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Patterns of glycaemic control and associated factors among adult patients with diabetes attending medical referral clinics in two public hospitals in North-West Ethiopia: a cross-sectional study

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ABSTRACT

Background Poor glycaemic control is the most challenging issue in diabetes care globally. The glycated haemoglobin (HbA1c) value is the most standard monitoring parameter for appropriate glycaemic control status.

Objective To assess the patterns of glycaemic control and associated factors among patients with diabetes attending medical referral clinics in North-West Ethiopia.

Design An institution-based cross-sectional study.

Setting This study was conducted in two public hospitals (Felege-Hiwot Comprehensive Specialized Hospital and Tibebe Ghion Specialized Hospital), Amhara National Regional State, North-West Ethiopia.

Participants A total of 355 adult patients with diabetes were included in the study using a systematic sampling technique. Patients were recruited from both hospitals proportionally between July and September 2021.

Outcome measures Glycaemic control was assessed using HbA1c levels. Data were collected using a checklist and structured questionnaire and analysed using a binary logistic regression model.

Results The overall prevalence of poor glycaemic control was 66.2% (95% CI 61.1% to 71%). Age 31–45 years (AOR=0.30, 95% CI 0.12 to 0.75), 46–60 years (AOR=0.12, 95% CI 0.04 to 0.33) and >60 years (AOR=0.09, 95% CI 0.02 to 0.31), lower educational status (AOR=3.48, 95% CI 1.01 to 12.01), type 2 diabetes (AOR=3.36, 95% CI 1.56 to 7.27), poor adherence to antidiabetic drugs (AOR=4.18, 95% CI 1.70 to 10.30), physical inactivity (AOR=4.30, 95% CI 2.11 to 8.76), longer duration of diabetes mellitus (AOR=2.06, 95% CI 1.13 to 3.75) and high body mass index (AOR=3.83, 95% CI 1.31 to 11.19) were associated with poor glycaemic control.

Conclusion The prevalence of poor glycaemic control was high. Age, lower educational status, type 2 diabetes, physical inactivity, high body mass index, longer duration of diabetes and poor adherence to antidiabetic drugs were associated with uncontrolled glycaemia.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous studies have shown that poorly controlled diabetes is a challenging issue, leading to various complications and negative health outcomes.
⇒ Worldwide, around 30%–60% of patients have poorly controlled diabetes.
⇒ Factors such as medication adherence, diet, exercise and access to healthcare services have been identified as influencing glycaemic control in patients with diabetes.

WHAT THIS STUDY ADDS

⇒ This study added the glycaemic control levels and its associated factors among adult patients with diabetes.
⇒ Factors of poor glycaemic control were age, lower educational status, type 2 diabetes, physical inactivity, high body mass index, longer duration of diabetes and poor adherence to antidiabetic drugs.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study can be useful for future research to improve glycaemic control in patients with diabetes.
⇒ To optimise glycaemic control in this population, educational strategies should include achieving weight control and improving adherence to recommended diet and medications. Hospitals should put their effort into educating patients with diabetes and creating awareness to promote tight drug adherence and lifestyle modification, particularly for patients with type 2 diabetes.
⇒ The governmental health institutions should make the glycated haemoglobin test standard and available at affordable cost in collaboration with the regional health bureau and the Federal Ministry of Health in Ethiopia.

INTRODUCTION

Diabetes mellitus is a complex chronic disease that occurs in individuals with absolute insulin deficiency or insulin resistance and glucose intolerance, which results in

hyperglycaemia.[1 2] In low-income and middle-income countries, diabetes is increasing significantly, along with other non-communicable diseases, which are estimated to be 77% undiagnosed.[3 4] While both type 1 and type 2 diabetes mellitus are becoming more prevalent worldwide, the increase in type 2 diabetes mellitus is notably more rapid.[5]

The overall prevalence of diabetes increases with age globally[6] and the prevalence of diabetes mellitus in the African region is reported as 9.7%–15.4%.[6 7] In Ethiopia, there were around 1.9 million adult patients with diabetes aged 20–79 years and another 2.9 million people living with impaired glucose tolerance who are at higher risk of developing diabetes.[8 9] The number of patients with diabetes in Ethiopia is 800 000, and it is projected that it will increase to 1.8 million by the year 2030.[10]

Patients with diabetes are more likely to experience a variety of significant, life-threatening consequences, which can raise medical expenses, lower quality of life and increase mortality.[11–13] After diabetes is diagnosed, hyperglycaemia needs to be closely monitored because it is a major global cause of death and morbidity due to both direct clinical consequences and increased mortality from chronic complications, mainly cardiovascular and renal diseases. Therefore, effective management of hyperglycaemia is crucial to mitigating these risks and improving patient outcomes.[2 8 13]

It is difficult to realise high glycaemic control, and preceding studies have shown many determinants contributing to poor control among patients, including their age, gender, level of education, weight, smoking status, marital status, the duration of diabetes, the medications taken and numerous other factors. However, it has proven difficult to validate precisely which of these factors is most directly associated with uncontrolled glycaemia. The reason behind this is that the earlier findings are inconsistent and have also suggested that glycaemic control and the factors affecting it differ across countries and between different ethnic groups. Therefore, there is a pressing need for better awareness of the components transforming glycaemic control to enhance diabetes care.[14–18]

The glycated haemoglobin (HbA1c) value is the most standard monitoring parameter for determining glycaemic control status and directing treatment interventions, according to recommendations from international standards. Additionally, HbA1c has been endorsed as a screening tool for individuals at high risk of diabetes by the WHO.[1 19–24]

Poor glycaemic control is the most challenging issue worldwide, as its prevalence is rising. People with type 2 diabetes should have their HbA1c levels checked twice a year, while those with type 1 diabetes should have their levels checked more frequently. Measuring HbA1c is not usually a simple task due to cost and local availability issues. In such cases, determining fasting or postprandial blood glucose levels can be considered as an alternative option.[6] In Ethiopia, studies on the assessment of glycaemic control based on HbA1c are very limited, despite the country's status as a developing nation burdened by poorly managed diabetes, which significantly increases the risk of chronic complications. Therefore, to better understand the current state of glycaemic control among patients with diabetes, this study aims to assess patterns of poor glycaemic control and associated factors among patients with diabetes.

METHODS

Study design and setting

This institution-based cross-sectional study was conducted in two public hospitals Felege-Hiwot Comprehensive Specialised Hospital (FHCSH) and Tibebe Ghion Specialised Hospital (TGSH), in North-West Ethiopia. Both hospitals are located in Bahir Dar, Amhara National Regional State, North-West Ethiopia. In the city of Bahir Dar there were two specialised public hospitals and four private general hospitals. FHCSH is 1 of the 42 governmental hospitals in Amhara National Regional State and TGSH is a huge teaching hospital. FHCSH provides service with 430 beds and 422 health professionals, and TGSH has more than 500 beds and 621 health professionals. The hospital serves more than 5000 000 people in its catchment area. A total of 1500 patients with diabetes, of which 940 from FHSCH and 560 from TGSH, had chronic follow-ups in 2021. This study was conducted from 1 July to 30 September 2021.

Sample size determination

The sample size was calculated using a single population proportion formula, considering a 70% prevalence of poor glycaemic control among patients with diabetes,[21] a 5% margin of error, a 95% CI and a non-response rate of 10%. Finally, the sample size was 355.

Sampling procedures

A systematic sampling technique was applied to select study participants. The sample size was proportionally allocated for both hospitals, so 236 and 119 participants were taken from FHCSH and TGSH, respectively. Adults aged 18 years and older who were diagnosed with diabetes mellitus were included in the study. All newly diagnosed patients with diabetes on treatment for <3 months, pregnant women, anaemia patients, patients with diabetes with a history of blood transfusion within 3 months for any reason, and patients on haemodialysis were excluded from this study.

Data collection procedure and measurement/instruments

A checklist and an interviewer-administered structured questionnaire were used to retrieve information from adult patients with diabetes and their medical documents. Data were collected by trained nurses who had experience in quantitative data collection. Interviews were conducted in a separate room to ensure confidentiality and to prevent social desirability bias.

Operational definitions

Glycaemic control: As per recommendations of the American Diabetes Association (ADA):[1]

- Good glycaemic control: HbA1c level <7 %.
- Poor glycaemic control: HbA1c level ≥7 %.

Adherence to antidiabetic medications

Patients who took all the prescribed antidiabetic medications in the last 7 days were considered to be medication adherent. Patient adherence to antidiabetic medications was assessed by self-reported medication intake for the week leading up to the interview, with patients asked to recall any missed doses daily over 7 days.[8]

Adherence to diet

Patients with diabetes who followed the recommended diet for 3 or more days in the last 7 days were classified as practising good dietary habits.[8]

Adherence to exercise

If the study participant followed the recommended level of exercise for ≥150 min in the last 7 days, they were considered to have adequate physical activity; otherwise, the patient was classified as having inadequate physical activity.[1]

Body mass index

Defined as the weight in kilograms of the individual divided by the square of the height in metres. BMI was classified as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) or obese (≥30.0 kg/m^2).[25]

Statistical analysis

The collected data were entered into EpiData V.3.1 and analysed using SPSS V.24. Descriptive statistics were calculated to describe the independent variables. Variables with p<0.25 on a bivariate logistic regression analysis were entered into a multivariate logistic regression analysis model to identify the independent predictors of poor glycaemic control. Values of p<0.05, 95% CI and adjusted OR were used to determine significant variables related to the dependent variable.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

Sociodemographic characteristics of study participants

A total of 355 study participants were included, of whom 185 (52.1%) were female. The mean (±SD) age of the participants was 46.3±14.5 years. The majority (301 (84.8%)) of the participants were followers of Orthodox Christianity. 245 (69%) of the study subjects were urban residents and around a third (32.7%) were illiterate. The majority (279 (78.6%)) of the subjects were married, and most of them were employed, followed by housewives.

Table 1 Sociodemographic characteristics of the study participants attending a diabetes follow-up clinic in Bahir Dar, North-West Ethiopia, 2021

Characteristics (n=355)	Categories	Number (%)
Age group (years)	18–30	67 (18.9)
	31–45	112 (31.5)
	46–60	127 (35.8)
	>61	49 (13.8)
Sex	Male	170 (47.9)
	Female	185 (52.1)
Religion	Orthodox Christianity	301 (84.8)
	Muslim	41 (11.5)
	Protestant	13 (3.7)
Residence	Rural	110 (31)
	Urban	245 (69)
Educational status	Unable to read and write	116 (32.7)
	Informal education	43 (12.1)
	Primary education	34 (9.6)
	Secondary education	58 (16.3)
	Higher education	104 (29.3)
Marital status	Single	51 (14.6)
	Married	279 (78.6)
	Divorced	13 (3.7)
	Widowed	11 (3.1)
Occupation	Student	20 (5.6)
	Farmer	73 (20.6)
	Employed	108 (30.4)
	Housewives	85 (23.9)
	Merchant	58 (16.3)
	Others	11 (3.1)

The mean (±SD) monthly income of the respondents was 5140±2866 Ethiopian Birr (ETB) or ~US$90±50 (table 1).

Patterns of glycaemic control

Out of 355 study participants, 235 (66.2%, 95% CI 61.1 to 71%) had poor glycaemic control (HbA1c ≥7%) and the remaining 120 (33.8%, 95% CI 29% to 38.9%) subjects had good glycaemic control (HbA1c <7%). The mean (±SD) HbA1c of the total study participants was 8.09±1.99% (figure 1).

Factors associated with poor glycaemic control

All variables were analysed using binary logistic regression, and in the bi-variable analysis: the age of the patient, religion, residence, educational status, types of diabetes with their duration, types of therapy, drug adherence, BMI, physical exercise, and dietary adherence had a value of p<0.25 (table 2).

The odds of poor glycaemic control among the 31–45 years age group decreased by 69.7% (AOR=0.303, 95% CI

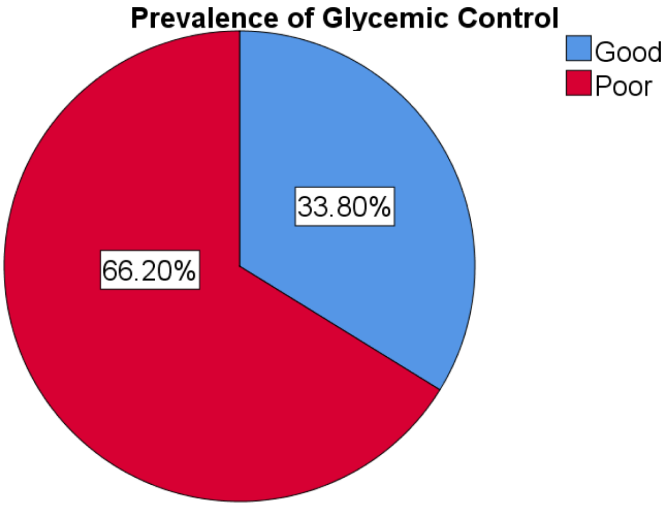

Figure 1 Patterns of glycaemic control among adult patients with diabetes attending medical referral clinics in Felege-Hiwot Comprehensive Specialized Hospital (FHCSH) and Tibebe Ghion Specialized Hospital (TGSH), North-West Ethiopia.

0.122 to 0.751) compared with the 18–30 years age group. The findings also showed that the risk of developing uncontrolled diabetes was reduced by 87.8% (AOR=0.122, 95% CI 0.045 to 0.330), and 90.5% (AOR=0.095, 95% CI 0.029 to 0.316) for the ages of 46–60 years and >60 years, respectively, compared with the ages 18–30 years.

The odds of poor glycaemic control were more than three times higher among patients with diabetes who had attended primary school compared with those with higher education (AOR=3.48, 95% CI 1.01 to 12.01).

Patients with type 2 diabetes had more than three times (AOR=3.36, 95% CI 1.55 to 7.26) higher rates of poorly controlled diabetes compared with those with type 1 diabetes. The odds of poor glycaemic control were more than four times higher among participants who do not engage in physical activity compared with those who engage in physical activity (AOR=4.30, 95% CI 2.11 to 8.76).

The odds of poor glycaemic control were more than four times higher among respondents with inadequate drug adherence compared with respondents with good drug adherence (AOR=4.18, 95% CI 1.70 to 10.30). Patients with a longer duration of diabetes had a two times (AOR=2.06, 95% CI 1.13 to 3.75) higher risk of developing poor glycaemic control compared with those with a shorter duration. The rate of poor glycaemic control was almost four times (AOR=3.83, 95% CI 1.31 to 11.19) higher in obese study subjects compared with normal body habits.

DISCUSSION

This study showed that almost two-thirds of adult patients with diabetes had poor glycaemic control. The result of this study was consistent with previous studies conducted in public hospitals in western Ethiopia,[26] the Ayder Comprehensive Specialized Hospital, Mekelle[27] and the Dessie Referral Hospital.[21] This might be because the study areas had closer sociodemographic factors and similarity in access to health service delivery, and the sample sizes of the studies were comparable. The findings of this study were also consistent with the review by Musenge *et al*,[28] which revealed that patients with diabetes did not achieve target glycaemia. The similarity might be a result of poor health service delivery by untrained professionals and the unavailability of different drugs in third-world countries. The result of this study revealed that the prevalence of poor glycaemic control was low compared with a study in North-West Ethiopia, Debre Tabor General Hospital.[29] The variations between these findings might be explained by the slight difference in sample size and randomisation, and because the studied populations were only patients with type 2 diabetes. The findings of this study were also lower than those of other studies conducted in sub-Saharan Africa[30] and India.[31] This discrepancy might be due to differences in the studied populations, sample size, method of assay for defining glycaemic control and/or laboratory standardisation, and variations in nutritional practice.

The proportion of poor glycaemic control in this study was higher relative to studies done at Jimma University Specialized Hospital,[19] Nigeria,[32] and Greece.[33] This variation might be because of differences in the studied population, sample size, method of assay for defining glycaemic control and/or specimen collection. The quality of care in our set-up might be poor compared with these two countries.

This study showed that poor glycaemic control among patients with diabetes in the 31–45 years age group decreased by 69.7%. The findings also revealed that the risk of developing uncontrolled diabetes was reduced by 87.8% and 90.5% for the ages 46–60 years and >60 years, respectively, compared with the 18–30 years age group. The result of this study was similar to that of a previous study conducted at Jimma University Specialized Hospital, Ethiopia.[19] This consistency might be because the study areas had closer sociodemographic factors and similarities in access to healthcare service delivery. However, this finding was not consistent with results from different studies, and reports from guidelines around the globe indicated that older age was associated with poor glycaemic control.[1 34–36] This difference might be due to variations in the studied population, sample size, level of understanding of prevention and treatment strategies, access to healthcare, and healthcare utilisation.

The current study revealed that patients with diabetes who attended primary school were more likely to have poor glycaemic control as compared with those who attended higher education, a finding consistent with a previous study at Debre Tabor General Hospital.[29] The reason might be due to the effects of educational status on a patient's implementation of different medical recommendations like appropriate use and handling of antidiabetic medications, lifestyle modifications and adherence to regular physical exercise.

Table 2 Factors associated with poor glycaemic control in patients with diabetes attending diabetes follow-up clinics in two selected hospitals, North-West Ethiopia, 2021

Characteristics	Glycaemic control		COR (95% CI)	AOR (95%CI)	P value
	Good	Poor			
Age, years					
18–30	15	52	1	1	
31–45	38	74	0.562 (0.280 to 1.126)	0.303 (0.122 to 0.751)*	
46–60	49	78	0.459 (0.233 to 0.903)	0.122 (0.045 to 1.330)*	<0.001
>60	18	31	0.497 (0.219 to 1.124)	0.095 (0.029 to 0.316)*	
Religion					
Orthodox Christianity	102	199	0.355 (0.077 to 1.631)	0.499 (0.08 to 3.107)	0.456
Muslim	16	25	0.284 (0.056 to 1.453)	0.182 (0.024 to 1.371)	0.098
Protestant	2	11	1	1	
Residence					
Rural	41	69	0.854 (0.500 to 1.282)	0.499 (0.24 to 1.036)	0.062
Urban	79	166	1		
Educational status					0.396
Illiterate	42	74	1.101 (0.637 to 1.903)	1.446 (0.617 to 3.386)	0.074
Able to read and write	11	32	1.818 (0.825 to 4.009)	2.493 (0.914 to 6.799)	0.048
Primary school	5	29	3.625 (1.297 to 10.134)	3.484 (1.010 to 12.016)*	0.713
Secondary school	22	36	1.023 (0.528 to 1.981)	0.861 (0.389 to 1.906)	
Higher education	40	64	1	1	
Type of DM					
Type 1	35	65	1	1	
Type 2	85	170	1.077 (0.662 to 1.752)	3.365 (1.558 to 7.267)*	0.002
Physical exercise					
Yes	44	48	1	1	
No	76	187	2.255 (1.383 to 3.675)	4.301 (2.111 to 8.763)*	<0.001
Drug adherence					
Yes	113	187	1	1	
No	7	48	4.144 (1.813 to 9.471)	4.187 (1.701 to 10.306)*	0.002
Duration of diabetes (years)					
<5	85	135	1	1	
≥5	35	100	1.799 (1123 to 2.881)	2.065 (1.135 to 3.757)*	0.018
BMI (kg/m^2)					
Normal	78	138	1	1	
Overweight	36	69	1.083 (0.664 to 1.767)	0.897 (0.478 to 1.682)	0.734
Obese	6	28	2.638 (1.047 to 6.648)	3.830 (1.310 to 11.197)*	0.014

*Statistically significant at p<0.05
AOR, adjusted OR; BMI, body mass index; COR, crude OR; DM, diabetes mellitus.

The findings of this study indicate that patients with type 2 diabetes had a higher rate of poorly controlled diabetes, which is also consistent with an Iranian study,[22] assessments from the ADA,[1 34] and the International Diabetes Federation (IDF), 2017 and WHO 2016 global reports of diabetes.[3 6] Patients with type 2 diabetes are more likely to develop different disorders such as metabolic syndrome, dyslipidaemia and insulin resistance. This implies that health professionals should design strategies emphasising the management of patients with type 2 diabetes.

This study also found that physical inactivity is significantly associated with poor glycaemic control. The finding was consistent with different previous studies in Nekemt Referral Hospital,[10] Brazil,[37] and Indonesia.[38] The findings supported the recommendation from

the ADA, which encourages all patients with diabetes to engage in moderate-to-vigorous physical exercise to improve glycaemic control if there is no contraindication.[34] Lack of knowledge about the benefits of physical exercise may be a reason for poor glycaemic control. Additionally, physical exercise has been shown to improve glycaemic control, increase insulin sensitivity, and repair some of the damage caused by complications associated with diabetes mellitus, such as impaired cardiovascular health.[39] The association between physical inactivity and poor glycaemic control emphasises the significance of encouraging consistent physical exercise as a fundamental element of diabetes treatment plans.

This study also exhibited that adult patients with diabetes with inadequate drug adherence were significantly associated with poor glycaemic control. It was also similar to studies at Mettu Karl Referral Hospital,[12] Zambia,[28] and Indonesia.[38] So, drug adherence is the key determinant to achieving good glycaemic control, and responsible experts should focus on specific measures to improve patient awareness. To enhance glycaemic control outcomes, healthcare practitioners should place a high priority on improving medication adherence among patients with diabetes. Patient education and support programmes are essential in tackling this difficulty.

This study ensured that patients with a longer duration of diabetes were significantly associated with poor glycaemic control. This was consistent with previous studies in Tikur Anbesa Specialized Hospital,[8] Nekemt Referral Hospital,[10] Dessie and Debre Tabor Referral Hospital,[21] Eastern Sudan,[7] Florida International University, USA,[36] and Indonesia.[38] These overall similarities might signify an increased duration of the disease process, continuously decreased insulin production, and an increased incidence of diabetes complications that finally increased blood glucose levels.[40] The patients with longer duration of diabetes may require more effective management techniques. This emphasises on having improved treatment plans and ongoing supervision for study populations.

The results of the study showed that obese patients had a significantly higher level of uncontrolled diabetes than adult patients with normal body habits. It was consistent with studies at Mettu Karl Referral Hospital,[12] Greece,[33] and Florida International University, USA.[36] This finding was strengthened by the ADA 2021 recommendation, which suggested that patients with diabetes, especially those with type 2 diabetes mellitus, should maintain optimal body habits with different lifestyle modifications to achieve good glycaemic control.[34] There is a high association between patients who are obese and uncontrolled diabetes, which emphasises the vital need for comprehensive weight management programmes as an essential part of diabetes therapy. Healthcare professionals should target weight control in order to improve the results of glycaemic control.

Strengths and limitations of the study

This study used the HbA1c test to assess the prevalence of glycaemic control. However, this study had the following limitations: First, we collected the data on adherence to diet, adherence to antidiabetes medication and adherence to physical exercise using the self-report method, which may introduce recall bias. Second, laboratory results documentation and determinations of HbA1c were challenging since it was not available in governmental hospitals and was expensive. Third, the cross-sectional nature of the study was another limitation that made us unable to draw definitive relationships between our findings and glycaemic control. Fourth, lipid profiles; serum total cholesterol, triglyceride, low-density cholesterol and high-density cholesterol levels were not analysed in the regression model due to a lack of documented results for the majority of the study participants.

CONCLUSION

The results of this study indicate that more than half of adult patients with diabetes in North-West Ethiopia had poor glycaemic control, which is consistent with the rates reported in other countries. We also demonstrated that poor glycaemic control was significantly associated with type 2 diabetes, age, physical inactivity, a lower educational status, a longer duration of diabetes, a high body mass index, and poor adherence to antidiabetic medication. Based on these findings, we recommend that healthcare providers emphasise on improving strategies aimed at strengthening antidiabetic medication adherence, weight control, lifestyle modification and glycaemic levels in their teaching approaches. To safeguard patients from the consequences of diabetes and possibly preventable glycaemic burden, healthcare practitioners should emphasise on the significance of maintaining appropriate glycaemic control.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the institutional review board of the College of Medicine and Health Sciences, Bahir Dar University (reference number Med/12543/6.2.3). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data sets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

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