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Glycemic Control and Factors Associated with It Among People with Type 2 Diabetes: A Single-Center, Cross-sectional Study from Ethiopia

ABSTRACT

Objective: This study is aimed to assess the glycemic control and factors associated with it among people with type 2 diabetes (T2D) at Debre Tabor comprehensive specialized hospital, northwest Ethiopia.

Materials and methods: Institutional-based cross-sectional study using a systematic sampling technique was conducted among 353 T2D patients from 1 September to 30 November 2021 at Debre Tabor comprehensive specialized hospital. A binary logistic regression model was fitted to identify factors associated with suboptimal glycemic control.

Results: Nearly one-fourth (23.2%) of T2D patients had suboptimal glycemic control. Duration of T2D < 1 year [adjusted odd ratio (AOR): 1.8; 95% CI: 1.33–15.4] and never being counselled about dietary habits (AOR: 1.4; 95% CI: 1.23–11.6) were positively associated whereas no family history of T2D (AOR: 0.5; 95% CI: 0.4–0.8) was negatively associated with suboptimal glycemic control.

Conclusions: This study revealed that a higher proportion of T2D patients had suboptimal glycemic control. Duration of T2D < 1 year, no family history of T2D, and never being counselled about diet habits were significantly associated with suboptimal glycemic control. Therefore, the Ethiopian Ministry of Health should design initiatives to provide continuous health education focusing on behavioral lifestyle modification. Implementation of HbA1c measurement for estimation of long-term diabetes control is also highly recommended. (Clin Diabetol 2023; 12; 3: 179–185)

Keywords: type 2 diabetes, suboptimal glycemic control, hypoglycemia, factors, Ethiopia

Background

Currently, type 2 diabetes (T2D) is an expanding global health problem, closely linked to the epidemic of obesity. Individuals with T2D are at high risk for both microvascular complications (including retinopathy, nephropathy, and neuropathy) and macrovascular complications (such as cardiovascular comorbidities), owing to hyperglycemia and individual components of the insulin resistance (metabolic) syndrome [1].

The study conducted in sub-Saharan African countries showed that about 74% of patients had suboptimal glycemic control [2]. In Ethiopia, about 80% of the respondents had uncontrolled fasting blood glucose levels [3]. The overall pooled prevalence of T2D in Ethiopia is 6.5% (95% CI: 5.8%, 7.3%) [4].

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Suboptimal glycemic control is one of the major problems that indicate a significant risk factor for the progression and complications caused by diabetes despite its main therapeutic objective for the prevention of organ damage and other complications arising from diabetes [5].

Glycemic control is affected by several factors such as female patients aged ≥ 40 years, the illiterate, and chat chewers being more likely to have suboptimal glycemic control. Moreover, longer disease duration, insulin administration, and albuminuria were significantly associated with suboptimal glycemic control. In contrast, a healthy diet, physical exercise, proper self-monitoring of blood glucose levels, and taking medicines as prescribed significantly increased the likelihood of good glycemic control [6].

The major contributory factors for suboptimal glycemic control are not well documented in Ethiopia specifically in the study area. Therefore, researching challenges and factors associated with suboptimal glycemic control among T2D patients at Debre Tabor comprehensive specialized hospital may help to identify the prevalence and root causes of suboptimal glycemic control.

Materials and methods

Study design and settings

An institutional-based cross-sectional study was conducted among T2D patients from 1 September to 30 November 2021 at Debre Tabor comprehensive specialized hospital, northwest Ethiopia. The hospital is organized into medical, surgical, pediatrics, gynecology, emergency, ophthalmology, and intensive care unit wards. Currently, it has a total of 125 inpatient beds in all wards, and 534 staff providing health care services for about 2,651,350 population. Patients who were diagnosed to have T2D, had at least 6 months follow-up, with at least three consecutive blood glucose measurements at Debre Tabor comprehensive specialized hospital were eligible to be included in the study. Newly diagnosed T2D patients, T2D patients with serious illness conditions, and psychiatric patients were excluded from the study.

Variables and measurements

The dependent variable was suboptimal glycemic control while sociodemographic variables, knowledge of T2D and self-management behavior-related factors were the independent variables.

Operational definitions

Good glycemic control: Average fasting blood glucose measurement between 70 and 130 mg/dL or HbA1c < 7% [7].

Suboptimal glycemic control: A blood glucose measurement of the three consecutive visits >130 or <70 mg/dL or HbA1c > 7% [7].

Data collection tools and procedures

The data collection tool was adopted from standardized interviewer-guided questionnaires and chart reviews by reviewing different literature [7, 8]. The interviewer-guided questionnaires consist of four parts: socio-demographic characteristics, suboptimal glycemic control related factors, self-monitoring of blood glucose (SMBG), self-management behavior of suboptimal glycemic control related factors, while chart review contains laboratory data of T2D patients. T2D patients were face-to-face interviewed and the charts of all patients were reviewed from chronic OPD accordingly to the eligibility criteria. The data collection tool was first prepared in English, translated to Amharic (the local language) then retranslated to English to check for its consistency. Three BSC nurses for data collectors and one BSC nurse for supervisors were recruited.

Data quality assurance and control

Two days of training were given for both data collectors and supervisors by the principal investigator. Before the actual data collection, a pretest was conducted on 5% of the total sample size with similar characteristics to those in the study. Based on their feedback, the necessary modification was done to the items accordingly. Moreover, the internal consistency of the questionnaires was demonstrated through the reliability analysis of Cronbach alpha value of 0.84. The data collection processes were closely supervised by the supervisor and principal investigator.

Ethics approval and consent to participate

All the ethical procedures followed the Declaration of Helsinki. Ethical clearance was obtained from the Research Ethics Committee of Debre Tabor University. Then, participants of the study were informed about the purpose of the study, the importance of their participation, and their right to withdraw at any time. Written informed consent was obtained before data collection. Participants were also informed about their right to withdraw at any time or to skip questions. Finally, the confidentiality of the information was maintained by omitting personal identifiers and using coding.

Statistical analysis

Data processing and analysis

Data were cleaned, entered into Epi data version 3.1 and exported to STATA version 14 statistical soft-

ware for analysis. Binary logistic regression analysis was computed to identify factors associated with suboptimal glycemic control. Variables with a p-value of less than 0.20 during bivariable regression were entered for multivariable logistic regression analysis. Then an adjusted odd ratio (AOR) with a 95% confidence interval and p-value < 0.05 were considered to declare the significant factors. A scatter plot was used to identify outliers and the model fitness was checked using the Hosmer-Lemeshow goodness of fit test which was 0.83. Finally, findings were presented using texts and tables.

Sample size and sampling procedure

To calculate the sample size, a previous study conducted on the proportion of patients with suboptimal glycemic control with a large proportion of similar characteristics to the current study was considered. Accordingly, the sample size was calculated using a single population proportion formula as

$$n = \frac{z\left(\frac{\alpha}{2}\right)^2 \times p(1-p)}{d^2}$$

$$n = \frac{(1.96)^2 \times 65\ (1-0.65)}{0.05^2}$$

with the assumption of 5% margin of error (d), 95% confidence level, p = 0.65 [7] and 10% non-response, n = 385.

Since the population in the study area was less than 10,000, a reduction formula was employed and the final sample size was 353. Then the study participants were selected using a systematic sampling technique.

Results

Socio-demographic characteristics of the respondents

In this study, a total of 353 type 2 DM patients were enrolled with a response rate of 100%. About 139 (41.4%) were males and the mean age of the study participants was 56.1 ± 9.6 years. More than two third (67.4%) were orthodox in religion and less than half (45%) of the study participants were government employed. The majority of the study participants (79.3%) were urban dwellers and half (50.1%) were higher education level by their educational status. Similarly, about three-fourths (75.1%) of the study participants were married, whereas more than two-thirds (68.8%) of the study participants earned a monthly income of > 96.2 USD (Tab. 1).

Table 1. Socio-Demographic Characteristics of Type 2 Diabetes (T2D) Patients at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia, 2021 (n = 353)

Socio-demographic variables	Frequency n (%)
Age	
Mean age	56.1 ± 9.6
Sex	
Female	139 (41.4)
Male	197 (58.6)
Religion	
Muslim	97 (27.5)
Orthodox	238 (67.4)
Protestant	18 (5.1)
Occupation	
Farmer	58 (16.4)
Government employee	159 (45.0)
Housewife	70 (19.8)
NGO employee	11 (3.1)
Private business	55 (15.6)
Educational level	
No formal education	54 (15.3)
Can read and write	73 (20.4)
Primary level	17 (4.8)
Secondary level	32 (9.1)
Higher education	177 (50.1)
Residence	
Rural	73 (20.7)
Urban	280 (79.3)
Marital status	
Never married	8 (2.3)
Married	265 (75.1)
Widowed	35 (9.9)
Divorced	45 (12.7)
Monthly income	
< 96.2 USD	110 (31.2)
>96.2 USD	243 (68.8)
Duration of T2D	
Mean duration of T2D	9.8 ± 3.2
Family history of T2D	
I don't know	7 (2.0)
No	194 (55.0)
Yes	152 (43.1)

Knowledge of patients on T2D

This study revealed that the overall suboptimal glycemic control was 23.2 % (95%CI: 19.0–27.5). Moreover, 43.6%, 42%, and 16.4% of study participants perceived that the cause of DM was explained by food habits, blood glucose and genetics, respectively. Likewise, 20.7%, 10.8% and 4.2% of study participants perceived that the cause of DM was explained by obesity, physical activity and medications, respectively (Tab. 2).

Table 2. Assessment of Knowledge among Type 2 Diabetes (T2D) Patients at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia, 2021 (n = 353)

Variables	Frequency n (%)
Family history of T2D	
I don't know	7 (2.0)
No	194 (55.0)
Yes	152 (43.1)
The cause of T2D	
Blood glucose	15 (4.2)
Poor food habit	154 (43.6)
Genetic	58 (16.4)
Lack of physical activity	38 (10.8)
Medication	15 (4.2)
Obesity	73 (20.7)
Aware of having T2D	
No	121 (34.3)
Yes	232 (65.7)
Aware of the diagnosis of T2D	
Blood glucose measurement	96 (27.2)
Hemoglobin A1c measurments	141 (39.9)
Aware of signs and symptoms	56 (15.9)
Aware of the presence of chronic conditions	
No	204 (57.8)
Yes	149 (42.2)
Aware of the management of T2D	
No	44 (12.5)
Yes	309 (87.5)
Aware of the types of management	
Advice	7 (2.0)
Blood glucose monitoring	22 (6.2)
Diet	7 (2.0)
Medication adherence	260 (73.7)
Physical activity	14 (4.0)
Aware of the complication of T2D	
Blood pressure	143 (40.5)
Eye problems	125 (35.4)
Heart diseases	86 (24.4)
Kidney problems	45 (12.7)
Neurological problems	54 (15.30
Aware of the history of admission by T2D	
No	309 (87.5)
Yes	44 (12.5)
Reason of admission	
High blood glucose level	39 (11.0)
Unknown diabetes	4 (1.4)
Ever gotten diabetic education	
No	45 (12.7)
Yes	308 (87.3)

Table 2 (cont.). Assessment of Knowledge among Type 2 Diabetes (T2D) Patients at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia, 2021 (n = 353)

Variables	Frequency n (%)
Area of education	
About lifestyle change	25(7.1)
How to manage hypoglycemia	28 (7.9)
Self-monitoring of blood glucose	57 (16.1)
Symptoms of hypertenssion	54 (15.3)
Symptoms of hypoglycemia	186 (52.7)
Aware of current medication	
Insulin	64 (18.1)
Insulin and other oral hypoglycemic agents	26 (7.4)
Metformin	151 (42.8)
Metformin, glibenclamide	109 (30.90
Metformin, insulin	3 (0.8)

Chart review of laboratory data of T2D patients

The mean triglyceride level (TRG) and cholesterol were found to be 116.2904 ± 24.38062 mg/dL and 149.1385 ± 32.55132 mg/dL respectively. The majority (86.7%) had normal ≤ 150 (TG) and few of the study participants (4.8%) had a high cholesterol level of ≥ 200 mg/dL. The mean (SD) of uric acid level, BUN, AST, and ALT was 3.8808 ± 1.72571 mg/dL, 13.6663 ± ± 5.61604 mg/dL, 27.8275 ± 7.77306 u/L, and 1.0 ± ± 0.0 u/L), respectively (Tab. 3).

Self-management behavior of glycemic control

The current study revealed that 215 (60.9 %) of the study participants were observed to be adhered to instructions for diet habits. More than half (55%) of the patients were engaged in physical exercise. Moreover, 91 (25.8 %), 52 (14.7 %), and 51 (14.4 %) of the study participants were involved in physical exercise with a frequency of > 5 times, < 2 times, and 2–5 times per week respectively. Whereas, about 282 (77.3%) study participants monitored their blood glucose levels at health institutions by themselves during the last seven days preceding the study (Tab. 4).

Factors associated with suboptimal glycemic control

Variables with a p-value less than 0.2, such as the occupational status of the study participants, housewife duration of T2D < 1 year, no family history of T2D and never being counselled about healthy diet were candidates for multivariable analysis.

Table 3. Document Review Data of Biochemical Parameters of the Study Participants at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia, 2021 (n = 353)

Laboratory test profiles	Frequency n (%)
Fasting blood glucose	
< 70 mg/dL	2 (0.6)
70–125mg/dL	54 (15.3)
≥ 126 mg/dL	297 (84.1)
Triglycerides [mg/dL]	
> 150 (high)	47 (13.3)
≤ 150 (normal)	306 (86.7)
Total cholesterol [mg/dL]	
≥ 2000 (high)	47 (13.3)
< 200 (normal)	306 (86.7)
HDL [mg/dL]	
< 40 (risk)	17 (4.8)
> 40 (normal)	336 (95.2)
LDL [mg/dL]	
>100 (high)	61 (17.3)
< 100 (normal)	292 (82.7)
Uric acid	
3.5–7.2 mg/dL (normal)	77 (21.8)
< 3.5 mg/dL (low)	232 (65.7)
7.2 mg/dL (high)	44 (12.5)
Albumin	
Albuminuria	350 (99.2)
Normal	3 (0.8)
MCHC [g/dL]	
33.4–35.5 (normal)	64 (18.1)
< 33.4 (low)	286 (81.0)
> 35.5 (high)	3 (0.8)

HDL — high-density lipoprotein; LDL — low-density lipoprotein; MCHC — mean corpuscular hemoglobin

Table 4. Self-Management Behavior of Suboptimal Glycemic Control among T2D Patients at Debre Tabor Comprehensive Specialized Hospital, Northwest Ethiopia, 2021 (n = 353)

Variables	Frequency n (%)
Food to strictly exclude from the daily food menu	
Alcohol	9 (2.5)
Banana	27 (7.7)
Cabbage	9 (2.5)
Honey	144 (40.8)
Potatoes	19 (5.4)
Glucosey food	136 (38.5)
Wheat bread	9 (2.5)
Engaging in physical exercise	
No	159 (45.0)
Yes	194 (55.0)
Frequency of physical activity/week	
< 2 times/week	52 (14.7)
> 5 times/week	91 (25.8)
2–5 times/week	51 (14.4)
Monitor your blood glucose	
No	80 (22.7)
Yes	273 (77.3)
Miss medication	
No	282 (79.9)
Yes	71 (20.1)
Frequency of missing medication/month	
< 2 times/week	16 (4.5)
> 5 times/week	26 (7.4)
2–5 times/week	12 (3.4)
Regularly inspect and care for your foot	
No	80 (22.7)
Yes	273 (77.3)

However, duration of T2D < 1 year, no family history of T2D, and never being counselled about a healthy diet were significantly associated with suboptimal glycemic control.

The odds of suboptimal glycemic control was 1.8 times (AOR: 1.8; 95% CI: 1.33–15.4) higher among patients with a duration of T2D < 1 year compared to patients with a duration of T2D > 10 years.

The odds of suboptimal glycemic control was 50% (AOR: 0.5; 95% CI: 0.4–0.8) lower among patients who have no family history of T2D compared to those having a family history of T2D. Likewise, the odds of suboptimal glycemic control was 1.4 times (AOR: 1.4; 95% CI: 1.23–11.6) higher among patients who were not counselled about diet habits compared to their counterparts.

Discussion

The current study revealed that the overall suboptimal glycemic control was 23.2 % (95% CI: 19.0–27.5). This value was lower as compared with the study conducted in sub-Saharan Africa where 70% of patients with T2D failed to achieve good glycemic control (HbA1c < 7%) [9]. The difference might be due to differences in study design, lifestyle, and socioeconomic status.

This finding was also lower as compared with the study done in Ayder comprehensive specialized hospital, Ethiopia which showed that 61.9% of the study participants had suboptimal glycemic control [10]. The difference might be due to socioeconomic status, access to health care, healthcare utilization and use of medication.

The current study revealed that 60.9 % of the study participants had adequate healthy eating plans during the previous week before the study. This finding was higher than the study conducted in Jimma, Ethiopia where 22.9% of study participants had adequate healthy eating plan during the previous week before the study [11]. This inconsistency might be due to differences in the delivery of life modification counselling in the two settings.

In this study, it is shown that more than half of the study participants were engaged in physical exercise. This finding was higher than the study conducted in Jimma, Ethiopia where 22% of study participants were involved in physical activity for more than 3 days during the last seven days preceding the study. This difference might be because of the existence of differences in providing education about the importance of physical exercise to control the glycemic level.

This study revealed that the odds of suboptimal glycemic control was 1.8 times higher among patients with a duration of T2D < 1 year compared to patients with a duration of T2D > 10 years. This finding was inconsistence with the study conducted in Jordan which showed that increased duration of DM was associated with increased odds of suboptimal glycemic control [12]. This inconsistency might be due to differences in exposure to medication and experience and counselling regarding glycemic control.

Moreover, this study showed that the odds of suboptimal glycemic control was 1.4 times higher among patients who were not counselled about diet habits compared to their counterparts. This finding was similar to the study conducted in Jordan where the odds of suboptimal glycemic control was 2.98 times higher among patients who were not counselled about diet habits compared to those who were counselled [12]. This similarity might be due to the similarity in delivering awareness creation for the patients in both countries.

The odds of suboptimal glycemic control was 50% lower among patients who had no family history of T2D compared to those having a family history of T2D. This study was congruent with a systematic review and meta-analysis study conducted in Ethiopia which showed that those participants who had a family history of DM were 6.14 times more likely to have suboptimal glycemic control as compared to their counterparts [4]. Similarly, studies conducted in different places in Ethiopia also supported our results [13–15]. The observed similarity might be attributed to the genetics of diabetes passed from parents and also attributed to shared behavioral risk factors among the families.

Limitation

Because the study used a cross-sectional study design, no causal link could be made between the independent and dependent variables. Finally, recall bias may constrain the subjective nature of some self-reported responses.

Conclusions

This study revealed that about one-fourth of T2D patients had suboptimal glycemic control. Moreover, the duration of T2D < 1 year and ever not being counselled on diet habits were a positive predictor of suboptimal glycemic control whereas having no family history of T2D was a negative predictor of suboptimal glycemic control. Therefore, the Ethiopian Ministry of Health should design initiatives to provide continuous health education focusing on behavioral lifestyle modification like physical activity and dietary modifications to adhere patients to the glycemic control measures. Furthermore, patients should take appropriate self-intervention. Implementation of HbA1c measurement in the routine follow-up of DM patients as a tool for estimation of long-term diabetes control is also highly recommended.

Availability of data and materials

Data will be available upon reasonable request from the corresponding author.

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Conflict of interests

None declared.

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