Keywords: Hyperglycemia, Poor Control, Metformin, Diabetes Medications, Frequency.

[1]Pharmacology and Toxicology Department, Faculty of Pharmacy, University of Aden, Republic of Yemen.
[2]Faculty of Pharmacy, University of Aden, Republic of Yemen.
[3]Babel Hospital - Aden, Republic of Yemen.
[4]Shifa Hospital- Aden, Republic of Yemen.
Corresponding Author: Samira A. Mahmood **Email:** samabdulla@yahoo.com

مستوى سكر الدم غير المنضبط وخصائصه بين المرضى البالغين الذين يعانون من مرض السكري النوع 2 في عدن، اليمن

سميرة عبدالله محمود[1]، شهد شهاب محمد[1]، امال عبدالخالق عبدالله[1]، محمود سعيد باحميش[2]، سامر خالد السلامي[2]، محمد خالد عبادي[2]، باسل ناصر مثنى[2]، منية منير عبده[2]، سونيا سيف صالح[2]، محمد أنور محمد[3]، ضياء موفق محمد[2]، هبه عبد الحكيم سعيد[2]، محمد مهدي الدوعني[2]، حنين طارق سيف[2]، فاطمة سالم بن بريك[2]، نوال رمزي عبدالتواب[2]، فاروق أنور جمن[4]، عبد الرؤوف يسلم باحكر[2]

ملخص الدراسة

المقدمة: أجريت هذه الدراسة لمعرفة مدى تواتر عدم انضباط مستوى السكر في الدم بين مرضى السكري من النوع 2 والخصائص ذات العلاقة.

المنهجية: هذه دراسة مقطعية أجريت على المرضى المترددين على 16 عيادة خارجية حكومية وخاصة متضمنة مركز السكر في هيئة مستشفى الجمهورية العام، عدن، في الفترة من 10 ابريل الى 10 يونيو 2019م. وشملت الدراسة المرضى الذين تم تشخيصهم بمرض السكري من النوع 2 والذين أعمارهم 18عاما وما فوق ويتعالجون بالأدوية لأكثر من سنة. تم جمع البيانات من خلال إجراء مقابلات مباشرة مع المرضى في العيادة باستخدام استبيان يتألف من خصائص المرضى والأدوية والخصائص الطبية.

النتائج: شارك في هذه الدراسة 180 مريضاً مصابين بالنوع الثاني من مرض السكري. وكان 52.8 % منهم من الذكور و47.2 % من الإناث بمتوسط عمر55.4±10.93 سنة. لوحظ ان 63.3% من المرضى لا يمارسون الرياضة بشكل منتظم وأن 54% منهم لديهم تاريخ عائلي لمرض السكري. أظهرت الدراسة أن 77.2% من المرضى لديهم نسبة السكر في الدم غير منضبطة. لقد أستخدم 109 من المرضى (60.5%) أدوية مضادة للسكري فقط بينما 71 مريضا (39.5%) استخدموا مضادات السكري وأدوية أمراض القلب والأوعية الدموية. أوضحت الدراسة أن المرضى الذين يعانون من عدم انضباط مستوى سكر الدم تعاطو الميتفورمين بشكل أقل (بمفرده أو على شكل دواء مركب) بينما استخدام الانسولين لديهم كان أكثر.

الاستنتاج: لوحظ زيادة في عدد المرضى المصابين بالسكري من النوع 2 الذين لديهم مستوى السكر في الدم غير منضبط. نوع الأدوية، وعدم كفاية ممارسة الرياضة، والبطالة، ومدة وتاريخ الأسرة لمرض السكري هي العوامل المتعلقة بمرض السكري النوع الثاني غير المنضبط.

كلمات مفتاحية: ارتفاع سكر الدم، سوء التحكم، ميتفورمين، أدوية السكري، تواتر.

[1]قسم الصيدلة والسموم كلية الصيدلة جامعة عدن الجمهورية اليمنية
[2]كلية الصيدلة جامعة عدن، الجمهورية اليمنية
[3] مستشفى بابل، عدن، الجمهورية اليمنية
4مستشفى شفاء، عدن، الجمهورية اليمنية

Introduction

Diabetes mellitus is a complex metabolic disorder that is associated with medical complications. Its prevalence is rising globally with the expected number to rise around 552 million by 2030 [1]. Recent studies have shown that type 2 diabetes mellitus (T2DM) with its complications and burdens represent a health problem in Yemen, notably Aden [2,3]. T2DM is characterized by chronic hyperglycemia that is associated with various long-term complications with negative impaction on the individuals and subsequently on the society [4]. In spite of the existence of various drug groups that help improve treatment of T2DM, a high number of the patients has poor glycemic control [5].

Previous studies have provided evidence of the power of good glycemic control to restrict the microvascular and macrovascular complications of diabetes [6,7]. Despite that, between 40% and 60% of patients worldwide still have poorly controlled diabetes [8,9]. Micro-and macro-complications including cardiovascular diseases are the consequence of long-standing uncontrolled blood glucose [9].

Evidence shows that there are factors influencing the glycemic control such as gender, age, duration of diabetes, type of medications, medical conditions, body mass index and life style [10,11]. Knowing the factors affecting the glycemic control might help patients, researchers and authorities to find strategies to improv the status of blood glucose in diabetic patients.

Therefore, the objectives of the present study were to find out the frequency of poor glycemic control among T2DM patients in out-patient settings in Aden and to identify factors related to poor glycemic control in order to raise the awareness of this problem for patients, healthcare workers and authorities to help in solving it.

Methods

Study design

The is a cross-sectional study conducted in 16 public and private medical out-patients' clinics (two from each of the eight districts in Aden randomly selected) including Aden Diabetes Center at Al-Gamhouria Modern General Hospital in Aden, Yemen.

Inclusion and exclusion criteria

Patients diagnosed with T2DM aged ≥ 18 years and treated for more than one year were eligible and included in this study. Treated diabetic patients for less than a year (who might be not better stabilized on drug therapy), pregnant, lactating mothers and patients refused to participate were excluded.

Sampling

Patients attended in the outpatients' clinics at the time of data collection from 10 April to 10 June 2019 and fulfill the study inclusion criteria were enrolled.

Data collection

Data were collected by well-trained pharmacy and medical students through face-to-face interview with patients in the clinic they attended using a structured questionnaire including:

- **Patients' characteristics:** gender, age, marital status, education, employment, residency, smoking, khat chewing, adherence to diet, medications exercise, self-monitoring of blood glucose levels and T2DM family history.
- **Medical characteristics:** comorbid conditions depending on patients interview and drugs prescribed, duration of diabetes, fasting blood glucose (FBG) performed on the day of interview after 8 hours fasting as patients reported.
- **Medications characteristics:** drugs used by the patients.

Definition of Terms

The following were used for:

FBG level:

- Controlled: ≤ 130 mg/dl
- Uncontrolled: > 130 mg/dl

Exercise:

- Regular: If the patient walks 30 minutes daily
- Irregular: Walking 30 minutes intermittent weekly

Adherence to diet or medications:

- Adherence: if the patient follows the doctor advices.
- No adherence: the patient does not follow the doctor advices

Education:

- Educated: the patient has finished university, institute or secondary school.
- Uneducated: The patient cannot read or write, or had primary school.

Statistical analysis

Analysis of the data was conducted by using SPSS (Version 23). The descriptive statistics (mean, standard deviation and percentages) was calculated. Chi-square analysis was performed to compare the proportions. The statistical significance was calculated using p <0.05.

Ethical consideration

The interview was conducted only after obtaining the verbal informed consent from each participant. Ethical approval was obtained from Research and Ethics Committee, Faculty of Medicine and Health Sciences, University of Aden.

Results

A total of 180 patients with T2DM participated in the study. The mean duration of diabetes was 8.9±7.30 and ranged from 1 to 40 years with a median of 7.5 years. Males constituted 52.8% and females 47.2%. The mean age was 55.4±10.93 years and the majority (71.7%) was in the age group ≥50 years. The highest percentage was married (91.1%) and urban (94.4%). Fifty-five percent were unemployed and 40.6% were uneducated as shown in Table 1.

The table also shows that 77.2% of the patients were uncontrolled (139/180). Of them, 51.1% were males and 48.9% females, whose ages was mainly in the age group of 50 years and above.

Table 1: Personal Characteristics of Patients Based on Fasting Blood Glucose Levels

	Total (n=180)		Controlled FBG (n=41)		Uncontrolled FBG (n=139)		*p*
	No.	**%**	**No.**	**%**	**No.**	**%**	
Gender							
Male	95	52.8	24	58.5	71	51.1	0.401
Female	85	47.2	17	41.5	68	48.9	
Age (years)							
< 50	51	28.3	11	26.8	40	28.8	0.808
≥ 50	129	71.7	30	73.2	99	71.2	
Marital status							
Married	194	91.1	38	92.7	126	90.6	0.687
Unmarried	16	8.9	03	07.3	13	09.4	
Educational level							
Educated	107	59.4	27	65.8	80	57.5	0.478
Uneducated	73	40.6	14	34.2	59	42.5	
Employment status							
Employed	81	45.0	22	53.7	59	42.5	0.205
Unemployed	99	55.0	19	46.3	80	57.5	
Residence							
Urban	170	94.4	40	97.6	130	93.5	0.321
Rural	10	5.6	01	02.4	09	06.5	
Class of drug used							
Antidiabetics only	109	60.6	27	65.8	82	59.0	0.776
Anti-diabetics and drugs for CVD	71	39.4	14	34.2	57	41.0	

CVD= cardiovascular diseases; FBG= Fasting blood glucose

Table 2 reveals that a large proportion of patients with poor glycemic control were non-smokers and khat chewers, did not self-monitor their blood glucose levels, did not adhere to exercise, had family history of diabetes, and showed good adherence to diet and medications. All differences were statistically insignificant except for the adherence of medication.

Concerning the poorly controlled group, Table 3 shows that 18.7% of them used insulin only or insulin with oral diabetic drugs, 25.9% used oral mono-therapy and 36.7% utilized oral combination therapy.

Table 2: Patients' Life Style, Habits and Medical Characteristics Based on Fasting Blood Glucose Levels

	Total (n=180)		Controlled FBG (n=41)		Uncontrolled FBG (n=139)		*p*
	No.	**%**	**No.**	**%**	**No.**	**%**	
Smoking							
Yes	19	10.5	06	14.6	13	09.3	0.333
No	161	89.4	35	85.3	126	90.6	
Khat chewing							
Yes	63	35.0	13	31.7	50	35.9	0.615
No	117	65.0	28	68.2	89	64.0	
Adherence to diet							
Yes	164	91.1	38	92.7	126	90.6	**0.001***
No	16	8.9	03	07.3	13	09.4	
Adherence to exercise							
Regular	89	49.4	25	60.9	64	46.0	0.093
Irregular	91	50.5	16	39.0	75	53.9	
Adherence to medication							
Yes	176	97.7	41	100.0	135	97.1	0.272
No	04	02.2	00	00.0	04	02.8	
Family history of DM							
Yes	98	94.4	18	97.5	80	93.5	0.123
No	82	05.6	23	02.4	59	06.4	
Comorbidity							
Yes	83	46.1	18	43.9	65	46.7	0.747
No	97	53.8	23	56.0	74	53.2	
Self-monitoring of glucose							
Yes	88	48.8	21	51.2	67	48.2	0.734
No	92	51.1	20	48.7	72	51.7	
Duration of diabetes							
1-10 years	128	71.1	34	82.9	94	67.6	0.420
≥ 11 years	52	28.8	07	17.0	45	32.3	

*$p<0.05$; FBG= Fasting blood glucose

Table 3: Type of Therapy of Studied Type2 Diabetic Patients Related to FBG Levels

	Controlled FBG (n=41)		Uncontrolled FBG (n=139)		
	No.	**%**	**No.**	**%**	***p***
Insulin	05	12.2	26	**18.7**	0.776
Insulin and oral drugs	06	14.6	26	**18.7**	0.875
Oral mono-therapy	15	36.6	36	25.9	0.320
Oral combination therapy	15	36.6	51	36.7	0.915

FBG= Fasting blood glucose

Table 4 displays antidiabetic drugs utilized by the participants. Metformin was less frequently used (alone or in combination) in poorly controlled patients, while insulin (alone or in combination with oral drugs) was more utilized. The use of the relatively new drugs such as DPP-4 inhibitors (Sitagliptin, Vildagliptin or Alogliptin) and Pioglitazone is limited in this study. The overall total use of metformin in this study is made 113/180 (62.8%).

Table 4: Antidiabetic Drugs Used by Type 2 Diabetic Patients (n=180)

Antidiabetic medications	Controlled FBG (n=41)		Uncontrolled FBG (n=139)		Total	
	No.	%	No.	%	No.	%
Insulin	05	12.2	26	18.7	31	17.2
Insulin + oral drugs	06	14.7	26	18.7	32	17.8
Metformin	10	24.4	18	13.0	28	15.6
Metformin + oral drugs	15	36.6	51	36.7	66	36.7
Sulfonylurea	03	07.3	15	10.8	18	10.0
DPP-4 Inhibitors	02	04.9	01	00.7	03	01.7
Pioglitazone	00	00.0	02	01.4	02	01.1

DPP-4=Dipeptidyl peptidase-4

Discussion

In this study, HbA1c value was not used because of relatively higher cost. Therefore, FBG more than 130mg/dl was used as the cut-off point for poor glycemic control where 77.2% of the study patients were poorly controlled. This high frequency of uncontrolled diabetes is of concern. Such finding is similar to Gopinath *et al* (2013) [12] who reported 78% of the participants with poor glycemic control. Also, Al-Qahtani *et al* (2017) [13] and Haghighatpanah *et al* (2018) [14] reported comparable finding. Moreover, this result is also approximately in line with several previous studies that came out with similar conclusions [15-19]. A study in Saudi Arabia revealed nearly similar proportion (74.9%) of uncontrolled patients to ours [19]. In the same context, another study done in Palestine found that 73% of the studied diabetics had poor glycemic control [16]. Likewise, a study conducted in Aden (2009) found 71.4% of diabetic patients were uncontrolled [15]. On the other hand, the finding of this study is more than that found by Li from China who reported that 57.3% of participants had poor control based on fasting blood glucose [20]. Similarly, Fasil *et al* (2019) revealed lower frequency of poor glycemic control in Ethiopia than our result [21].

The participants in this study had a mean age of 55.4±10.93 years which is less than that reported by Samara *et al* [16] in which the mean age was 60 ± 10 years, Al-Qahtani *et al* [13] whose mean age was 58.45±14.15 years as well as Haghighatpanah *et al* [14] and Mahmood [15]. Moreover, this finding does nearly agree with Omar *et al* from Sudan [17] and Mahmood *et al* from Yemen [3]. Moreover, in this study, 71.7% of the studied patients were in the age group 50 years and older.

The study displays that male patients constitute more than females which is in congruence with the result of Haghighatpanah *et al* [14]. Fifty-five percent of the study patients were unemployed and the majority were married and did not smoke. The unemployment affects badly the capability of the patients to buy medications and healthy food stuffs. Family history of diabetes was present by 54.4% which is in line with that reported by Alzaheb and

Altemani [19], but is less than that found by Mahmood [15]. Diabetic patients who smoke or chew khat were also present in this study but with lower figures (10.6% and 35% respectively). Al-Qahtani et al found that 7.3% of Saudi diabetic patients were smokers which seems to be almost in line with our finding [13].

In a study by Omar *et al* (2018), uncontrolled patients were unmarried which does not agree with our finding where the majority were married [17]. Moreover, the duration of diabetes of poorly controlled patients is not in line with the result of Gopinat *et al* who found two-thirds of uncontrolled patients had a duration more than ten years [12]. Taken altogether, the present study shows that being 50 years and above, married, unemployed, having sedentary life style, having family history of diabetes, duration of diabetes of ten years and less are features of poor glycemic control in this study.

Surprisingly, the study discovered that half of the uncontrolled group significantly adhered to diet, while two third of them adhered to medications which we could not find appropriate explanation for these results. In addition, almost half of the uncontrolled group used antidiabetic drugs only, while one third used antidiabetic and drugs for cardiovascular diseases. This again is unexpected. Treatment regimen strategies may require further investigation in the future.

The present study revealed a higher frequency of prescribing insulin alone or in combination with oral anti-diabetics for uncontrolled group. Since these patients were poorly controlled, it is expected to be treated with combination regimens including insulin [22]. In addition, using new drugs such as Sitagliptin, Apogliptin and Pioglitazone did not improve the blood glucose levels of these uncontrolled patients. This outcome agrees with Haghighatpanah *et al* [14].

This study also showed that metformin, which is strongly recommended as first line therapy for T2DM [23], was less prescribed for uncontrolled patients than controlled ones. On the other hand, a higher usage of metformin in this study has been noticed. Sixty-two percent of our patients were using metformin which is similar to a previous study done in Aden that reported 62% of the sample utilized metformin [2] but it is higher than that reported by Mahmood *et al*, from Aden, where 56% the study type II diabetic patients used metformin [3].

Limitation

Due to difficulties encountered measuring the height and body weight, we could not measure the body mass index of the participants in the present study.

Conclusion

A high frequency of poorly controlled T2DM patients was observed in this study. Type of medications, irregular exercise, unemployment, duration and family history of diabetes are features of uncontrolled diabetes in this study. Efforts to improve diabetic treatment outcomes could be taken into consideration in further studies.

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