

Self-Monitoring of Blood Pressure in Yemen: Preliminary Insights Into Knowledge, Attitudes and Practices of Hypertensive Patients

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Background: Self-monitoring of blood pressure (SMBP) is crucial for managing hypertension (HTN). However, there is a lack of information on the knowledge, attitudes and practices (KAPs) of hypertensive patients regarding SMBP in Yemen. Therefore, this study evaluated these KAPs among hypertensive patients in Yemen.

Methods: A descriptive cross-sectional study was conducted among 598 adult hypertensive patients conveniently sampled from 19 hospitals in five governorates of Yemen (Amran, Dhamar, Sa'dah, Sana'a, and Ibb) in 2023. Data about demographics, HTN, and KAPs regarding SMBP were collected using a structured questionnaire and analyzed using descriptive statistics.

Results: The response rate was 90.6% (598/660). Of respondents, 30.6% were aware of SMBP, with 72.1% of these practicing it at home. Only 20.2% of patients with perceived awareness knew the optimal timing for BP measurements, and 30% were unaware of any of the precautions SMBP. Although 96.2% of patients believed that SMBP can reduce organ complications, only 39.9% considered it accurate. Of patients aware of SMBP, most (84.2%) endorsed recommending it. Nevertheless, 30.3% of those using SMBP practiced it irregularly, and 53% documented their BP readings, 57.6% shared their home BP readings with physicians, 56.1% compared home and clinic values, and 8.3% reported considering all precautions. Healthcare provider advice (85.6%) and family motivation (75.6%) were the most common reasons for practicing SMBP, followed by owning BP devices (46.2%), while difficulty to operate devices (41.2%), and inability to afford them (35.3%) were the most common reasons for not practicing it.

Conclusion: Adult hypertensive patients in Yemen show low awareness of SMBP, with notable gaps in understanding proper measurement timing, frequency, and precautions. Doubts about SMBP's accuracy are concerning, yet many express willingness to recommend it, trusting healthcare providers' guidance. Reducing cost barriers and simplifying device use could enhance SMBP adoption, improving HTN management in this vulnerable population.

Keywords: knowledge, attitude, practice, hypertension, self-monitoring of blood pressure, Yemen

Introduction

High blood pressure (BP), also called hypertension (HTN), is a significant risk factor for heart disease, stroke and kidney disease that can cause hypertension-mediated organ damage in various organs, including the brain, heart, kidneys, central and peripheral arteries, and eyes.¹ Hypertension is a major risk factor for ischemic or hemorrhagic stroke, with over 50% of hypertensive patients having other cardiovascular risk factors.² Even a slight increase in BP raises the risk of cardiovascular disease (CVD) and mortality. For every 20 mmHg increase in systolic BP or 10 mmHg increase in diastolic BP, the risk of death from ischemic heart disease and stroke doubles.³

Uncontrolled HTN leads to increased utilization of healthcare resources, with annual direct healthcare costs of approximately \$131 billion.⁴ Globally, the number of adults aged 30 to 79 years with HTN increased from 650 million in 1990 to 1.28 billion in 2019. Of those with HTN, approximately 580 million are unaware that they have the condition, 720 million do not receive the treatment they need, and one in five adults has controlled HTN.⁵

Self-monitoring of BP (SMBP) involves taking BP measurements outside of a clinical setting, typically at home. When combined with clinical support, such as counseling and educational tools, SMBP can improve the quality and accessibility of care for individuals with HTN, leading to better BP control. In addition, SMBP can aid in the diagnosis of HTN and help patients actively participate in their BP management, leading to improved adherence to antihypertensive medications.⁶ SMBP, with or without additional support, can be beneficial in controlling BP compared to usual care.⁷ Ischemic and hemorrhagic strokes can be predicted using SMBP at home, where home BP was found to be an independent predictor for ischemic and hemorrhagic stroke in the general population.⁸ Elevations in home systolic/diastolic BP have been associated with a higher risk of total, ischemic and hemorrhagic strokes compared to conventional BP values.⁸ Home BP values provide prognostic information about cardiovascular risk and mortality better than office BP.⁹ Morning BP readings offer more accurate predictions of coronary artery disease (CAD) and stroke than clinic BP readings, highlighting the importance of monitoring morning BP for early detection and prevention of serious health conditions.¹⁰

A recent study in Saudi Arabia found that home BP monitoring (HBPM) techniques were inadequate, but patients' knowledge regarding BP measures was moderate to high.¹¹ The study found that individuals with a family history, adequate monthly income and chronic diseases had significantly higher knowledge and better practices.¹¹ Another study found that more than 70% of hypertensive Saudi patients were aware of HTN complications and had adequate general knowledge of the condition, but uncontrolled BP and poor self-care practices were major findings.¹² A study in Pakistan found that only 23.4% of patients with HTN had SMBP before receiving therapeutic education, with 39.6% of them aware of the practice. Moreover, 60% of patients had discussed with medical staff about self-monitoring and were encouraged to practice SMBP.¹³ Another study showed that about 40% of hypertensive Pakistani individuals did not own a sphygmomanometer, and less than 25% performed HBPM regularly.¹⁴

In developing countries, SMBP is generally low. For instance, a study in Ethiopia found that only 8.9% of adult hypertensive patients in public hospitals in South Wollo Zone self-monitored their BP, with living in urban areas, having co-occurring conditions, frequent healthcare visits, receiving guidance with appropriate equipment, and being aware of HTN self-care being the factors associated with SMBP.¹⁵ Likewise, in Arsi Zone of Oromia State in Ethiopia, 7.8% of patients were found to self-monitor their BP, and 31.5% were aware of it.¹⁶ SMBP was more likely among patients who were recommended to self-monitor their BP and were aware of HTN-related complications.¹⁶

Although the use of SMBP is higher in developed countries, it is still not optimal. For instance, a multicenter study in Italy found that 74.7% of hypertensive patients performed HBPM regularly. Moreover, a significant proportion of patient devices do not meet the accuracy criteria recommended by the US Association for the Advancement of Medical Instrumentation.¹⁷ In France, 42.1% of hypertensive patients reported having an HBPM device compared to 11.1% of normotensive individuals.¹⁸

Investigating the knowledge, attitudes, and practices (KAPs) regarding SMBP among hypertensive patients is critical to identify gaps in understanding and develop interventions to improve the use of self-monitoring devices outside clinical settings, such as at home or work. Moreover, it provides valuable information on the factors influencing the use of SMBP and sheds light on patient engagement, adherence, barriers and facilitation related to SMBP. However, the rise in poverty, political and societal problems, and the overall economic crisis in Yemen have resulted in low public awareness of SMBP and its importance in reducing the risk of CVDs, as well as practicing it. Yemen represents a particularly challenging setting for SMBP, where years of conflict have rendered the health system fragile, with limited access to healthcare facilities, qualified personnel, and affordable devices. Sociocultural customs such as the widespread chewing of khat, combined with high rates of illiteracy and low levels of health literacy, further complicate accurate BP monitoring. These barriers underline the importance of our study in providing context-specific evidence on both knowledge and practical barriers to SMBP not only in Yemen but also in other conflict-affected, low-resource settings.

Interventions that improve patients' awareness of HTN may improve the use of antihypertensive medications and reduce adverse CVD-related events.¹⁹ SMBP plus telemonitoring or self-management has been found to increase the likelihood of BP control.²⁰ However, a systematic review and meta-analysis found that SMBP alone does not improve BP control, but may be effective when combined with other interventions, such as systematic medication titration by doctors, pharmacists, or patients, education, or lifestyle counseling.²¹ SMBP helps physicians track HTN control, adjust medication dosages, and gather comprehensive data on patients' blood pressure, enabling informed decisions about treatment plans.²²

In Yemen, CAD is the leading cause of death, followed by stroke, while other hypertensive complications rank as the eighth most common cause of death.²³ Nonetheless, there is a lack of information on the KAPs of hypertensive patients regarding SMBP. Therefore, this study aimed to evaluate the KAPs regarding SMBP among adult hypertensive patients seeking medical care in hospitals across five Yemeni governorates (Sana'a, Dhamar, Ibb, Amran and Sa'dah).

Methods

Study Design, Population and Setting

A descriptive cross-sectional study was conducted among adult hypertensive patients seeking medical care in 19 hospitals (six in Amran, five in Dhamar, five in Sa'dah, two in Sana'a, and two in Ibb) from March to June 2023.

Patients of both sexes, regardless of whether they were treated as inpatients or outpatients, were included in the study if they were older than 30 years and had been diagnosed with HTN or had been taking antihypertensive medications for more than six months. Pregnant women and patients who refused to give informed consent for voluntary participation were excluded.

Sample Size Calculation and Sampling Strategy

Based on an expected proportion of the KAP outcome of 50% due to the absence of similar previous studies in the country, a confidence level of 95% and an accepted margin of error of 5%, a minimum sample size of 384 was calculated. Nevertheless, 598 patients were included to increase the statistical power of the study.

Because it was difficult to determine the sampling frame and for practical reasons related to time and resource constraints, a convenience sampling method was used to select study participants until the sample size was reached. The final sample of hypertensive patients was distributed as follows: 225 from Amran, 106 from Sana'a, 141 from Dhamar, 64 from Ibb and 62 from Sa'dah.

Data Collection

A semi-structured questionnaire was used to collect data from study participants through face-to-face interviews. The questionnaire was developed after reviewing relevant literature and similar KAP surveys in low- and middle-income countries. Its items were adapted to fit Yemen's sociocultural context and healthcare setting. For the purpose of this study, "awareness" was defined as whether participants had ever heard of SMBP; "knowledge" as the understanding of correct timing, frequency, and precautions for SMBP; "attitudes" as beliefs and perceptions regarding the usefulness, accuracy, and effectiveness of SMBP; and "practices" as behaviors related to SMBP, including frequency and timing of measurement, documentation of readings, communication with physicians, and adherence to recommended precautions.

The questionnaire consisted of three parts. The first part included questions about sociodemographic data, including age, gender, educational level, occupation, monthly income, and health insurance. The second part included questions about HTN, including the duration of HTN, the number of medications used for HTN, complications, and family history of HTN. The third part included questions related to patients' KAPs regarding SMBP. The questionnaire was pilot-tested on 50 patients to assess its reliability. It was found to be moderately reliable, with a Cronbach alpha coefficient of 0.786. Participants in the pilot study were excluded from the final analysis of the study data.

Data Analysis

Data were coded and verified using Microsoft Excel spreadsheets and then imported into IBM SPSS Statistics, version 21.0 (IBM Corp., Armonk, NY, USA) for analysis. Categorical variables related to patients' characteristics and their KAPs of SMBP patients were summarized using frequencies and percentages.

Ethical Considerations

This study conformed to the ethical principles of the Declaration of Helsinki on human studies. The protocol of this study was ethically approved by the Faculty of Medicine and Health Sciences, Amran University, Amran, Yemen. Additionally, verbal consent was obtained from all study participants before data collection after being informed about its purpose. The use of verbal consent was approved by the Faculty of Medicine and Health Sciences, given the descriptive KAP design of

the study, which involved interviews only and posed minimal risk. This approach was further justified by the anticipated high illiteracy rate among the study population, which could impede their ability to read or sign written consent forms. Verbal consent was also considered more culturally appropriate and acceptable within this context. Measures were undertaken to maintain the anonymity of collected data and ensure participants' privacy and confidentiality.

Results

Of 660 questionnaires distributed, 598 were completed, with a response rate of 90.6%.

Sociodemographic Characteristics of Study Participants

Table 1 shows that most hypertensive patients were males (56%), aged 40 to 65 years (59.7%), married (79.3%), residing in rural areas (53.3%), and uneducated (57.7%). More than half of the patients had a monthly income of less than 55,000 Yemeni rials (54.5%), and the majority did not have health insurance (92.5%).

HTN-Related Characteristics of Study Participants

Table 2 shows that most patients had been diagnosed with HTN within the last five years (40.3%), followed by those diagnosed with HTN for 5–10 years (36.5%) and for more than 10 years (23.2%). On the other hand, 60% of patients

Table 1 Sociodemographic Characteristics of Study Participants (N = 598)

Characteristics	n (%)
Sex	
Male	335 (56.0)
Female	263 (44.0)
Age (years)	
<40	73 (12.2)
40–65	357 (59.7)
>65	168 (28.1)
Marital status	
Single	19 (3.2)
Married	474 (79.3)
Divorced	11 (1.8)
Widowed	94 (15.7)
Occupation	
Public service employee	87 (14.6)
Private sector employee	88 (14.7)
Unemployed	159 (26.6)
Freelance work	264 (44.1)
Residence	
Rural	319 (53.3)
Urban	279 (46.7)
Educational level	
Uneducated	345 (57.7)
Primary education	121 (20.2)
Secondary education	64 (10.7)
University education	68 (11.4)
Monthly income (Yemeni rials)	
<55,000	326 (54.5)
55,000–110,000	180 (30.1)
>110,000	92 (15.4)
Health insurance	
Yes	51 (8.5)
No	547 (91.5)

Table 2 HTN-Related Characteristics of Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Characteristics	n (%)
Duration of HTN (years)	
<5	241 (40.3)
5–10	218 (36.5)
>10	139 (23.2)
Family history of HTN	
Yes	359 (60.0)
No	239 (40.0)
Number of drugs used to treat HTN	
One	293 (49.0)
Two	199 (33.3)
Three	77 (12.9)
Four	29 (4.8)
Co-morbidities and complications	
Stroke	114 (19.1)
Myocardial infarction	151 (25.3)
Eye disease	195 (32.6)
Kidney disease	209 (34.9)
Atherosclerosis	99 (16.6)
Cardiomegaly	127 (21.2)

Note: *The total number of patients was 598.

Abbreviation: HTN, hypertension.

reported a family history of HTN. Approximately one-half of patients were treated with a single antihypertensive drug, followed by those receiving a combination of two drugs (33.3%) and three drugs (12.9%). However, only 4.8% were treated with a combination of four drugs. Most patients reported a familial history of HTN (60%). Kidney and eye diseases (34.9% and 32.6%, respectively) were the most frequent co-morbidities and complications, followed by myocardial infarction (25.3%), cardiomegaly (21.2%), stroke (19.1%), and atherosclerosis (16.6%).

Awareness and Practice of SMBP

Of the 598 adult hypertensive patients seeking medical care in hospitals of five Yemeni governorates, 183 (30.6%) were aware of SMBP, while 243 (40.6%) were unaware, and 172 (28.8%) were unsure about hearing of SMBP (Figure 1). On the other hand, of the 183 patients who reported awareness of SMBP, 132 (72.1%) of hypertensive patients in the present study reported that they were practicing it at home.

Knowledge About SMBP

Table 3 shows that only 20.2% knew that BP should be measured in the morning and evening. However, 24% of hypertensive patients were unaware of the optimal timing of BP measurements, and 26.2% of patients reported that BP should be measured

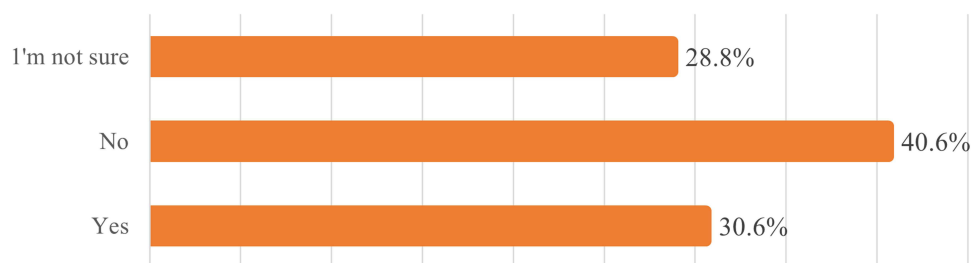


Figure 1 Awareness of SMBP among hypertensive patients seeking medical care in hospitals of five Yemeni governorates (2023).

Table 3 Knowledge About SMBP Among Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Knowledge Item	n (%)
Timing of BP measurement	
In the morning	40 (21.9)
In the evening	13 (7.1)
In the morning and evening	38 (20.8)
When symptoms occur	48 (26.2)
Do not know	44 (24.0)
Precautions to be considered before measuring BP	
Caffeine intake within 30 minutes	65 (35.5)
Exercise within 30 minutes	66 (36.0)
Khat chewing	50 (27.3)
Status of stress	71 (38.8)
All the above precautions	18 (9.8)
None of the above precautions	55 (30.0)
Importance of writing down BP readings at each measurement	
Yes	135 (73.8)
No	46 (25.1)
Do not know	2 (1.1)
Importance of sharing BP readings with a physician	
Yes	143 (78.1)
No	38 (20.8)
Do not know	2 (1.1)

Note: *The total number of patients was 183.

Abbreviations: HTN, hypertension; BP, blood pressure; SMBP, self-monitoring of blood pressure.

only in the presence of symptoms. Considering stress before blood pressure measurement was the most recognized precaution, reported by 38.8% of participants, followed by awareness of avoiding exercise (36%), caffeine consumption (35.5%), and khat chewing (27.3%). However, nearly one-third (30%) reported no awareness of these precautions, and only 9.8% knew about them all. The majority of participants recognized the importance of documenting BP readings at each measurement and the importance of sharing BP readings with a physician (73.8% and 78.1%, respectively).

Attitudes Toward SMBP

Table 4 shows that the majority of hypertensive patients (96.2%) believed that SMBP is useful for reducing organ complications associated with HTN. While 61.7% perceived SMBP as effective for controlling BP, only 39.9% considered it accurate. However, most patients (84.2%) stated that they would encourage others to practice SMBP.

Practices Regarding SMPBP

Table 5 shows that 30.3% of patients practiced SMBP irregularly, while 21.2% of patients measured their BP more than once a day. Approximately one-third of patients did not specify a particular time for measuring their BP, followed by those who measured their BP when symptoms occurred (25%) and those measuring it in the morning (20.5%). More than half of patients (53%) reported having their BP readings charted, 57.6% shared their home BP readings with their physicians, and 56.1% compared their home BP values with those in the clinic. Most patients (31.1%) reported taking no precautions before measuring their BP, while only 8.3% reported considering all precautions.

Reasons for Practicing SMBP

Of the 132 patients who reported practicing SMBP, 85.6% attributed their practice of SMBP to healthcare provider (HCP) advice, followed by family and personal motivation (75.6%) and ownership of BP devices (46.2%). However, only 11.4% practiced SMBP because of their awareness through campaigns or social media (Table 6).

Table 4 Attitudes Toward SMBP Among Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Attitude Statement	n (%)
I think that SMBP is important to reduce HTN-related organ complications.	
Yes	176 (96.2)
No	6 (3.3)
Unsure	1 (0.5)
I think that SMBP is effective for controlling BP.	
Yes	113 (61.7)
No	15 (8.2)
Unsure	55 (30.1)
I think that SMBP is not accurate.	
Yes	39 (21.3)
No	73 (39.9)
Unsure	71 (38.8)
I would recommend SMBP to others.	
Yes	154 (84.2)
No	29 (15.8)

Note: *The total number of patients was 183.

Abbreviations: HTN, hypertension; BP, blood pressure; SMBP, self-monitoring of blood pressure.

Table 5 Practices of SMBP Among Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Practice Question	n (%)
How frequently do you measure your BP?	
Once a day	19 (14.4)
More than once a day	28 (21.2)
Once a week	22 (16.7)
Twice a week	20 (15.2)
Once a month	3 (2.3)
Irregularly	40 (30.3)
What time of the day do you measure your BP?	
In the morning	27 (20.5)
In the evening	11 (8.3)
In the morning and evening	23 (17.4)
When symptoms occur	33 (25.0)
No specific timing	38 (28.8)
Do you maintain a chart of your BP readings?	
Yes	70 (53.0)
No	62 (47.0)
Do you show the readings that you measure to your physician?	
Yes	76 (57.6)
No	56 (42.4)
Do you compare your home BP readings with clinic BP readings?	
Yes	74 (56.1)
No	58 (43.9)
Which of the following precautions do you take when measuring your BP?	
Caffeine intake within 30 minutes	37 (28.0)
Exercise within 30 minutes	37 (28.0)
Khat chewing	31 (23.5)
Status of stress	37 (28.0)
All the above precautions	11 (8.3)
None of the above precautions	42 (31.8)

Note: *The total number of patients was 132.

Abbreviations: HTN, hypertension; BP, blood pressure; SMBP, self-monitoring of blood pressure.

Table 6 Reasons for Practicing SMBP Among Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Reason for Practicing SMBP	n (%)
Healthcare provider advice	113 (85.6)
Family and personal motivation	100 (75.6)
Ownership of BP devices	61 (46.2)
Awareness through campaigns or social media	15 (11.4)

Note: *The total number of patients practicing SMBP was 132.
Abbreviation: SMBP, self-monitoring of blood pressure.

Table 7 Reasons for Not Practicing SMBP Among Hypertensive Patients Seeking Medical Care in Hospitals of Five Yemeni Governorates (2023)*

Reason for Not Practicing SMBP	n (%)
Unable to afford a device	18 (35.3)
Difficulty in understanding device operation	21 (41.2)
Other reasons	12 (23.5)

Note: *The total number of patients not practicing SMBP was 51.
Abbreviation: SMBP, self-monitoring of blood pressure.

Reasons for Not Practicing SMBP

Of the 51 patients who reported not practicing SMBP, the majority found it difficult to understand how to operate the device (41.2%), while 35.3% were unable to afford the device and 23.5% attributed not practicing SMBP to other reasons (Table 7).

Discussion

HTN is a major public health issue, and SMBP is an essential intervention in its management. Nevertheless, the present study revealed a notable gap in the awareness of Yemeni hypertensive patients across five governorates of SMBP, with less than one-third of patients being aware of SMBP. Given that SMBP is vital for the control of HTN, this low level of awareness is concerning. The prevalence of awareness of SMBP in our study is lower compared to the prevalence found in studies in Ghana (43.3%),²⁴ Nigeria (54.7–78.8%),^{25–27} Italy (74.7%),¹⁷ and Jordan (82%),²⁸ but it is higher compared to Ethiopia (7.8–8.9%),^{15,16} and Singapore (24%),²⁹ These discrepancies could be due to the differences in sample sizes and sampling processes. However, it is important to note that none of these studies included representative samples of hypertensive individuals.

Apart from the low rate of awareness of SMBP, the present study revealed critical gaps in good knowledge among them. Our study revealed a number of misunderstandings and misconceptions among BP patients, suggesting a lack of health awareness and education from HCPs and the national media. For instance, only 20.2% of patients with perceived awareness knew the necessity of measuring BP both in the morning and evening. Moreover, more than half of patients were either unaware of the optimal timing of measuring BP or believed that BP should only be measured when symptoms arise. This finding disagrees with the international guidelines, such as the AHA recommendations, to take at least two BP readings in the morning before medication intake and in the evening before supper,³⁰ The approach of multiple readings at specific times, including morning and evening, is needed to assess BP phenotypes accurately and can account for circadian variations and improve diagnostic accuracy.³¹ The reliance on symptomatic monitoring of BP in the present study is problematic because even severely elevated BP can be without signs and symptoms of acute target organ injury.³² According to a meta-analysis of HTN care in low- and middle-income countries, many people have BP measured only in response to symptoms, missing out on the early intervention strategies needed to manage HTN effectively.³³ In Oman, only 38% of patients were found to regularly measure their BP, while the remaining reported measuring it only when feeling tired.³⁴

In this study, awareness of hypertensive patients regarding precautions prior to BP measurement was notably inadequate, with approximately one-third demonstrating knowledge of precautions such as stress management and avoiding exercise, caffeine, and chewing khat. Accurate BP measurement requires adherence to standardized protocols, including avoidance of stimulants, physical activity and stress prior to measurement, as highlighted by international guidelines.³⁰ Typically, BP changes occur within 30 minutes of caffeine intake but may persist for more than four hours.³⁵ Caffeine intake and physical exertion within 30 minutes of measurement can transiently elevate BP.³⁶ Khat chewing is a widespread cultural habit in Yemen, with up to 90% of adult males and 50% of adult females estimated to chew khat leaves.³⁷ It is associated with increased BP and risk of HTN.³⁸ Therefore, the lack of or deficient understanding of such precautions can have a significant impact on the accuracy of BP measurement and the overall management of HTN.

The attitudes of hypertensive patients in this study were generally positive. The vast majority (96.2%) of patients believed that SMBP reduces HTN-related organ complications, reflecting strong awareness of its long-term benefits. Likewise, 84.5% of Saudi and 86.3% of Nigerian hypertensive patients believed that measuring BP at home is important.^{11,26} However, only 61.7% of patients in our study perceived SMBP as effective for direct BP control, suggesting a potential gap in understanding its immediate therapeutic role. In contrast, 83.3% of hypertensive patients in Nigeria perceived that SMPB is useful.²⁶

Even though people thought that SMBP could help prevent complications, only 39.9% of hypertensive patients in this study thought it was accurate, raising concerns about the trust of patients in SMBP. Similarly, 60%, 56.6% and 45.1% of patients in Oman, Nigeria and Saudi Arabia, respectively, were convinced of the performance of SMBP devices.^{11,26,34} The concerns regarding the accuracy of SMBP among hypertensive patients can be attributed to several factors, including device calibration, user training, and the validation status of monitors. While a small proportion of patients in the present study believed in the accuracy of SMBP, over 80% advocated encouraging others to practice it. This finding is consistent with that reported in Oman and Saudi Arabia, where over 80% of patients stated that they would recommend the practice of SMBP to other patients.^{11,34} In contrast, 71.2% of Nigerian hypertensive patients stated that they would SMBP to others.²⁶

The present study found that approximately two-thirds of hypertensive patients aware of SMBP reported practicing it at home, indicating a gap between awareness and practice for the remaining third. However, this SMBP adoption rate is higher than that reported among patients in Ghana (25.3%), Oman (40%), Nigeria (44.6%), and Saudi Arabia (64.7%).^{11,24,27,34} Aside from practicing SMBP at home, this study showed that these practices varied a lot among hypertensive patients. This shows that there are problems with both following guidelines and educating patients about them. In this context, the majority of patients measured their BP irregularly, without adhering to specific timing or only when experiencing symptoms, while only 21.2% measured their BP more than once daily. In Oman, 62% of hypertensive patients reported measuring BP irregularly when feeling tired.³⁴ In contrast, in Saudi Arabia, 53.7% of patients reported measuring their BP more than once a day.¹¹ Over half of patients (53%) charted their readings, and 57.6% shared data with physicians. These gaps highlight a defect in aligning with evidence that BP control improves patient-provider communication and treatment adherence when integrated into care plans.³⁹ This finding is consistent with that reported for Omani patients (42%) and Nigerian patients (56.3%) who reported charting their BP measurements.^{26,34} In contrast, 27% of Saudi patients reported recording BP readings.¹¹

The present study revealed that 56% of patients compared their home readings with BP readings in the clinic setting, which is consistent with the finding reported among Omani and Saudi patients.^{11,34} Conversely, it is lower than that (83%) reported for Nigerian patients checking their SMBP readings with clinic readings.²⁶ Accordingly, it is difficult to rule out the possibility of white-coat HTN and to ensure the proper functioning of their SMBP devices. It is noteworthy that white-coat HTN, which is high BP in clinical settings but normal readings elsewhere, can lead to overdiagnosis and unnecessary treatment if undetected.⁴⁰ Not comparing home readings limits physicians' ability to identify this phenomenon.

The enhancers for practicing SMBP in the present study as mainly included advice received from HCPs, underscoring their pivotal role in motivating SMBP among hypertensive patients. This finding highlights that HCP recommendations can significantly enhance patient engagement in SMBP, particularly in low-resource settings where trust in medical authority remains high. As a result, strengthening HCP-led education can directly improve patient uptake and accuracy. In contrast, 42%, 46.8% and 59.6% of Omani, Ghanaian and Saudi patients, respectively, attributed their BP measurement to

recommendations from HCPs.^{11,24,34} Family and personal motivation (75.6%) appeared as the second primary reason for adopting SMBP, indicating that social support can augment clinical guidance. However, ownership of BP devices at home was mentioned by 46.2% of patients, indicating that access to devices alone may not encourage patients to practice SMBP. Similarly, 46.3% of Nigerian patients were personally motivated to practice SBMP, and 35.8% adopted SMBP because of the availability of BP devices at home.²⁶ The role of awareness campaigns or social media as motivators for using SMBP in the present study was minimal, cited by 11.4% of patients. In Saudi Arabia, advice from friends was reported by 22.4% of patients measuring BP at home.¹¹ In Ghana, colleague patients were second to HCPs as a source of information on SMBP to Ghanaian patients, cited by 39.8% of patients, while 6.7% mentioned the media as a source of information.²⁴ Regarding barriers to SMBP uptake among informed patients, 41.2% cited difficulties in operating devices, reflecting a gap in training. In contrast, only 3% of Nigerian patients not practicing SMBP mentioned not knowing how to operate the device.²⁷ Affordability challenges (35.3%) further restricted access, suggesting that cost remains a prohibitive factor in LMICs, even for low-cost devices. Similarly, the device cost was the most frequently cited reason for not practicing SMBP in Nigeria.^{26,27} Policymakers should consider measures to improve affordability, including subsidizing validated BP devices, integrating them into national insurance programs, and negotiating reduced procurement costs for distribution in health facilities.

This study provides preliminary KAP data on SMBP among hypertensive patients in Yemen. Nevertheless, we must acknowledge several limitations when interpreting the findings. Firstly, the study was primarily descriptive and relied on a convenience sampling approach for selecting participants from hospital settings. Therefore, the findings may not be generalizable to the broader population of hypertensive patients in the community. However, it was difficult to determine the sampling frame. To address these limitations, we increased the sample size and conducted the study across five governorates of the country to enhance representativeness. In addition, community-based analytical studies are recommended to investigate the factors contributing to the non-use of SMBP as a care strategy for controlling HTN. Secondly, the reliance on self-reported data for SMBP measurements could introduce bias into the study, potentially leading to inaccuracies due to inherent limitations in participant-reported data collection methods. Accordingly, efforts to mitigate these biases should be considered in future studies to improve the accuracy and reliability of the findings.

Conclusion

Awareness of SMBP among adult hypertensive patients in Yemen is low, marked by significant knowledge gaps in proper measurement timing, frequency, and essential precautions. Furthermore, doubts about SMBP accuracy represent a major concern among patients about the reliability of BP readings. Strong patient willingness to recommend SMBP and reliance on HCP advice, on the other hand, show that SMBP has a lot of potential to be widely used if it is backed up by the appropriate interventions. Moreover, addressing barriers like high device costs and complicated technical details could also help more hypertensive patients in Yemen use SMBP, which would lead to better HTN management in this vulnerable group. Incorporating SMBP education into routine clinical care, coupled with structured patient training and initiatives to provide affordable monitoring devices, is therefore warranted. Strengthening HCP counseling, alongside community-based training programs and awareness campaigns, can bridge knowledge-practice gaps and promote more effective hypertension control at the national level.

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Disclosure

The authors have no conflicts of interest associated with this study.

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