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Poor glycemic control and its associated factors among diabetes patients attending public hospitals in West Shewa Zone, Oromia, Ethiopia: An Institutional based cross-sectional study

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ABSTRACT

Purpose: Diabetes mellitus (DM) is increasing at an alarming rate throughout the world and its complications of has become a major public health concern in all countries. Glycemic control is the most important predictor for DM related complications and deaths. However information on glycemic control remains scarce in Ethiopia including our study area. Hence, the aim of this study was to assess the magnitude and factors associated with poor glycemic control among diabetic outpatients at West Shewa public Hospitals, Ethiopia.

Methods: A facility-based cross-sectional study was conducted from June 01 to September 30, 2020. Poor glycemic control was assessed by glycated hemoglobin level and a systematic random sampling method was employed to select participants. An interviewer-administered structured questionnaire was used and the data entered into Epi data version 3.1 and exported into SPSS version 22 for analysis. Logistic regression was conducted to identify predictors of poor glycemic control. A p-value of <0.05 was considered statistically significant.

Results: A total of 390 participants were involved in the study with mean age of 46.45 ($\pm$15.6) years. The study finding showed that the prevalence of poor glycemic control was found to be 63.8%. Age of $\geq$50 years (AOR = 2.77; 95% CI: 0.15,0.85), being single (AOR = 2.55; 95% CI: 0.179,.857), having high low-density lipoprotein cholesterol (AOR = 3.44; 95% CI: 1.65, 7.12), being female gender (AOR = 2.4; 95%CI: 0.31,0.816), alcohol intake (AOR = 1.88; 95% CI: 1.135, 3.1) and presence of diabetic peripheral neuropathy (AOR = 1.24; 1.1,1.39) were associated with poor glycemic control.

Conclusion: About two-thirds of participants had poor blood glucose control. Increased age, high low-density lipoprotein cholesterol, family history of diabetes, being single, being female, diabetic peripheral neuropathy and alcohol intake were associated with poor glycemic control. Hence, effort should be made towards reducing these factors among DM patients by the concerned body.

1. Introduction

Diabetes mellitus (DM) is a common metabolic disorder caused by deficiency in insulin secretion, action or both [1]. It is one of the largest global health emergencies of the 21stcentury [2]. According to global estimate of DM in 2015, the number of people live with DM aged 20–70 years was predicted to rise to 642 million by 2040 (3). The burden of DM is higher in developing countries where screening and access to care are not readily available (4). Likewise, in Ethiopia, the world health organization DM country profile in 2016 revealed that the overall prevalence of DM was 3.8% [5].

For a successful control of long-term diabetic complications, optimal glycemic control is paramount. Glycemic control (GC) is a term which refers to the optimal levels of blood glucose in a people living with DM (6). The American Diabetes Association (ADA) indicated glycosylated hemoglobin (HbA1c) as best measure of GC, as a goal of optimal blood glucose control to prevent complications and decrease its management cost (7).

Despite the evidence from several studies establishing the benefits of intensive DM management in chronic complications, high proportion of patients remain poorly controlled (8). In Africa, study in Cameron and Guinea reported 74% and in Tanzania 69.7% of DM patients had poor GC [8,9]. In Ethiopia, a study done in Mettu Karl Referral Hospital and Tikur Anbessa Specialized hospital reported 72.7% and 80% of DM

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patients had poor GC respectively (10,11).

Identification of the factors related with poor GC is vital in order to institute appropriate interventions for improving GC. Previous studies revealed that the GC is affected by ethnicity, age, sex, education, employment status, marital status, body mass index, smoking status, diabetes duration, presence of comorbidities, non-adherence and type of medications used (12).

GC is the corner stone in managing the DM. According to the International Diabetes Federation and the ADA guidelines, HbA1c value is the most recommended monitoring parameter for appropriate GC [1]. However, studies on the assessment of GC using HbA1c in Ethiopia including our study area very scarce, majority included only type 2 DM patients and there is inconsistencies between its associated factors. Therefore, the aim of this study was to assess the prevalence and factors associated with poor GC among adult diabetic outpatients at West Shewa public hospitals, Ethiopia.

2. Methods and materials

2.1. Study area, design and study period

An institution based cross-sectional study was conducted from June 01 to September 30, 2020 among 390 diabetic patients attending their follow-up at chronic illness clinic of West Shewa zone public hospitals, Ethiopia. The total population of the West Shoa Zone is estimated to be 2,058,676 of which 1,028,501 are males and 1,030,175 are females in 2018/2019. In this zone, there were 520 health posts, 92 health centers, and 8 hospitals. The Hospitals were Ambo referral Hospital, Ambo general hospitals, Gendeberet general hospital, Bako Primary hospital, Jaldu Primary hospital, Enchini Primary hospital, Gudar Primary hospital and Gedo general hospitals.

These hospitals provide internal medicine, chronic illness care laboratory, radiology, dental and pharmacy, pediatrics, family planning, maternity, gynecologic/obstetric, surgery, emergency, ambulatory clinic TB and HIV services to the people in the zone. Ambo General Hospital and Ambo University Referral Hospital is located at the center of Ambo town, which is the capital of the zone and around 114 km far from the center of the country Addis Ababa to the West.

2.2. Eligibility criteria

Diabetic patients with age ≥18 years on treatment for at least six months were included, while patients with critical illness who unable to communicate at the time of data collection, patients with hearing problem, psychiatric illness and gestational diabetes were excluded.

2.3. Sample size determination

The sample size was calculated using a single population proportion formula with 95% confidence interval, 64.1% [13] proportion and a margin of error 5% i.e. $N = \frac{(z\alpha/2)2\ p\ (1-p)}{d2} = \frac{(1.96)2\ 0.641\ (1-0.641)}{(0.05)(0.05)} = 354$ and by adding 10% for nonresponse the final sample size was 390.

2.4. Sampling technique and procedure

There are eight public hospitals in West Shewa Zone. Accordingly, Ambo University Referral Hospital was selected purposively due to it serves majority of patients in the zone, and the other three hospitals (Ambo General Hospital, Gedo General Hospital and Guder general hospital) were selected randomly. Then, the samples will be proportionally allocated for each hospital (Table 1). The study subject from each selected hospitals was taken by systematic random sampling by using their medical record number as sampling frame.

Table 1
Proportional allocation of sample size to randomly selected hospitals at West Shewa public hospitals, Ethiopia, 2020.

Selected hospitals	No of population	Proportionally allocated samples
Ambo general hospital	1200	109
Ambo University referral hospital	1500	136
Guder primary hospitals	600	54
Gedo general hospital	1000	91
Total	4300	390

2.5. Data collection tool and procedures

Data were collected by face to face interview using pretested structured questionnaire which was adapted after reviewing several related literatures (10, 11, 14–16). Data were collected by health professionals: three trained BSc nurses, one laboratory technologist and one health officer who served as a supervisor.

Weight scale, sphygmomanometer and stadiometer were used to measure weight, blood pressure and height respectively. Height was measured to the nearest centimeter (cm) using a stadiometre with the study participants standing erect on the floor with the back against a vertical mounted ruler. Weight of the participants were measured on a standardized scale and body mass index (BMI) was calculated by dividing weight by height square. Blood pressure (BP) was measured by sphygmomanometer after the participants had rested for 10 min. For those study participants with a systolic blood pressure (SBP) of ≥140 mmHg and a diastolic blood pressure (DBP) of ≥90 mmHg, BP was repeated and finally the mean of the two measurements was taken. Diabetic peripheral neuropathy was assessed by Michigan Neuropathy Screening Instrument.

2.6. Biochemical measurements

Blood sampling consisted of drawing 3 ml of blood from the antecubital vein under aseptic conditions using plain vacationer tubes will be obtained after an overnight fast (≥8hrs). The blood samples will left at room temperature to allow clotting for 15–20 min and centrifuged at 3000 rpm for 10 min. The levels of glucose, total cholesterol (TC) and triglycerides (TG) measured by COBAS c 311 chemistry analyzer (Roche diagnostic Germany). All laboratory measurements were done as per guideline.

2.7. Operational definitions

Poor glycemic control: was defined as when average glycated hemoglobin level of ≥7%.

Good glycemic control: In our study context when the average glycosylated hemoglobin was <7%.

Alcohol consumption: if reported consumption of alcohol twelve-month prior to the study.

Hypertension: patients whose systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg or use of antihypertensive medication irrespective of the current BP were considered as hypertensive.

Diabetic peripheral neuropathy: was present in our study context if the patient's history version of MNSI questionnaire score was ≥7 abnormal responses in the legs and/or if the lower extremity examination version of MNSI scores was ≥2.5.

2.8. Data processing and analysis

Data were checked for completeness manually, coded and entered into Epi data software version 3.1. Then it was exported to SPSS software version 22 for the analysis. Measures of central tendency and dispersion for continuous variables were computed. Frequency distribution was

employed for categorical variables.

Bivariable analysis was employed to determine association between poor GC and each independent variable. Variables that were found significant at p-value< 0.25 in bivariable logistic regression analysis were selected as candidate variables for multivariable logistic analysis. Multicollinearity diagnosis was done by checking variance inflation factor greater than 10% and there were no problems with multicollinearity. Multivariable analysis was carried out to identify independent predictors of poor GC and to control confounders. Backward stepwise logistic regression was used to determine independent predictors with p-value less than 0.05 with their respective AOR and 95% of CI. The model fitness was tested by using Hosmer and Lamshow goodness of fit test and the model was declared fit (P > 0.05).

2.9. Data quality assurance

The questionnaire were translated from English language to local language and translated back to English language to check its consistency. Two days training was given for supervisor and data collectors on how to approach study subjects, handling of biological samples and sample collection. Pretest was done on 5% of sample size in Holeta Hospital to check clarity and internal consistency with Cronbach's Alpha 76.4% of the questionnaire and checklist prior to the actual data collection. Some modifications were made based on the result of the pretest. The equipment for measuring height, weight and blood pressure were calibrated to the standard before measuring each participant. Completeness, accuracy, clarity and consistency of data were checked daily after data collection time by supervisor and the overall activities were monitored by principal investigator. A consistency was tested by a double-entry method and inconsistent entries were crosschecked.

Standard operating procedure was used for all laboratory analysis of blood samples. The Internal quality control materials for each lipoproteins (HDL-C, LDL-C, TG, and TC) and HbA1c were included during running each test. The tests were conducted based on the manufacturers' instruction. The quality assurance principles for pre-analytical, analytical and post-analytical stages were applied to assure the quality result. Those intermediate results were repeatedly checked. Visual inspections of neatness of the lab and working bench performed to avoid cross contamination. There was properly recording of the daily result and daily follow up by principal investigator.

a. Pre-analytical phase

The qualities of samples were assured starting from the time of collection. Fasting blood samples collected aseptically by applying universal safety precautions. Proper labeling and storage of blood samples were assured. After collected and packing, all samples shipped to the Ambo University Referral Hospital Laboratory and stored at -20 °C refrigerator. Monitoring the refrigerator temperature of -20 °C made as a daily work. Assembling and sorting all the required material for the work and the neatness of lab and working bench were assured before sample analysis began.

b. Analytical phase

Based on the manufacturers' instruction, all blood samples were analyzed for lipid profiles, HbA1c, and FBS by COBAS-C-311-chemistry analyzer (Roche diagnostic Germany) automation. The reagents and the test method were assessed with a known control materials. The internal quality control materials for each lipoproteins (HDL-C, LDL-C, TG, and TC), HbA1c and FBS were run in each test. The standard laboratory procedure was followed and the analysis process was monitored by principal investigator.

c. Post-analytical phase

The results were recorded in a registration book with the individual's bar-code in daily work. In order to avoid the errors in the results of the test, the reporting was repeatedly checked before. The quality assured results was reported to the principal investigator.

3. Results

3.1. Socio-demographic characteristics

During the study period, 390 diabetic patients participated in the study and the mean age was 46.45 years (±15.6). Almost half of the respondents were males (50.8%), more than three-fourth was married (76.4%) and majority of participants was urban dwellers (62.3%). Many of the respondents (51.3%) were orthodox, one-third (31.5%) were governmental employee. Regarding participant educational status, one-fourth (23.8%) of them had primary education. About 105 (26.9%) of study participants were recall family history of DM (Table 2).

3.2. Clinical and behavioral characteristics of participants

Among study participants, majority (80.5%) of them was diagnosed with diabetes for less than 10 years. A total of 201 (51.5%) study participants were in the normal category of BMI, whereas 126 (32.3%) of the participants were overweight.

Among the total participants, more than half (56.9%) used a non-insulin drug and 129 (33.1%) were on insulin and majority of 353 (90.5) had not used statin. In regard to the laboratory investigations a 16.7% had elevated low-density lipoproteins cholesterol (LDL-c), 114 (29.2%) had elevated total cholesterol (TC) and 247 (63.3%) had elevated triglycerides and 187 (47.9%) had lowered high-density lipoproteins cholesterol (HDL-c) (Table 3).

3.3. Prevalence of poor glycemic control among diabetic patients

The overall prevalence of the prevalence of poor glycemic control (PGC) was 63.8% [95%CI: 59.0, 68.5] among the study population. Among this, the prevalence of PGC among type one and type two diabetes patients was found to be 66(59.5%), 183 (65.6%) respectively.

3.4. Factors independently associated with poor controlled glycemia

On bivariate evaluation, twelve variables like age, sex, education level, marital status, physical exercise, history of hypertension, history of alcohol consumption, statin treatment, treatment regimen, family History of DM, LDL-C and presence of diabetic peripheral neuropathy (DPN) showed evidence of some association with the outcome at a p-value of <0.25, hence included in the multivariable logistic regression analysis.

The factors that were identified to be significantly associated with the poor GC were; increased age, High LDL-c, family history of DM, being female, presence of DPN, being single and alcohol consumption. Participants in their 5thdecade (50 and above years) were 2.77 times more likely to develop PGC compared to patients younger than 30 years (AOR = 2.77; 95% CI: 0.15, 0.85) controlling for all other factors in the model. Those participants who were single were 2.55 times more likely to develop PGC than their counterpart (AOR = 2.55; 95% CI: 0.179, 0.857) after controlling for other variables. Participants who were female were 2.4 times more likely to develop PGC than male participants (AOR = 2.4; 95% CI: 0.31, 0.816).

Similarly, those participants who had high LDL-C were 3.44 times more likely to develop PGC than counterpart (AOR = 3.44; 95% CI: 1.65, 7.12). Those participants who consume alcohol were 1.88 times more likely to develop PGC than counterpart (AOR = 1.88; 95% CI: 1.135, 3.1) after controlling for other variables. Participants with family history of DM were 2.9 times more likely to develop PGC than who haven't family history of DM (AOR = 2.9; 95%CI: 1.763, 4.77). Finally Patients

Table 2
Socio-demographic characteristics of patients and prevalence of poor controlled glycemia of participants with diabetes mellitus, West Shewa, Ethiopia, 2020 (n = 390).

Variables	Category	Number	Percent	Outcome of Glycemic Control	
				A1c ≥ 7% (%)	A1c <7% (%)
Sex	Male	198	50.8	58 (70.7%)	140 (29.3%)
	Female	192	49.2	109 (56.8%)	83 (43.2%)
Age (Year)	Mean (SD)	46.45 (15.67)			
Average monthly income (ETB)	Under 30	70	17.7	24 (34.3%)	46 (65.7%)
	30–39	59	15.1	23 (39.0%)	36 (61.0%)
	40–49	97	24.9	49 (50.5%)	48 (49.5%)
	50 and above	164	42.1	96 (58.5%)	68 (41.5%)
	<1000	87	22.3	54 (62.1%)	33 (37.9%)
	2000–2999	27	6.9	19 (70.4%)	8 (29.6%)
	>3000	193	49.5	126 (65.3%)	67 (34.7%)
Marital status	Married	298	76.4	197 (66.1%)	101 (33.9%)
	Single	73	18.7	41 (56.2%)	32 (43.8%)
	Divorced	13	3.3	6 (46.2%)	7 (53.8%)
	Widowed	6	1.5	5 (83.3%)	1 (16.7%)
Religion	Orthodox	199	51.0	128 (64.3%)	71 (35.7%)
	Protestant	154	39.5	100 (64.9%)	54 (35.1%)
	Muslim	22	5.6	14 (63.6%)	8 (36.4%)
	Wakefata	12	3.1	5 (41.7%)	7 (58.3%)
	Others	3	.8	2 (66.7%)	1 (33.3%)
Educational status	Can't read and write	85	21.8	58 (68.2%	27 (31.8%)
	Only Read & Write	28	7.2	22 (78.6%)	6 (21.4%)
	primary education [1–8]	93	23.8	56 (60.2%)	37 (39.8%)
	Secondary education [9–12]	70	17.9	43 (61.4%)	27 (38.6%)
	Level I-IV and Diploma	52	13.3	32 (61.5%)	20 (38.5%)
	Degree and above	62	15.9	38 (61.3%)	24 (38.7%)
Occupational status	House wife	55	14.1	32 (58.2%)	23 (41.8%)
	Gov't Employee	123	31.5	72 (58.5%)	51 (41.5%)
	Non-Gov't Employee	32	8.2	22 (68.8%)	10 (31.3%)
	Student	33	8.5	16 (48.5%)	17 (51.5%)
	Merchant	41	10.5	26 (63.4%)	15 (36.6%)
	Daily laborer	11	2.8	8 (72.7%)	3 (27.3%)
	Farmer	95	24.4	73 (76.8%)	22 (23.2%)
Residence	Rural	147	37.7	98 (66.7%)	49 (33.3%)
	Urban	243	62.3	151 (62.1%)	92 (37.9%)
Family History of Hypertension	Yes	83	21.3	58 (69.9%)	25 (30.1%)
	No	307	78.7	191 (62.2%)	116 (37.8%)
Family History of DM	Yes	105	26.9	64 (61.0%)	41 (39.0%)
	No	285	73.1	185 (64.9%)	100 (35.1%)

with DPN were 1.24 times more likely to develop PGC than their counterparts (AOR = 1.24; 1.1,1.39) (Table 4).

4. Discussion

The main goal of DM management is to ensure optimal GC in order to prevent and delay its complications. Poor GC is a main health problem that significantly contributes to the development of DM-related complications. The current study intended to assess the prevalence of poor GC and its associated factors in adult DM patients on follow-up at Public hospitals in West Shewa, Ethiopia. In this study 63.8% [95%CI: 59.0, 68.5] of the study subjects had poor GC which was in line with studies done in Gondar, Ethiopia 64.7% [14], Ayder, Ethiopia 61.9% [15], Shenan Gibe, Southwest Ethiopia 59.2% [16] and in Morocco 66.3% [17]. The finding of the current study highlights the need to do more on optimal management of DM.

However, the current study was lower than other studies conducted in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia 80% [10], Mettu, Ethiopia 72.7% [11], Debra Tabor, Ethiopia 71.4% [18] and South of the Sahara 74% [19]. The possible reasons for those discrepancies could be due to differences in study population, sample size and the method used to assess the glycemic level. Similarly the current finding was higher than studies conducted in in Nigeria 50.1% [20], 12.9% in United States [21] and china 50.3% [22]. The possible reason for this difference could be due to a difference in the available health care service, behavioral and clinical characteristics of the patients and the difference in health insurance coverage.

The findings obtained from the multivariable logistic regression analysis showed that increasing age, High LDL-c, family history of DM, being female, diabetic peripheral neuropathy, being single and alcohol consumption were significantly associated with poor glycaemic control. Of these seven factors, family history, age and sex are non-modifiable risk factors which raise the likelihood of poorly controlled diabetes.

The study revealed that family history of DM was significantly associated with poor GC. This finding is consistent with the other similar studies [18,23]. The probable reason might be DM has inherent genetic risk factors which have the ability to influence its severity and duration [24].

The current study also found high LDL-c is significantly associated with poor GC. This finding is in agreement with previous similar study done in Ayder comprehensive hospital, North Ethiopia [15]. This might be explained by the fact that chronic entry of fatty acids into β-cells is supposed to be involved in its pathogenesis and cause pancreatic β-cell failure ensuing in poor GC [25].

Furthermore, our study shown that patients with insufficient physical activities had poor GC, which is consistent with prior studies done in Saud Arabia and Jimma, Ethiopia [23,26,27]. The possible justification might be due to having inadequate knowledge about use of physical exercise and fear of hypoglycemia. Besides, physical exercise has not

Table 3
Clinical and behavioral characteristics of patients and prevalence of Poor Controlled Glycemia of participants with diabetes mellitus, West Shewa, Ethiopia, 2020 (n = 390).

Variables	Category	Number	Percent	Outcome of Glycemic Control	
				A1c ≥ 7% (%)	A1c<7% (%)
Diabetes Mellitus Type	T1DM	111	28.5	66 (59.5%)	45 (40.5%)
	T2DM	279	71.5	183 (65.6%)	96 (34.4%)
Duration of DM	<5yrs	207	53.1	130 (62.8%)	77 (37.2%)
	5–10yrs	107	27.4	68 (62.6%)	40 (37.4%)
	≥10yrs	76	19.5	52 (68.4%)	24 (31.6%)
Treatment regimen	Oral hypoglycemic agents	222	56.9	142 (64.0%)	80 (36.0%)
	Injection (Insulin)	129	33.1	83 (64.3%	46 (35.7%)
	Oral and injection	39	10.0	24 (61.5%)	15 (38.5%)
Statin treatment	Yes	37	9.5	22 (59.5%)	15 (40.5%)
	No	353	90.5	227 (64.3%)	126 (35.7%)
BMI (kg/m2)	Low (<18.5)	22	5.6	16 (35.7%)	6 (27.3%)
	Normal (18.5–24.9)	201	51.5	124 (61.7%)	77 (38.3%)
	Overweight (25–29.9)	126	32.3	82 (65.1%)	44 (34.9%)
	Obese (≥30)	41	10.5	27 (65.9%)	14 (34.1%)
Hypertension	Yes (≥140/90)	169	43.3	117 (69.2%)	52 (30.8%)
	No (<140/90)	221	56.7	132 (59.7%)	89 (40.3%)
Alcohol intake	Yes	133	34.1	80 (60.2%)	53 (39.8%)
	No	257	65.9	169 (65.8%)	88 (34.2%)
Smoking status	Yes	47	12.1	32 (68.1%)	15 (31.9%)
	No	343	87.9	162 (47.2%)	181 (52.8%)
Vigorous-intensity aerobic physical activity	Yes (≥75–150 min/week)	118	30.3	77 (65.3%)	41 (34.7%)
	No (<75–150 min/week)	272	69.7	172 (65.1%)	100 (36.8%)
Moderate-intensity aerobic physical activity	Yes(≥150–300 min/week)	141	36.2	97 (61.7%)	54 (38.3%
	No (<150–300 min/week)	249	63.8	162 (65.1%)	87 (34.9%)
Total cholesterol	<200 mg/dl (Normal)	276	70.8	169 (61.2%)	107 (38.8%)
	≥200 mg/dl (High)	114	29.2	80 (70.2%)	34 (29.8%)
Triglyceride	Normal (<150 mg/dl)	143	36.7	95 (66.4%)	48 (33.6%)
	High (≥150 mg/dl)	247	63.3	154 (62.3%)	93 (37.7%)
HDL-C	Normal (>60 mg/dl)	203	52.1	98 (68.0%)	32 (65.7%)
	Low (≤60 mg/dl)	187	47.9	111 (59.4%)	46 (40.6%)
LDL-C	Normal (<130 mg/dl)	325	83.3	196 (60.3%)	129 (39.7%)
	High (≥130 mg/dl)	65	16.7	53 (81.5%)	(18.5%)

only been reported to raise GC, but also to boost a patient's insulin sensitivity and to repair some of the damage caused by DM associated complications, such as impaired cardiovascular health [28].

In this study, poor glycemic control is appeared to be greater among patients with age ≥50 years compared to patients with age <30 years of age. This finding is comparable with other study conducted in Nekemte, Ethiopia [29] and Dar es Salaam, Tanzania [9]. The relationship between poor glycemic control and age could be due to older age group might have longer diabetes duration than the younger age group. Longer duration of DM is related with poorer GC, probably due to progressive β-cell impairment and decreased insulin secretion [30].

In line with a study carried out by Demoz GT et al. [31]in our study, being female gender was also found predictor of poor GC. The possible reason might be due to Ethiopian female might not attend their follow-up therapy as needed as male due to additional workload in home and thus be less likely to follow their drug therapy attentively.

In agreement with study done in Sudan, current study finding revealed that being single were significantly associated with poor GC [32]. Possible reason might be due to married patients were expected to have better support from their spouses in terms of adherence to recommended nutrition, clinic attendance and prescribed medications. But, perhaps single patients might lack the adequate/sufficient care of the family and have poor GC.

Moreover, in agreement with one study this study found that alcohol consumption was significantly associated with poor GC [33]. However, other studies [34,35] report alcohol consumption improves GC. Hence, this conflicting association should be confirmed by further better studies.

Finally, in agreement with study done in India and Ambo the current study revealed that presence of diabetic peripheral neuropathy was significantly associated with poor GC [36,37]. The possible reason might be due to presence of comorbidity including diabetic peripheral neuropathy predisposes patients to low adherence to the medication due to increasing the pill burden to the patient.

4.1. Limitation of the study

The study was cross-sectional study design, where causal relationship between the independent and dependent variables cannot be established. Finally, the subjective nature of self-reported response for some items might be limited by recall bias.

5. Conclusion

Overall, the findings from the current study indicate that glycemic control in DM is generally poor. Increasing age, high LDL-c, family history of DM, being female gender, diabetic peripheral neuropathy, being single and alcohol consumption were significantly associated with poor GC. Thus, effort should be made towards reducing modifiable factors to improve GC by the concerned body.

Ethical approval

Ethical clearance was obtained from the academic research directorate of Ambo University, College of Health Science and Medicine, and the official letter of cooperation was written to the respective health facility heads and permission letters were obtained from the respective health facility heads. Written informed consent was obtained from all the study subjects before participating in to the study. All the information was kept confidential and the study was done as per the ethical guidelines of the Declaration of Helsinki.

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There was no funding for this study.

Table 4
Factors associated with PGC among diabetic patients at public hospitals West Shewa, Ethiopia, 2020 (n = 390).

Variables	Category	GC (n)		Bivariable analysis			Multivariable analysis		
		Yes	No	P-value	COR	(95% CI)	P-value	AOR	(95% CI)
Sex	Female	140	58	0.014	0.468	0.255, .857	0.002	2.4	0.31,0.816
	Male	109	83	1	1	1	1	1	1
Marital status	Married	197	101	1	1	1	1	1	1
	Single	41	32	0.044	0.34	0.125, 0.97	0.019	2.55	0.179, .857
	Divorced	6	7	0.054	0.24	0.055, 1.02	0.129	0.382	0.110 1.3
	Widowed	5	1	0.027	19.47	1.41, 268	0.086	7.696	0.75, 79.26
Age (year)	Under 30	24	46	1	1	1	1	1	1
	30–39	23	36	0.013	.231	. 072, .77	.918	0 .94	0.307 2.89
	40–49	49	48	.038	1.96	.110, 1.668	0.130	1.7	0.292, 1.171
	50 and above	96	68	0.010	0.157	. 039,.67	0.021	2.77	0.15,0.85
Alcohol intake	Yes	97	72	0.112	2.117	0.839, 5.34	0.014	1.888	1.135, 3.1
	No	95	126	1	1	1	1	1	1
Family History of DM	Yes	68	37	0.224	1.489	0.784	0.000[a]	2.900	1.763, 4.770
	No	124	161	1	1	1	1	1	1
Family History of Hypertension	Yes	53	30	0.075	0.525	.258,1.06	0.099	0.620	0.351, 1.09
	No	139	168	1	1	1	1	1	1
Physical activity	Yes	87	54	1	1	1	1	1	1 1
	No	162	87	0.604	1.307	0.476, 3.589	0.047	1.7	0.33, 0.99
LDL-C	Normal	124	145	1	1	1	1	1	1
	High	68	53	0.002	4.043	1.67, 9.759	0.001	3.44	1.65, 7.12
DPN	No	59	82	1	1	1	1	1	1
	Yes	133	116	0.025	1.234	1.03,1.8	0.000[a]	1.24	1.103,1.39

[a] Value statistically significant; AOR: adjusted odds ratio; COR-Crude odds ratio, 1: reference.

Declaration of conflicting interests

The authors declare that they have no competing interests.

CRediT authorship contribution statement

Daba Abdissa: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Writing – original draft, Writing – review & editing. **Delessa Hirpa:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Writing – original draft, Writing – review & editing.

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List of abbreviations

ADA	American Diabetes Association
AOR	Adjusted Odds Ratio
BMI	Body Mass Index
CI	Confidence in Interval
COR	Crude Odds Ratio
CVD	Cardiovascular Disease
BP	Blood Pressure
DPN	Diabetic peripheral neuropathy
DM	Diabetes Mellitus
ETB	Ethiopian Birr
GC	Glycemic control
HbA1c	Glycated Hemoglobin
HTN	hypertension
PGC	poor glycemic control

References

[1] American Diabetes Association. 2. Classification and diagnosis of diabetes: standards of medical care in diabetes—2018. Diabetes Care 2018 Jan 1;41 (Supplement 1):S13–27.
[2] International Diabetes Federation. IDF Diabetes atlas. 7th edtn. International Diabetes Federation; 2015. p. 11–31. Available from, https://www.diabetesatlas.org/upload/resources/previous/files/7/IDF%20Diabetes%20Atlas%207th.pdf.
[3] Atlas ID. Global estimates for the prevalence of diabetes for 2015 and 2040. Diabetes Res Clin Pract 2017;128:40–50.
[4] Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Res Clin Pract 2010 Jan 1;87(1):4–14.
[5] WHO. Ethiopia. World Heal Organ.; 2016 (Diabetes country profile, trend of Diabetes in Ethiopia) Available from, https://www.who.int/diabetes/country-profiles/eth_en.pdf.
[6] American Diabetes Association Standards of medical care in diabetes – 2009 (position statement). Diabetes Care 2009;32:S13–61.
[7] American Diabetes Association. Standards of medical care in diabetes. January Diabetes Care 2014;37(Suppl.1):S14. 7.
[8] Khattab M, Khader YS, Al-Khawaldeh A, Ajlouni K. Factors associated with poor glycemic control among patients with type 2 diabetes. J Diabetes Complicat 2010 Mar 1;24(2):84–9.
[9] Kamuhabwa AR, Charles E. Predictors of poor glycemic control in type 2 diabetic patients attending public hospitals in Dar es Salaam. Drug Healthc Patient Saf 2014;6:155.
[10] Tekalegn Y, Addissie A, Kebede T, Ayele W. Magnitude of glycemic control and its associated factors among patients with type 2 diabetes at TikurAnbessa Specialized Hospital, Addis Ababa, Ethiopia. PLoS One 2018 Mar 5;13(3):e0193442.
[11] Sheleme T, Mamo G, Melaku T, Sahilu T. Glycemic control and its predictors among adult diabetic patients attending Mettu Karl Referral Hospital, Southwest Ethiopia: a prospective observational study. Diabet Ther 2020 Aug;11(8):1775–94.
[12] Cheng LJ, Wang W, Lim ST, Wu VX. Factors associated with glycaemic control in patients with diabetes mellitus: a systematic literature review. J Clin Nurs 2019 May;28(9–10):1433–50.
[13] Oluma A, Abadiga M, Mosisa G, Etafa W. Magnitude and predictors of poor glycemic control among patients with diabetes attending public hospitals of Western Ethiopia. PLoS One 2021 Feb 25;16(2):e0247634.
[14] Abebe SM, Berhane Y, Worku A, Alemu S, Mesfin N. Level of sustained glycemic control and associated factors among patients with diabetes mellitus in Ethiopia: a hospital-based cross-sectional study. Diabetes, Metab Syndrome Obes Targets Ther 2015;8:65.
[15] Mideksa S, Ambachew S, Biadgo B, Baynes HW. Glycemic control and its associated factors among diabetes mellitus patients at Ayder comprehensive specialized hospital, Mekelle-Ethiopia. Adipocyte 2018 Jul 3;7(3):197–203.
[16] Yigazu DM, Desse TA. Glycemic control and associated factors among type 2 diabetic patients at Shanan Gibe Hospital, Southwest Ethiopia. BMC Res Notes 2017;10:597.
[17] Chetoui A, Kaoutar K, Elmoussaoui S, Boutahar K, El Kardoudi A, Chigr F, et al. Prevalence and determinants of poor glycaemic control: a cross-sectional study among Moroccan type 2 diabetes patients. Int Health 2020 Jan 20:ihz107.
[18] Gebermariam AD, Tiruneh SA, Ayele AA, Tegegn HG, Ayele BA, Engidaw M. Level of glycemic control and its associated factors among type II diabetic patients in

debre tabor general hospital, northwest Ethiopia. Metabol Open 2020 Dec 1;8: 100056.
[19] Camara A, Balde NM, Sobngwi-Tambekou J, et al. Poor glycemic control in type 2 diabetes in the South of the Sahara: the issue of limited access to an HbA1c test. Diabetes Res Clin Pract 2015;108(1):187–92.
[20] David EA, Aderemi-Williams RI, Soremekun RO, Nasiru IY, Auta A. Glycemic control and its determinants among patients with type 2 diabetes in a specialist hospital in Northeast, Nigeria. SAJ Pharma Pharmacol 2019;6.
[21] Ali MK, McKeever Bullard K, Imperatore G, Barker L, Gregg EW. Characteristics associated with poor glycemic control among adults with self-reported diagnosed diabetes—National Health and Nutrition Examination Survey, United States, 2007–2010. MMWR Morb Mortal Wkly Rep 2012 Jun 15;61(2):32–7.
[22] Li J, Chattopadhyay K, Xu M, Chen Y, Hu F, Chu J, Li L. Glycaemic control in type 2 diabetes patients and its predictors: a retrospective database study at a tertiary care diabetes centre in Ningbo, China. BMJ Open 2018 Mar 1;8(3):e019697.
[23] Alzaheb RA, Altemani AH. The prevalence and determinants of poor glycemic control among adults with type 2 diabetes mellitus in Saudi Arabia. Diabetes, Metab Syndrome Obes Targets Ther 2018;11:15.
[24] Gong L, Kao WH, Brancati FL, Batts-Turner M, Gary TL. Association between parental history of type 2 diabetes and glycemic control in urban African Americans. Diabetes Care 2008 Sep 1;31(9):1773–6.
[25] Unger RH. Lipotoxicity in the pathogenesis of obesity-dependent NIDDM: genetic and clinical implications. Diabetes 1995 Aug 1;44(8):863–70.
[26] Alramadan MJ, Magliano DJ, Almigbal TH, Batais MA, Afroz A, Alramadhan HJ, Mahfoud WF, Alragas AM, Billah B. Glycaemic control for people with type 2 diabetes in Saudi Arabia–an urgent need for a review of management plan. BMC Endocr Disord 2018 Dec;18(1):1–2.
[27] Hailu E, Mariam WH, Belachew T, Birhanu Z. Self-care practice and glycaemic control amongst adults with diabetes at the Jimma University Specialized Hospital in south-west Ethiopia: a cross-sectional study. Afr J Primary Health Care Family Med 2012;4(1).
[28] Thent ZC, Das S, Henry LJ. Role of exercise in the management of diabetes mellitus: the global scenario. PLoS One 2013 Nov 13;8(11):e80436.
[29] Fekadu G, Bula K, Bayisa G, Turi E, Tolossa T, Kasaye HK. Challenges and factors associated with poor glycemic control among type 2 diabetes mellitus patients at Nekemte Referral Hospital, Western Ethiopia. J Multidiscip Healthc 2019;12:963.
[30] SaadMF, Knowler WC, Pettitt DJ, et al. Sequential changes in serum insulin concentration during development of non-insulin-dependent diabetes. Lancet 1989;1:1356–9.
[31] Demoz GT, Gebremariam A, Yifter H, Alebachew M, Niriayo YL, Gebreslassie G, Woldu G, Bahrey D, Shibeshi W. Predictors of poor glycemic control among patients with type 2 diabetes on follow-up care at a tertiary healthcare setting in Ethiopia. BMC Res Notes 2019 Dec 1;12(1):207.
[32] Omar SM, Musa IR, Osman OE, Adam I. Assessment of glycemic control in type 2 diabetes in the Eastern Sudan. BMC Res Notes 2018 Dec;11(1):1–5.
[33] Marjanović M, Đido V, Bralić Lang V, Martinović Željko, Ovčina A. The association of clinical characteristics and Lifestyle habits with poor glycemic control in patients with type 2 diabetes mellitus. Eur J Med Health Sci 2021;3(1):79–84.
[34] Mackenzie T, Brooks B, O'Connor G. Beverage intake, diabetes, and glucose control of adults in America. Ann Epidemiol 2006 Sep 1;16(9):688–91.
[35] Hong JW, Noh JH, Kim DJ. Association between alcohol intake and hemoglobin A1c in the Korean adults: the 2011-2013 Korea National health and nutrition examination survey. PLoS One 2016 Nov 28;11(11):e0167210.
[36] Woldu MA, Wami CD, Lenjisa JL, Tegegne G, Tesafye G, Dinsa H. Factors associated with poor glycemic control among patients with type 2 diabetes mellitus in Ambo Hospital, Ambo; Ethiopia. Endocrinol Metab Syndrome 2014;3(143): 2161. 1017.
[37] Sanal TS, Nair NS, Adhikari P. Factors associated with poor control of type 2 diabetes mellitus: a systematic review and meta-analysis. J Diabetol 2011;3(1):1. 0.