

# openheart Blood pressure self-monitoring practice and associated factors among adult hypertensive patients on follow-up at South Wollo Zone Public Hospitals, Northeast Ethiopia

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## ABSTRACT

**Background** Hypertension is a silent killer that causes serious health issues in all parts of the world. It is risk factor for cardiovascular disease, stroke and kidney disease. Self-monitoring practice has been identified as an important component of hypertension management. Hence, this study aimed to assess blood pressure (BP) self-monitoring practice and associated factors among adult hypertensive patients on follow-up in South Wollo Zone public hospitals, Northeast Ethiopia.

**Methods** Hospital-based cross-sectional study was conducted from 1 June 2022 to 30 June 2022, among 336 adult hypertensive patients on follow-up at selected South Wollo Zone public hospitals. Data were collected by using self-administered pretested structured questionnaires; the collected data were entered into Epi-data V.4.6 and then exported to SPSS V.25 software for analysis. Descriptive statistics such as frequency and percentage were used to describe the study participants. Tables and texts were used for data presentation. Binary logistic regression was conducted to test the association between the independent and dependent variables. Adjusted OR (AOR) with 95% CI was estimated to identify the factors associated with BP self-monitoring and the level of significance was declared at  $p < 0.05$ .

**Results** The proportion (95% CI) of BP self-monitoring practice among hypertensive patients in South Wollo Zone Public Hospitals was 8.93% (95% CI 6.3% to 12.5%). In the multivariable analysis, urban residence (AOR 3.97, 95% CI (1.11 to 14.20)), comorbidity (AOR 4.80, 95% CI (1.23 to 18.69)), regular healthcare professional visit (AOR 4.64, 95% CI (1.02 to 21.14)), advice on the type of devices used for BP self-monitoring (AOR 5.26, 95% CI (1.49 to 18.58)) and knowledge on hypertension self-care (AOR 13.13, 95% CI (4.21 to 40.99)) were positively associated with BP self-monitoring practice.

**Conclusion** The proportion of BP self-monitoring practice was low. Living in urban areas, comorbidity, regular healthcare professional visits, advice on the type of devices used for BP self-monitoring, and knowledge of hypertension self-care were positively associated with BP self-monitoring practice.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Blood pressure measurement is the only early diagnostic method for hypertension.
- ⇒ Patients should measure and monitor their blood pressure to prevent hypertension crises and other crises.

## WHAT THIS STUDY ADDS

- ⇒ Low proportion of hypertensive patients were monitoring their blood pressure outside the clinical setting.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ This study alarms healthcare providers and other concerned individuals to increase the support and education of patients to monitor their blood pressure at home.

## INTRODUCTION

Hypertension (HTN) is a condition in which the blood pressure (BP) is abnormally high, resulting in problems such as a significant increase in cardiovascular risk. It is a serious, but an avoidable risk factor for coronary artery disease, haemorrhagic and ischaemic stroke, and heart failure.<sup>1</sup> Long-term HTN destroys blood vessels all over the body, especially in target organs like the heart, kidneys, brain and eyes. Myocardial infarction, heart failure, renal failure, strokes and vision impairment are the most common complications.<sup>2</sup>

BP self-monitoring (BPSM) is the term for a patient's regular use of a personal sphygmomanometer outside of a clinical context.<sup>3</sup> When a person takes their BP outside of the clinic—at home, at work or elsewhere—this is known as self-monitoring.<sup>4</sup> Self-monitoring of BP was established in the 1930s and is

currently used by about 10% of the general population in the UK.<sup>5</sup>

Self-monitoring of BP is an excellent technique to improve HTN management and can be included to hypertensive patients' routine care at regional HTN management clinics.<sup>6</sup> According to research, home BP measures are more accurate than office BP tests in terms of prediction accuracy.<sup>7</sup> When self-monitoring BP, patients engage in self-care measures. Treatment adherence has improved and BP has decreased as a result of these incidents. In hypertensive patients, BPSM is projected to become a standard aspect of their treatment.<sup>8</sup>

Japanese HTN guideline has explained that BPSM has several of benefits; highly reproducible, greater prognostic value, extremely effective for the evaluation of drug effects and their duration, used for telemedicine, facilitates long-term BP control, improves adherence to medications, detects seasonal variations and long-term changes in BP, essential for the diagnosis of white-coat HTN and masked HTN, detects morning and night-time HTN, important for the diagnosis and treatment of HTN principally (in diabetes mellitus, pregnancy, children and renal diseases), and has a great effect on the medical economy.<sup>9</sup>

BPSM is becoming a fundamental part of HTN management and primary care patients who self-initiated BPSM reported being more self-efficacious, but a lack of participation and guidance from their doctors generated confusion and hindered the true advantage of BPSM.<sup>10</sup> However, the act of discussing their BPSM readings with their healthcare providers gives rise to a greater doctor-patient therapeutic relationship.<sup>11</sup>

BPSM could be an effective method to improve HTN control and it could be integrated into the usual care of hypertensive patients in the HTN management centre of the community.<sup>6</sup> The practice of BPSM has numerous benefits to control of BP, improving the adherence rates to antihypertensive medications and approval of a better lifestyle.<sup>12</sup>

The failure to comply with HTN's self-care practice is the main reason for the poor control. Self-care activities have proven to be a significant and cost-effective intervention in the management and prevention of HTN and its complications. Adherence to medicine, a low-fat diet, daily exercise, alcohol restriction, smoking cessation, weight loss, self-monitoring of BP, regular health checks and stress reduction are all examples of HTN self-care.<sup>13</sup>

Several researchers have found that self-monitoring of BP in HTN patients varies between 24% and 82% in different European nations.<sup>14–17</sup> Higher education, governmental employment, having an income of >Br3500, duration of HTN >6 years, having health insurance, having co-morbidities, receiving a health professional recommendation towards self-monitoring of BP and having knowledge of HTN-related complications were all found to be factors that were significantly associated with self-monitoring of BP in an Ethiopian study.<sup>18–23</sup>

Because there is limited information from Ethiopia focusing on the study area, the study will fill the gap for BPSM practice and associated factors among adult hypertensive patients in follow-up South Wollo Zone public hospitals.

## METHODS AND MATERIALS

### Study area and period

The study was conducted from 1 June 2022 to 30 June 2022, at selected south Wollo zone public hospitals. There are a total of 14 public hospitals in the South Wollo zone serving about 4million people, of which 11 of them are primary hospitals, 2 of them are general hospitals and 1 is a comprehensive specialised hospital. The capital of the South Wollo zone is Dessie city, which is located 401 km far from Addis Ababa in the north-east of Ethiopia and has a multitude of health facilities, including 2 government hospitals, 8 health centres, and 3 private general hospitals, 2 surgery centres, and 10 higher clinics.

### Study design

A facility-based cross-sectional study was conducted.

### Population

All hypertensive adults who visit public hospitals in South Wollo Zone were the source population, and all adult hypertensive patients on follow-up in the selected public hospitals during the data collection period were the study population.

### Inclusion and exclusion criteria

All hypertensive patients who are above 18 years of age and taking antihypertensive drugs greater than or equal to 6 months and who have been on follow-up were included in the study. In contrast, patients who were unable to communicate and were severely ill were excluded from the study since they cannot provide valid information.

### Sample size determination

The sample size was determined using a single population proportion formula based on the following assumptions: considering a 95% of confidence level, 3% margin of error and 7.75% population proportion. Research was done at Arsi zone BP monitoring practice.<sup>1</sup>

$$N = \frac{(Z_{\alpha/2})^2 (p)(1-p)}{d^2}$$

where  $d^2$

N: Sample size,

$Z_{\alpha/2} = 1.96$  (standardised normal distribution curve value for the 95% CI),

$p = 0.0775$  (proportion of good practice)

$D = 0.05$  (degree of margin of error)

$$\frac{(1.96)^2 (0.0775) (0.9225)}{(0.03)^2}$$

$$= 305$$

For the second objective, the sample size was calculated by using Epi Info V.7.2.5 StatCalc. Since the sample

size calculated for the first objective was larger than the sample size calculated for the second objective, by adding a 10% non-response rate to the calculated sample size, the final sample will be 336.

### Sampling technique and procedures

From the total of 14 public hospitals located in the South Wollo Zone, 5 hospitals were selected randomly and the selected hospitals are Dessie comprehensive specialised hospital, Borumeda general hospital, Haik primary hospital, Kelela primary hospital and Woreilu primary hospital.

The study participants were chosen from each selected hospital using a systematic random sampling approach with a skip interval of 2 and the first study subject among the two was selected by lottery method. For each hospital, the proportionate allocation algorithm was used to determine the number of participants.

Allocating sampling proportional to the total population of each stratum using the formula:

$$n_i = n \times \frac{N_i}{N}$$

Where n=total sample size to be selected (336),  
N=total population of all selected hospitals (840)  
N<sub>i</sub>=total population in each selected hospital  
n<sub>i</sub>=sample size for each stratum

### Variables of the study

#### Independent variables

#### *Patient-related factors (sociodemographic, behavioural and clinical factors)*

- ▶ Age.
- ▶ Sex.
- ▶ Level of education.
- ▶ Occupation.
- ▶ Family history of HTN.
- ▶ Duration of the disease.
- ▶ Health insurance.
- ▶ Comorbidities.
- ▶ History of HTN complication.
- ▶ knowledge on HTN self-care and complication
- ▶ Regular healthcare professional visits.
- ▶ Smoking.

#### *Healthcare professional related factors*

- ▶ Recommendations for using BPSM.
- ▶ Advice on the procedure of BPSM.
- ▶ Advice on type of device used for BPSM.

#### *Dependent variable*

- ▶ Practice of BPSM (good vs poor).

### Operational definitions

A self-monitoring gadget is a tool used to measure BP on one's own, without the aid of a medical professional.<sup>20</sup>

BPSM is the self-measurement of BP by patients at home using a self-monitoring device.<sup>20</sup> It was assessed by asking the question 'Do you currently self-monitor your

BP (ie, check your BP by yourself using a self-monitoring BP device at home)?<sup>20</sup>

Knowledge of HTN self-care and complications was assessed by asking nine knowledge questions with yes/no responses. By computing a mean score from answering correctly with yes=1 and no=0 ranging from 0 to 9 with a mean score of 5. Respondents were labelled to have.<sup>14 24</sup>

Good knowledge if the study participants score 6 and above.<sup>14</sup>

Poor knowledge if the study participants score 6 and above.

### Data collection tool and procedure

A semistructured questionnaire was prepared and used after studying relevant literature on the subject under investigation. For data collection, an Amharic language version of the questionnaire was employed. The data were collected by one health professional (clinical nurse) at each selected public hospital and one BSc nurse was assigned as a supervisor for each hospital. Data were collected through face-to-face interviews by the data collector; supervisors check on the spot to ensure its completeness. The patient was initially asked about his or her interest in taking part in the study. Once a qualified data collector has finished the service, the patient who consents to participate was subsequently questioned.

### Data quality control

To ensure uniformity, the questionnaire was translated from English to Amharic by a language expert translator and then back to English by a second expert translator who is a health professional. The questionnaire was pretested on 5% (17) of the overall sample size of HTN patients on follow-up at Kombolcha primary hospital, with any necessary revisions made before it is used for actual data collection. The study equipment and data collection process were taught to data collectors and supervisors over the course of 2 days. The collected data were checked for completeness by the primary investigator and supervisors.

### Data processing and analysis

The information obtained was double-checked, coded and entered into Epi-Data V.4.6. The data were then exported to V.25 of the SPSS for statistical analysis. The study participants were described using descriptive statistics such as frequency, percentage and measures of central tendency. Tables and text were used to present the data. Then, to identify factors associated with BPSM, a binary logistic regression model was used. To examine the relationship between dependent and independent factors, all independent variables with a p<0.25 were included in the multivariable logistic regression model. Using multivariable logistic regression analysis, a p=0.05 was used to declare as statistically significant; an adjusted OR (AOR) with a 95% CI was used to identify factors significantly associated with BPSM. Model fitness was checked by Hosmer and Lemshow statistic and the p value obtained

**Table 1** Sociodemographic characteristics of hypertensive patients who were attending public hospitals in South Wollo Zone, Northeast Ethiopia, 2022 (n=336)

Variable	Response	Frequency	Per cent
Sex of respondents	Male	196	58.3
	Female	140	41.7
Religion of respondents	Orthodox	150	44.6
	Muslim	161	47.9
	Protestant	19	5.7
	Others	6	1.8
Educational status of respondents	Illiterate	29	8.6
	Primary education	18	5.4
	Secondary education	111	33.0
	Above secondary education	178	53.0
Marital status of respondents	Single	63	18.8
	Married	235	69.9
	Divorced	26	7.7
	Widowed	12	3.6
Residence	Urban	199	59.2
	Rural	137	40.8
Average monthly income	<ETB1000	54	16.1
	ETB1000–ETB1999	59	17.6
	ETB2000–ETB2999	100	29.8
	≥ETB3000	123	36.6

was 0.92 and multicollinearity was checked by using variance inflation factor.

## RESULTS

### Sociodemographic characteristics of respondents

A total of 336 respondents were enrolled in the study making a response rate of 100%. The mean age of the participants was 43 years with SD of  $\pm 14$  years. More than half 196 (58.3%) and 199 (59.2%) of the respondents were males and urban dwellers, respectively. The majority 235 (69.9%) of the respondents were married. Regarding educational status, 178 (53.0%) of the respondents have attended above secondary education. Regarding average monthly income, nearly one-third 123 (36.6%) of the respondents had  $\geq 3000$  Ethiopian birr average monthly income (table 1).

### Behavioural and health-related characteristics of participants

Among the participants, nearly one-third 130 (38.7%) had health insurance. The duration of their disease for 238 (70.8%) respondents was 5 years or less since its diagnosis by health professionals. Regarding behaviour, 77 (22.9%) of them were currently smoking and 246 (73.2%) of the respondents had regular follow-up according to their appointment (table 2).

### Healthcare professional related factors

Of the total respondents, nearly half 166 (49.4%) of the respondents had been recommended by health

professionals toward using BPSM; around one-third 116 (34.5%) were advised on the procedure of BPSM, and 256 (76.2%) of them were told about HTN-related target organ complications by a healthcare professional during follow-up (table 3).

### Knowledge of HTN self-care and complications

Among the total of 336 hypertensive patients, 85 (25.3%) had good knowledge of HTN self-care and complications.

### BPSM practice

Three hundred and thirty-six hypertensive patients were invited to answer the question ‘Do you currently self-monitor your BP (ie, check your BP by yourself using a self-monitoring BP device at home)?’ and it was found that 31 (8.93%) of them use personal BP device to monitor their BP at home.

### Factors associated with BPSM practice

In bivariable logistic regression analysis, age, sex, residence, health insurance, comorbidity, regular healthcare professional visit, recommendation toward BPSM, advice on the procedure of BPSM, advice on the type of devices used for BPSM and knowledge on HTN self-care were associated with BPSM practice at  $p \leq 0.25$ . However, only residence, comorbidity, regular healthcare professional visits, advice on the type of devices used for BPSM and knowledge on HTN self-care were significantly associated with BPSM practice at  $p < 0.05$ .



**Table 2** Behavioural and health-related characteristics of hypertensive patients who were attending public hospitals in South Wollo Zone, Northeast Ethiopia, 2022 (n=336)

Variables		Frequency	Per cent
Health insurance	Yes	130	38.7
	No	206	61.3
Family history of HTN	Present	0	0
	Absent	240	71.4
	Not sure	96	28.6
Duration of HTN	≤5 years	238	70.8
	6 to 10 years	68	20.2
	>10 years	30	8.9
Have someone who cover medication costs	Yes	147	43.7
	No	189	56.3
Comorbidities	Yes	55	16.4
	No	281	83.6
Currently smoking	Yes	77	22.9
	No	259	77.1
Have regular follow-up	Yes	246	73.2
	No	90	26.8
Comorbidity	Heart disease	122	36.3
	Kidney disease	103	30.9
	Diabetes	61	18.2
	Eye disease	25	7.27
	Others	25	7.27

Keeping other variables in the model constant, the odds of BPSM among participants who have comorbidities were nearly five times (AOR 4.80, 95% CI (1.23 to 18.69)) higher than participants who had no comorbidity. Patients living in urban areas were four times (AOR 3.97, 95% CI (1.11 to 14.20)) more likely to have BPSM practice as compared with patients living in rural areas. Similarly, patients having regular follow-up were nearly five times (AOR 4.64, 95% CI (1.02 to 21.14)) more likely to have BPSM practice as compared with patients having no

regular follow-up. Keeping other variables in the model constant, being advised by health professionals on the type of device used for BPSM increases the odds of BPSM by fivefold (AOR=5.26, 95% CI (1.49 to 18.58)) compared with patients not advised by health professionals on type of device used for BPSM. Moreover, patients having good knowledge about HTN self-care and complications were thirteen times more likely to have BPSM practice as compared with patients having poor knowledge about HTN self-care and complications. (AOR=13.13, 95% CI (4.21 to 40.99)) (table 4).

## DISCUSSION

The proportion of BPSM among hypertensive patients in this study was 8.93% (95% CI 6.3% to 12.5%). This finding is lower when compared with studies conducted in America, Czech Republic, USA, Canada and Italy the reported proportions of 53.8%, 40%, 41.6%, 50% and 74.7%, respectively.<sup>21 22 25–27</sup> This variation might be due to differences in sample size, socioeconomic status of population and sampling procedure since the study in America was undertaken with an online survey, patients in low-income category might not be involved due to service inaccessibility which could overestimate the proportion of BPSM. The other reason for the low proportion of BPSM obtained in this study as compared with a study conducted in Czech Republic is the population segment difference where the study was conducted among 552 hypertensive patients aged (25–75 years). Study design and study setting differences for US study where a cross-sectional, correlational design was used among urban community population, study setting differences for Canada study where the study conducted among community pharmacies hypertensive patients and differences in sample size for study in Italy where it was conducted among 855 hypertensive patients.

This result is also lower than findings reported from studies done in West Midlands (UK), Muscat (governorate of Sultanate of Oman) and Amman (Jordan) that shows the proportion of BPSM; 30.7%, 40% and 82%, respectively.<sup>12 23 26</sup> The variation might be due to differences in

**Table 3** Healthcare professional related factors among hypertensive patients who were attending public hospitals in South Wollo Zone, Northeast Ethiopia, 2022 (n=336)

Variable	Response	Frequency	Per cent
Recommendation for using BP self-monitoring	Yes	166	49.4
	No	170	50.6
Advised on the procedure of BP self-monitoring	Yes	116	34.5
	No	220	65.5
Advised on type of BP self-monitoring device	Yes	77	22.9
	No	259	77.1
Told about hypertension related target organ complication	Yes	256	76.2
	No	80	23.8

BP, blood pressure.

**Table 4** Factors associated with BP self-monitoring practice among hypertensive patients who were attending public hospitals in South Wollo Zone, Northeast Ethiopia, 2022 (n=336)

Variables	Category	BP self-monitoring practice		COR (95% CI)	AOR (95% CI)
		Yes	No		
Age of respondent				0.98 (0.95 to 1.00)	0.97 (0.94 to 1.01)
Sex of respondent	Male	14	182	0.59 (0.28 to 1.26)	0.84 (0.29 to 2.40)
	Female	16	124	1	1
Residence	Urban	25	174	3.79 (1.41 to 10.17)	3.97 (1.11 to 14.20)
	Rural	5	132	1	1
Health insurance	Yes	8	122	0.55 (0.24 to 1.27)	2.05 (0.14 to 28.93)
	No	22	184	1	1
Someone who covers your medicine	Yes	9	138	0.52 (0.23 to 1.18)	0.40 (0.03 to 5.22)
	No	21	168	1	1
Comorbidities	Present	8	47	2.00 (0.84 to 4.77)	4.80 (1.23 to 18.69)
	Absent	22	259	1	1
Regular follow-up	Yes	25	221	1.92 (0.71 to 5.18)	4.64 (1.02 to 21.14)
	No	5	85	1	1
Recommendation on BP self-monitoring	Yes	25	141	5.85 (2.18 to 15.68)	0.65 (0.11 to 3.97)
	No	5	165	1	1
Advice on the procedures of BP self-monitoring	Yes	25	91	11.81 (4.38 to 31.82)	5.12 (0.81 to 32.40)
	No	5	215	1	1
Advice on type of device used for BP self-monitoring	Yes	22	55	12.55 (5.31 to 29.66)	5.26 (1.49 to 18.58)
	No	8	251	1	1
Knowledge about hypertension self-care	Good	25	60	20.50 (7.54 to 55.77)	13.13 (4.21 to 40.99)
	Poor	5	246	1	1

AOR, adjusted OR; BP, blood pressure.

sample size (1815 for the study done at West Midlands, UK), the difference in study setting (a study in Jordan was conducted among institutions in Amman, the capital city of Jordan and the pharmacist participation in counselling patients on the proper use of BP monitors and delivering needed relevant education in addition to other health-care professional as a study report)

This finding was also lower than results reported from a study done in Karachi (southern Asia), northeastern Singapore (Asia), northern Carolina and China where the prevalence of BPSM among hypertensive patients was 25%, 24%, 43.1% and 24.5%, respectively.<sup>12 26 28 29</sup> The variation might be due to differences in study setting where the study was conducted at the tertiary hospital for the study of Karachi, Southern Asia and differences in sample size (700) for the study done at Northern Carolina.

Advice on type of devices used for BPSM was an important significant factor for BPSM. Respondents who were advised on the type of devices used for BPSM were five times more likely to have BPSM practice as compared with those who were not advised. This finding was supported by a study done in the USA, Northern Carolina and Arsi Zone (Ethiopia).<sup>12 19 21</sup> The reason

might be since having awareness about BPSM devices can increase the demand of BPSM which finally improves BPSM practice.

Patients who had good knowledge about HTN self-care and related target organ complications were thirteen times more likely to have BPSM when compared with their contraries. This result was consistent with studies conducted in the USA<sup>28</sup> and Arsi Zone Southeastern Ethiopia.<sup>19</sup> The reason might be due to the fact that having knowledge of HTN-related organ complications will make the patient more conscious about the seriousness of the disease and the patient might be tensioned to control the disease and focuses on strategies of managing the disease like BPSM because knowing complications make the patient think that he/she will die due to the complications of the disease if they are not controlled and knowing about HTN self-care will also create confidence and self-efficacy for using self-monitoring devices.

Those patients who had comorbidities were nearly five times more likely to have BPSM practice than those having comorbidities. This result was supported by a study done at Arsi Zone Southeastern Ethiopia.<sup>19</sup> The reason might be due to the fact that the presence of comorbidity increased concern about controlling the disease which

intern leads to improved health facility visits, increased knowledge of HTN self-care and increased chance to get health professionals counselling these finally leads to increased BPSM practice.

Those patients who had regular follow-up (regular health facility visit) were nearly five times more likely to have BPSM practice than those having no regular health follow-up. This result was supported by an online survey report conducted in USA.<sup>14</sup> The reason might be due to the fact that having regular follow-up is associated with increased knowledge of HTN self-care, which can increase the practice of BPSM.

Urban residents were nearly four times more likely to have BPSM than those who were rural residents. The possible reason is that living in an urban area increased information access which in turn increased knowledge of HTN self-care which can increase the practice of BPSM.

## CONCLUSION

The proportion of BPSM among hypertensive patients who were attending public hospitals in South Wollo Zone, Northeast Ethiopia was low. Having urban residence, comorbidity, regular healthcare professional visits, advice on the type of devices used for BPSM and knowledge of HTN self-care were factors significantly associated with BPSM practice. Healthcare providers should focus on hypertensive patients who had comorbidities, no regular healthcare professional visits and who had no adequate knowledge regarding HTN self-care and complications. Awareness creation programmes should be set and the patients should be taught on HTN-related complications and BPSM practice procedures and the precautions required during utilisation. Furthermore, they should inform the patient to self-monitor their BP. The Zone health department should encourage and design awareness creation programmes regarding BPSM into HTN self-care programmes by using different mainstream media, which considers accessibility to the rural community. Further research with a strong study design and multisite is suggested for researchers.

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**Data availability statement** Data are available on reasonable request. The dataset will not be shared in order to protect the participants' identities but is available from the corresponding author on reasonable request.

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