Research article

Glycemic control among ambulatory type 2 diabetes patients with hypertension Co-morbidity in a developing country: A cross sectional study

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A B S T R A C T

Background: Achieving target blood glucose in type 2 diabetes patients with hypertension remains a challenge despite the availability of different classes of drugs to treat these conditions.

Objective: to assess the level of glycemic control and identify associated factors among ambulatory type 2 diabetes patients with hypertension co-morbidity.

Methods: We conducted a hospital based cross-sectional study from April 4 to May 11, 2016 among ambulatory type 2 diabetes patients with hypertension comorbidity at Jimma University Medical Center. We collected data on patient demographics, diabetes complications, and treatments using pretested questionnaire and data extraction format from a total of 300 eligible patients. We included consecutive patients that visited the hospital during the study period. We performed statistical analysis using SPSS version 21. Logistic regression analyses were done to identify the factors associated with poor glycemic control. P-value <0.05 was considered statistically significant.

Results: The majority of patients (60%) had poor glycemic control. The mean (SD) fasting blood glucose level over three consecutive months was 152.5 (65.7) mg/dl. Factors associated with poor glycemic control were age 41–60 years (AOR = 3.05, 95%CI: 1.20–7.77), age older than 60 years (AOR = 2.62, 95%CI: 1.01–6.80), presence of drug related problems (AOR = 2.29, 95%CI: 1.20–4.39), and low adherence to medications (AOR = 4.26, 95%CI: 1.70–10.65).

Conclusion: The prevalence of poor glycemic control among ambulatory type 2 diabetes patients with hypertension comorbidity was high.

1. Introduction

Diabetes mellitus is becoming a global pandemic affecting about 9.3% (463 million) of the global population in 2019 [1]. About 80 % of people with diabetes are living in low- and middle-income countries with multiple comorbidities [1,2]. Prevalence of diabetes in Ethiopia in the adult population (20–79 years old) in 2019 was 3.2% [1]. Hypertension is the most common diabetes-related comorbidity in sub-Saharan Africa affecting significant proportion of patients with diabetes [3,4]. Optimization of glycemic control in patients with type 2 diabetes reduces the risk of developing diabetes comorbidities [1,4].

Although different classes of antidiabetic medications for the treatment of type 2 diabetes are available, achieving target blood glucose in diabetes patients in general and in diabetes patients with hypertension

comorbidity in particular, remains a big challenge [5]. Studies from low income countries show that about two-thirds of type 2 diabetes patients with hypertension do not achieve target blood glucose [6,7]. It has been reported that more than 60% of diabetes patients fail to attain the recommended glycemic targets despite the use of strict clinical practice guidelines to control blood glucose level [8].

The prevalence of uncontrolled blood glucose in sub-Saharan Africa is high. For example, in Kenya, about 81.9% of type 2 diabetes patients have poor glycemic control [9]. In Ethiopia, poor glycemic control in type 2 diabetes patients is common and the rate of glycemic control is low [10,11,12,13]. It has also been reported that uncontrolled blood glucose is one of the causes for acute hyperglycemic emergencies and hospital admission in type 2 diabetes patients leading to prolonged hospital stay [10,14]. Though there have been studies undertaken on glycemic control

of type 2 diabetes patients, there is lack of studies undertaken that examined level of glycemic control in type 2 diabetes patients with hypertension co-morbidity. Achieving glycemic target for diabetes patients is tough which is attributed to several factors such as age, duration of diabetes, level of education, choice of antidiabetic medications, and poor medication adherence [10,15,16,17]. This study examined the level of poor glycemic control and associated factors among ambulatory type 2 diabetes patients with hypertension in a developing country.

2. Methods and patients

This cross-sectional study was undertaken at Jimma University Medical Center (JUMC) from April 4 to May 11, 2016. The hospital is the sole teaching and referral hospital in Southwest Ethiopia. It provides specialized health services for approximately 15,000 inpatient, 160,000 outpatient attendants a year [18]. We included ambulatory type 2 diabetes patients with hypertension comorbidity and ≥18 years old, patients on medication treatment for both diabetes and hypertension, and those who had monthly follow up at the diabetes clinic of JUMC. Patients with every three months follow-up, patients with irregular follow-up (not seen at all three visits), and patients without fasting blood sugar records, patients with psychiatric co-morbidity and incomplete medical records were excluded from the study. The details of the methods section of this study has been reported elsewhere [19]. The main outcome of this study was the level of glycemic control among type 2 diabetes patients with hypertension comorbidity.

2.1. Sample size and sampling method

Sample size was calculated using a single population proportion formula with the assumption of 5% margin of error, 95% level of confidence, 50% prevalence of poor glycemic control among ambulatory type 2 diabetes patients with hypertension and 10% non-response rate. Through calculation, the final sample size was 309. All ambulatory type 2 diabetes patients with hypertension co-morbidity who visited Jimma University Medical Center diabetes clinic during the study period, and who fulfilled the inclusion criteria were consecutively enrolled into the study until the required sample size was achieved.

2.2. Data collection process and quality assurance

Data on patients' demographics, medication adherence, beliefs about their medications and medication experiences were collected by face-to-face interview using Afaan Oromoo and Amharic versions of structured questionnaires (supplementary material 1). The questionnaires were back translated from Afaan Oromoo and Amharic to English to ensure the reliability of the data collection tool. The detail of the data collection process has been published elsewhere [19]. Fasting blood glucose and blood pressure were measured at each follow up visit for 3 consecutive months. We calculated the average of 3 measurements done over 3 consecutive months to determine the level of glycemic control and blood pressure control. Respectively. The study was approved by institutional review board of Jimma University. Written informed consent was obtained from the patients before the start of data collection.

A Morisky Medication Adherence Scale (MMAS-8) [20] was used to collect information about the patients' medication adherence. MMAS-8 is a tool with 8 questions with dichotomous responses (Yes/No) for the first seven questions and multiple choices for last question. Numerical value of 1 was given for yes and 0 for no. For the patient who answered never or rarely for the last question, score of 0 was given and 1 otherwise. Adherence level was finally decided by taking the sum of responses to 8 questions. The level of adherence was determined based on the following scores: 0 to <6 (low); 6 to <8 (medium); 8 (high).

Beliefs about Medicines Questionnaire (BMQ) [21] was used to assess patients' beliefs about their medicines. The tool has been validated for use in the chronic illness groups studied. It comprises 2 scales: the

BMQ-Specific and the BMQ-General. The BMQ-Specific assesses representations of medication prescribed for personal use and the BMQ-General assesses beliefs about medicines in General. The BMQ-specific, an 11-items questionnaire, incorporates 2 subscales; the Specific-Necessity and Specific-Concern. The Specific-Necessity subscale assesses patients' beliefs about the necessity of prescribed medication and the Specific-Concern subscale addresses their concerns regarding potential adverse outcomes from prescribed medication use. The BMQ-general, an 8-items questionnaire, also comprises 2 subscales; the General-Harm and the General-Overuse. The General-Harm subscale assesses patients' general beliefs and concerns about potential harm of medicines and the degree to which they are perceived by the individual as being harmful. The General-Overuse subscale addresses patients' considerations regarding certain aspects of medication overuse, such as healthcare providers' over-investment of trust in medicines or over-administration of medicines due to lack of time. Respondents indicate their level of agreement with each statement about medicines on a five-point Likert scale. Scores obtained for the individual items were summed to give total score.

2.3. Statistical analyses

We analyzed the data using SPSS Version 21. We used binary logistic regression to assess the association between independent variables and level of glycemic control. We performed bivariate logistic regression first to identify variables candidate for multivariable logistic regression. Variables with p-value ≤ 0.25 in bivariate analysis were entered into multivariable logistic regression to identify factors independently associated with poor glycemic control. Variables with p-value ≤ 0.05 were considered to statistically significantly associated with poor glycemic control.

2.4. Operational definitions and definition of terms

Co-morbidity: the presence of additional diseases other than index disease in an individual [22].

Drug-related problems: events or circumstances that actually or potentially interfere with desired health outcomes in drug therapy. These include need for additional drug therapy, ineffective drug, dosage too low, noncompliance, unnecessary drug therapy, adverse drug reaction and dosage too high [23].

Fasting blood glucose: blood glucose measured from venous blood after at least 8 h of overnight fasting [4].

Good glycemic control: Diabetic patients whose mean fasting blood glucose level was 80–130 mg/dl over three months consecutive measurements [4].

Poor glycemic control: Diabetic patients whose mean fasting blood glucose level is < 80 mg/dl or >130 mg/dl over three consecutive measurements for three months [4].

Hypertension: systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg [24].

Adherence level: it was categorized by taking the sum of 8 questions response and Morisky medication adherence score out of 8 was rated as 0 to <6 (low); 6 to <8 (medium); 8 (high).

Beliefs about Medicines: it was categorized into poor belief (below scales midpoint) and strong belief (above scales midpoint).

3. Results

3.1. Socio-demographic characteristics of patients

Out of a total of 309 patients, 300 (97.1%) fulfilled the inclusion criteria and were included in the study. About 65% (194) of the study patients were males. The mean (SD) age of the patients was 54.4 (11.7) years (Table 1).

Table 1. Socio-demographic characteristics of type 2 diabetes patients with hypertension co-morbidity at JUMC.

Variable	Category	Number (%)
Sex	Male	194(64.7)
	Female	106(35.3)
Age in years	21–40	27(9.0)
	41–50	68(22.7)
	51–60	93(31.0)
	61–70	34(11.3)
	>70	78(26.0)
Marital status	Married	262(87.3)
	Widowed	23(7.7)
	Divorced	15(5.0)
Educational level	Non-literate	126(42.0)
	Primary	95(31.7)
	High school	41(13.7)
	College and above	38(12.7)
Occupation	Farmer	102(34.0)
	Housewife	54(18.0)
	Government employee	49(16.3)
	Merchant	38(12.7)
	Retired	35(11.7)
	Others*	22(7.3)

* Unemployed, daily laborer and student.

3.2. Patients' medication experience

The majority of patients (182, [60.7%]), had strong beliefs about the necessity of prescribed medication for controlling their illness. One hundred eighty-four (61.3%) of patients had poor belief regarding the potential adverse consequences of taking medication (Table 2).

3.3. Prescribed medications, drug related problems, and medication adherence

The mean (SD) number of prescribed medications was 4.1(1.2), ranging from 2 to 10 medications per patient. One hundred two (34.0%) patients were taking ≥5 medications. Nearly two-thirds (63.0%) of the patients were on monotherapy for diabetes.

The mean (SD) number of DRPs was 1.7 (1.1). Details of this of information is published elsewhere [19]. The majority (82.0%) of patients had at least one DRP. A total of 228 (76.0%) patients had good medication adherence.

3.4. Glycemic control and associated factors

The mean (SD) fasting blood glucose (FBG) measurement of patients over 3 consecutive months was 152.5(65.7) mg/dl. The majority of

Table 2. Beliefs about medications of diabetes patients with hypertension co-morbidity at JUMC.

Variables		Frequency (%)
Necessity belief	strong	182(60.7)
	weak	118(39.3)
Concern belief	strong	116(38.7)
	weak	184(61.3)
Harm belief	strong	78(26.0)
	weak	222(74.0)
Overuse belief	strong	124(41.3)
	weak	176(58.7)

patients (180, [60.0%]) (95% CI: 54.5–65.5) had poor glycemic control. In bivariate logistic regression analysis, age, medication adherence, and drug related problems were significantly associated with poor glycemic control at p-value < 0.05 (Table 3).

In multivariable logistic regression, age, presence of drug related problem and adherence were significantly associated with poor glycemic control at p-value < 0.05. Patients in the age group 41–60 were more than 3 times (AOR = 3.05, 95%CI: 1.20–7.77) more likely to have poor glycemic control compared to patients in the age group 21–40 years. Similarly, patients in the age group >60 years were 2.6 times (AOR = 2.62, 95%CI: 1.01–6.80) more likely to have poor glycemic control compared to patients in the age group of 21–40 years. Patients with drug related problems were about 2.3 times (AOR = 2.29, 95%CI: 1.20–4.39) more likely to have poor glycemic control than their counterparts. Patients with low medication adherence were about 4.3 times (AOR = 4.26, 95%CI: 1.70–10.65) more likely to have poor glycemic control than those with high medication adherence (Table 4).

4. Discussion

We conducted a cross-sectional study to assess the rate of poor glycemic control and identify factors associated with glycemic control among ambulatory type 2 diabetes patients with hypertension comorbidity. We found that about two-third (61%) of the patients, had strong belief about the necessity of prescribed medication for controlling their illness. The level of patient belief about the potential adverse consequences of taking medication was low (38.7%). This study showed that the majority (60%) of patients had poor glycemic control. The rate of blood pressure control at first, second, and third visits were 36.3%, 40.3% and 35.3% respectively.

The study has shown that the majority (60%) of patients had poor glycemic control. The rate of glycemic control in this study was lower than the report from Jimma University Medical Center, Ethiopia, where 70.9% of patients had poor glycemic control [25]. However, it was comparable the studies undertaken at Limmu Genet Hospital and Gondar, Ethiopia, where 63.8% and 64.7% of patients respectively, had poor glycemic control [26,27]. This result was also comparable with the finding from Jordan where 65.1 % of participants had poor glycemic control [28]. Furthermore, the level of glycemic control in our study was lower than the findings in developing countries undertaken in Malaysia [10] and Kenya [13] where 77% and 81.6% of the patients respectively, had poor glycemic control. We noted that, our finding was higher than the finding from Ambo, Ethiopia where 50% of participants were reported to have poor glycemic control [29]. The discrepancies in the level of glycemic control in different study settings might be attributed to variations in the study settings and differences inthe study populations.

This study indicated that age groups 41–60 and older than 60 years, presence of any drug related problems (DRP) and poor adherence to medication were factors associated poor glycemic control. Patients in the age groups older than 40 years had poor glycemic control compared to those younger than 40 years. This could be because of the presence of multiple comorbidities and functional disabilities including reduced physical exercise at increased age that contributes to complexity of managing diabetes, poor medication adherence, and long duration of diabetes in such population. Conditions such as cognitive impairment and impaired function could also be other challenges [30].

Patients with low adherence to the prescribed medications were also more likely to have poor glycemic control. This finding was consistent with the report of study conducted in Malaysia [10] which showed that achievement of glycemic control was higher among adherent patients than among non-adherent patients. This can be explained by the fact that effectiveness of drug treatment depends primarily on the efficacy of the prescribed medication and adherence of the patient to the treatment.

We found that the presence of drug related problems was significantly associated with poor glycemic control. Patient with drug related problems had poor level of glycemic control compared to patients without

Table 3. Binary logistic regression of factors associated with poor glycemic control in ambulatory type 2 diabetes patients with hypertension co-morbidity at JUMC.

Variable Category		Glycemic control		P-value	COR(95%CI)
		Poor	Good		
Age in years	21–40	8	19		1
	41–60	104	57	0.001*	4.33 (1.79,10.52)
	>60	68	44	0.005*	3.67 (1.48,9.11)
Educational level	Non literate	79	47	0.417	1.22 (0.76,1.94)
	Literate	101	73		1
Necessity belief	Strong	109	73	0.96	1
	Weak	71	47		1.01 (0.63,1.62)
Concern belief	Strong	76	40	0.121	1.46 (0.90,2.37)
	Weak	104	80		1
Harm belief	Strong	50	28	0.39	1.26 (0.74,2.16)
	Weak	130	92		1
Overuse belief	Strong	77	47	0.534	1.16 (0.73,1.86)
	Weak	103	73		1
Adherent to Medication	High	121	107		1
	Medium	22	7	0.020*	2.78 (1.14,6.76)
	Low	37	6	<0.001*	5.45 (2.22,13.43)
Duration of DM in years	≤5	31	170		1
	6–10	12	49	0.432	1.64 (0.64,2.81)
	≥11	11	27	0.045*	2.23 (1.01,4.97)
Duration of HTN in years	≤5	128	84		1
	6–10	33	24	0.734	0.90 (0.50,1.63)
	≥11	19	12	0.923	1.04 (0.48–2.25)
Presence of DRP	Yes	161	85	<0.001*	3.49 (1.88–6.47)
	No	19	35		1
Co-morbid disease	Yes	48	22	0.095	1.62 (0.92–2.86)
	No	132	98		1
Number of medications	<5	119	79	0.960	1
	≥5	61	41		0.99 (0.61–1.61)

* Statistically significant variables with p-value<0.05.

Table 4. Multivariable logistic regression of factors associated with poor glycemic control in ambulatory type 2 diabetes patients with hypertension co-morbidity at JUMC.

Variable category		Glycemic control		P-value	AOR (95%CI)
		Poor	Good		
Age (in years)	21–40	8	19		1
	41–60	104	57	0.019*	3.05 (1.20,7.77)
	>60	68	44	0.048*	2.62 (1.01,6.80)
Presence of DRP	No	19	35		1
	Yes	161	85	0.012*	2.29 (1.20,4.39)
Adherence to medication	high	121	107		1
	medium	22	7	0.057	2.43 (0.97,6.07)
	low	37	6	0.002*	4.26 (1.70,10.65)

* Statistically significant at p-value 0.05 cut off point.

drug related problems. This difference could be patients with drug related problems often have poor medication adherence that would in turn affect glycemic control [31]. However, our finding was not in line with the findings of other studies [10,13,29] where drug related problem was not found to be a statistically significant predictor of poor glycemic control in these studies.

Our study had some limitations. One of the major limitations was lack of HbA1c test (a gold standard test to confirm level of glycemic control in diabetes) to determine the level of glycemic control. Fasting blood sugar test cannot provide a reliable information on the level of glycemic control. Patients are often told not to eat or drink anything (fast) for about 8 h on the date of their follow up at the diabetes clinic. However, we were not sure that all patients were fasting at all visits of the diabetes clinic during the study period. The study was a single facility-based study that we were not able to examine the level of glycemic control of patients with type 2 diabetes at multiple sites. We included patients with type 2 diabetes with hypertension comorbidity that we did not include patients with type 2 diabetes without hypertension and this may possibly be one of the limitations. The study is also an observational study (cross-sectional study) with a short duration of follow up to examine the level of glycemic control and recall bias for semi-structured interviews.

5. Conclusions

The proportion of patients with poor glycemic control was high. Age groups older than 40 years, presence of drug related problems, and low

adherence to medication were the factors associated with poor glycemic control. Interventions to improve glycemic control in this group of patients should consider the factors associated with poor glycemic control.

Declarations

Author contribution statement

T. Desse, and M. Yimam: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

H. Hebo: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data included in article/supplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

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