

Evaluation of knowledge and practices of hypertensive patients regarding home blood pressure monitoring

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary Background. Home blood pressure monitoring (HBPM) is a crucial part of managing and preventing complications of hypertension.

Objectives. The study's objective was to evaluate adult hypertension patients' knowledge of and attitudes towards home blood pressure monitoring (HBPM). However, it is uncertain whether individuals with hypertension in Saudi Arabia monitor their blood pressure at home.

Material and methods. In a cross-sectional survey, a total of 830 cases, ranging from 18 years of age and above of both genders, were selected. Patients with hypertension for more than six months were included. Data was collected by filling out the designed questionnaire.

Results. Knowledge related to blood pressure (BP) measurements was moderate to high, whereas the practices of home blood pressure monitoring were not satisfactory. Our results imply that patients are informed about hypertension (HTN) in general but are less aware of specific factors associated with it, specifically their own degree of BP control. There was no statistically significant association between the age of the participants, gender, educational level, occupation, residency region and the duration of HTN compared with knowledge and level of practice; however, it was observed that participants who had sufficient average monthly income, positive family history of hypertension and patients with chronic disease(s) had significantly better knowledge and good practices.

Conclusions. The knowledge of hypertensive patients related to HBPM was found to be moderate, while their practices were poor. Hypertensive patients > 60 years of age showed better practices. Both knowledge and practices were comparatively better in patients who were married, those who had a sufficient monthly income, those with a family history of HTN and those who had associated comorbidities.

Key words: knowledge, hypertension, patients, self care.

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Background

Hypertension continues to be a predominant non-communicable disease and a leading risk factor for mortality globally. The prevalence of hypertension is extremely significant; it affects 30% of people worldwide and can reach up to 60 to 70% for those over 65 years of age [1]. Additionally, between 40 and 60% of hypertensive patients lack diagnosis, and the disease is not properly treated in 70 to 90% of patients. However, these numbers differ significantly between countries [2]. Less than 1 in 5 are estimated to have their blood pressure under effective control, which contributes to more than 10 million deaths annually [3, 4]. Hypertension is a significant but avoidable risk factor for heart failure, chronic renal disease, haemorrhagic and ischemic stroke and coronary artery disease. Because it frequently goes undiagnosed for years or even decades, hypertension is also referred to as a "silent killer". The majority of patients with hypertension have no symptoms at all. As a result, the only way to identify it is to have one's blood pressure checked frequently

[5]. Even slight errors in the measurement of blood pressure in a population might have significant consequences. Underestimation can result in greater negative cardiovascular outcomes, just as overestimation might cause ineffective treatment. A population-wide overestimation of actual blood pressure of 5 mm Hg could lead to the incorrect use of antihypertensives in almost 30 million patients, unnecessarily subjecting them to the negative side effects of the drugs and adding unneeded expenses [6]. Underestimations of the same 5 mm Hg can cause nearly 20 million patients to go undiagnosed, with a possible 25% increase in fatal strokes and myocardial infarction [7].

To increase patients' engagement and ability to self-manage their condition, the American Heart Association (AHA), American Society of Hypertension (ASH) and Preventive Cardiovascular Nurses Association (PCNA) encourage clinicians to use home blood pressure monitoring (HBPM) more frequently for the majority of patients with known or suspected hypertension. This will allow the care team to help patients achieve and maintain control of their condition, as well as prevent heart attacks and strokes [2, 5]. The likelihood that office BP measurements may



produce inaccurate estimations of a patient's actual BP level is rising. However, HBPM has a higher level of predictive accuracy than office BP measurement. Studies have shown that HBPM can result in a modest but clinically significant drop in blood pressure. This is one substitute for conventional office care that, when combined with clinical support, could increase the accessibility and quality of care for those with hypertension while also making BP control more convenient and approachable for the general population. There is growing evidence of the efficiency and advantages of HBPM. HBPM may help with blood pressure regulation, guide treatment selection and offer both diagnostic and prognostic data. Additionally, HBPM has been demonstrated to be cost-effective, with fewer medical appointments needed to achieve BP control. US guidelines state that HBPM may increase patients' adherence to antihypertensive medication regimens, even though this is not regarded as a standard of treatment for the management of hypertension. Compared to 24- or even 48-hour ambulatory monitoring, HBPM is less expensive and offers more data over time [8]. This may also help with the diagnosis of masked and white-coat hypertension [9]. Additionally, it is very repeatable, has a higher predictive value and is very efficient for determining the duration of the effects of drugs [5].

There is a lack of research that has addressed the knowledge and attitudes of adult patients with hypertension toward BP self-monitoring. Therefore, the purpose of this study was to evaluate the knowledge, attitudes and practices of adult hypertensive patients regarding HBPM, as well as to find factors that influence HBPM in adult hypertensive patients.

Material and methods

Study design and population

This cross-sectional study evaluated the knowledge and practices of hypertensive Saudi patients regarding home blood pressure monitoring during the period from the beginning of March 2021 till the end of August 2021.

Data collection

Convenience sampling was used to recruit participants, who were approached by family and friends. They were requested to complete the surveys via a link created by the free, open-access "Google forms". The WhatsApp application was used to send the survey. The survey was provided in two languages on social media (Arabic - English). Inclusion criteria were patients of both genders with hypertension for more than six months who lived in Saudi Arabia and were over 18 years of age.

Questionnaire design

A structured questionnaire was used as a study tool. This tool was developed after consulting relevant studies conducted in Saudi Arabia and reviewing literature [5, 9–14]. The survey's objective was explained on the cover page of the questionnaire. Participants who received the self-administered survey verbally agreed to participate. A sample questionnaire was used as a pilot study to evaluate its readability and usability, as well as the relevancy of the questions. Based on the participants' recommendations, the questionnaire's reproducibility and the validity of the questions were updated. The final version of the questionnaire was classified into sections. The first section of the questionnaire covered socio-demographic data such as age, gender, educational level, marital status, occupation, residency, monthly income and current smoking status. The second section concerned data relevant to HTN such as a family history of HTN, duration of HTN, number of antihypertensive medications used, availability of health insurance and the presence of associated comorbidities. The third section concerned the healthcare providers evaluating the factors that affect HBPM. The fourth sec-

tion concerned the knowledge and attitudes regarding HBPM. In this section, it was assessed whether participants believe it is important, beneficial or inaccurate in any manner and if they would advise others to utilise HBPM.

The last section concerned the challenges for HBPM, such as the presence of health insurance, thinking that measuring blood pressure at home is inaccurate, knowing how to measure blood pressure at home, knowing normal blood pressure readings, remembering the last blood pressure reading and recording the BP measurements.

Medical students collected the information using an electronic questionnaire. The sample size was estimated using the G power calculator with a confidence level of 95% and a margin of error of 5%; a sample size of 800 participants was calculated, and we targeted 830 participants to compensate for any missing data.

Age was categorized into 3 groups (18–40, 41–60, over 60 years of age), and the 3 groups were compared.

The level of knowledge and practices of the participants were assessed based on the responses, where correct responses were given a score of 1, and incorrect response was given a score of 0. The score of each item was totalled to obtain the final knowledge and practice scores, which were then categorised based on percentages. A score of more than 75% was considered good, 60–75% was considered fair, and less than 60% was considered poor.

Statistical analysis

Statistical Package for the Social Sciences (SPSS) IBM statistics 20 was used to examine the data. To summarise the characteristics of the examined sample, descriptive statistics such as means, standard deviations, medians and interquartile ranges were employed. The *t*-Test was used to analyse the quantitative data, and the Chi-square test was used to determine the associations between the qualitative variables. Pearson correlation was utilised to evaluate the strength of the association between the quantitative variables. To find predictors of good knowledge and practices, logistic regression analysis was utilised. A statistical significance was defined as a *p*-value less than 0.05.

Ethical consideration

Permission to conduct the study was obtained from the Institutional Review Board (IRB) committee of Princess Nourah Bint Abdulrahman University. Approval was obtained on 16 August 2021 under the number 21-0328E.

Results

Socio-demographic data was evaluated in 830 participants. The majority (55.2%) belonged to the category of age ranging between 18–40 years, 70.7% were females, 66.1% had a university or higher education, 54.5% were married, 44% had a government job, 77.5% were living in the western region of Saudi Arabia, and 76.7% had a sufficient average monthly income (Table 1).

A family history of HTN was reported among 58.4%, and 46.3% had HTN for more than 6 years. It was found that 10.5% of the participants were using 3 drugs for HTN, and only 36.9% had health insurance. Associated comorbidities were reported by 38.6% of the participants, and 81.2% were current smokers (Table 2).

Regarding the attitudes and practices related to HTN, it was reported that 55.4% follow HTN treatment regimens with their physician. About three-quarters of the participants reported that they were advised to measure BP at home, and this advice was given by a physician in approx. 60% of cases. Approximately 53.7% reported that they checked their BP more than once a day, and approx. 57.2% did this both in the morning and evening. Only 27.1% stated that they record their BP measurements. Approximately 40% mentioned that they measure BP within 30 minutes of exercise. Nearly half of the participants reported comparing their home BP readings with the clinical readings (Table 3).

		<i>n</i>	%
Age (in years)	18–40	458	55.2
	41–60	289	34.8
	> 60	83	10.0
Gender	male	243	29.3
	female	587	70.7
Educational level	illiterate	25	3.0
	below university	256	30.8
	university or higher	549	66.1
Marital status	single	311	37.5
	married	452	54.5
	divorced	67	8.1
Employment	government	365	44.0
	private	100	12.0
	unemployed	365	44.0
Residence	western region	643	77.5
	central region	187	22.5
Average monthly income	sufficient	637	76.7
	insufficient	193	23.3

		Fre- quency	%
Family history of hypertension	yes	485	58.4
	no	345	41.6
Duration of hypertension	≤ 6 years	446	53.7
	> 6 years	384	46.3
Knowledge about the number of antihypertensive medications being used	yes	458	55.2
	not sure	133	16.0
	no	239	28.8
Number of antihypertensive medications used (<i>n</i> = 458)	1 drug	280	61.1
	2 drugs	130	28.4
	3 drugs	48	10.5
Presence of health insurance	yes	306	36.9
	no	524	63.1
Associated comorbidities	yes	320	38.6
	no	510	61.4
Smoking status	current smoker	674	81.2
	never smoked	74	8.9
	previous smoker	82	9.9

		<i>n</i>	%
Follow-up on antihypertensive treatment	yes	460	55.4
	no	370	44.6
Someone advised the measuring blood pressure at home	yes	612	73.7
	no	218	26.3
The person who advised the measuring blood pressure at home (<i>n</i> = 612)	physician	365	59.6
	friend	137	22.4
	others	110	18.0
Frequency of checking blood pressure	once a day	130	15.7
	more than once a day	446	53.7
	once a week	177	21.3
	twice a week	77	9.3

Home-monitored BP	yes	537	64.7
	no	293	35.3
Time of measuring blood pressure	morning	133	16.0
	evening	79	9.5
	morning & evening	475	57.2
	no specific time	143	17.2
Recording of BP measurements	yes	225	27.1
	no	605	72.9
Specific time measuring blood pressure	within 30 minutes of caffeine intake	206	24.8
	within 30 minutes of exercise	328	39.5
	in a noisy environment	156	18.8
	during stress	82	9.9
	no particular time	58	7.0
	Comparison of home blood pressure readings with clinical readings	yes	396
	no	434	52.3

It was reported by 70% and 84.5% of the participants that they knew how to measure BP, and they found measuring it at home important, respectively. About 45.1% of the participants had the opinion that measuring BP at home is inaccurate. 86.3% reported that they advised others to measure blood pressure at home for a follow-up, and 43.7% remembered their last BP reading. About 34.2% had the opinion that BP was higher when taken by a doctor than when measured at home, and 66.6% mentioned that BP should be recorded when sitting. Unfortunately, only half of the participants knew the normal BP reading (Table 4). The correct method of recording was mentioned by less than a third of the participants (data not shown).

		<i>n</i>	%
Know how to measure blood pressure at home	yes	581	70.0
	no	249	30.0
Think that measuring blood pressure at home is important	yes	701	84.5
	no	129	15.5
Think that measuring blood pressure at home is inaccurate	yes	374	45.1
	no	456	54.9
Advise others to measure blood pressure at home for a follow-up	yes	716	86.3
	no	114	13.7
Remember the last blood pressure reading	yes	363	43.7
	no	467	56.3
Know the normal blood pressure reading	yes	427	51.4
	no	403	48.6
Think that BP is higher when taken by a doctor than when measured at home	yes	284	34.2
	no	391	47.1
	not sure	155	18.7
Body position when you measure your blood pressure	other	147	17.7
	sitting	553	66.6
	lying on your back	130	15.7

The knowledge and practice level of the participants were assessed, where correct responses were given a score of 1, and incorrect responses were given a score of 0. The total score was calculated to get the knowledge and practice scores, which were then categorised based on percentages. A score of more than < 75% was considered good, 60–75% fair, and < 60% poor.

Our data showed that 41% had good knowledge, and only 18.8% demonstrated good practices (Table 5).

The assessment of the relationship between knowledge and practices with socio-demographic and other baseline characteristics is given in Table 6. The age of the participants did not show any statistically significant association with knowledge level, but the practices showed a significant association where those who were > 60 years of age had demonstrated comparatively better practices than others ($p < 0.05$). No statistically significant association was observed between both gender and educational lev-

el and knowledge and practice scores ($p > 0.05$). It was observed that participants who are married demonstrated significantly better knowledge ($p < 0.05$) and practices ($p < 0.001$). It was also observed that participants who had sufficient average monthly income and those with a positive family history of HTN had significantly better knowledge and practice scores ($p < 0.001$). Hypertensive patients who had other associated comorbidities demonstrated better knowledge and practice scores ($p < 0.05$).

There was no statistically significant association observed regarding the duration of HTN with knowledge and practice level ($p > 0.05$). Participants who were current smokers demonstrated significantly better knowledge, and those who were previous smokers had shown good practices ($p < 0.05$). Knowledge and practice scores were better in participants who had health insurance ($p < 0.05$) (Table 6).

Table 5. Frequency distribution of knowledge and practices

	Good	Fair	Poor	Total
Knowledge	340 (41.0%)	315 (38.0%)	175 (21.1%)	830 (100 %)
Practices	156 (18.8%)	367 (44.2%)	307 (37.0%)	830 (100 %)

Table 6. Relationship of knowledge and practices related to blood pressure recording with socio-demographic characteristics

		Knowledge			<i>p</i>	Practices			<i>p</i>
		Good	Fair	Poor		Good	Fair	Poor	
Age	18–40 years	177	173	108	0.295	72	198	188	0.023
		38.6	37.8	23.6		15.7	43.2	41.0	
	41–60 years	124	111	54		64	128	97	
		42.9	38.4	18.7		22.1	44.3	33.6	
	> 60 years	39	31	13		20	41	22	
		47.0	37.3	15.7		24.1	49.4	26.5	
Gender	male	98	94	51	0.959	47	104	92	0.869
		40.3	38.7	21.0		19.3	42.8	37.9	
	female	242	221	124		109	263	215	
		41.2	37.6	21.1		18.6	44.8	36.6	
Educational level	illiterate	4	13	8	0.118	3	11	11	0.845
		16.0	52.0	32.0		12.0	44.0	44.0	
	below university	111	91	54		46	117	93	
		43.4	35.5	21.1		18.0	45.7	36.3	
	university or higher	225	211	113		107	239	203	
		41.0	38.4	20.6		19.5	43.5	37.0	
Marital status	single	107	122	82	0.009	36	133	142	< 0.001
		34.4	39.2	26.4		11.6	42.8	45.7	
	married	207	164	81		108	198	146	
		45.8	36.3	17.9		23.9	43.8	32.3	
	divorced	26	29	12		12	36	19	
		38.8	43.3	17.9		17.9	53.7	28.4	
Occupation	government	163	130	72	0.278	77	157	131	0.094
		44.7	35.6	19.7		21.1	43.0	35.9	
	private	39	43	18		25	43	32	
		39.0	43.0	18.0		25.0	43.0	32.0	
	unemployed	138	142	85		54	167	144	
		37.8	38.9	23.3		14.8	45.8	39.5	
Region	western region	270	234	139	0.229	127	286	230	0.276
		42.0	36.4	21.6		19.8	44.5	35.8	
	central region	70	81	36		29	81	77	
		37.4	43.3	19.3		15.5	43.3	41.2	

Table 6. Relationship of knowledge and practices related to blood pressure recording with socio-demographic characteristics

		Knowledge			p	Practices			p
		Good	Fair	Poor		Good	Fair	Poor	
Average monthly income	sufficient	288	232	117	< 0.001	128	295	214	< 0.001
		45.2	36.4	18.4		20.1	46.3	33.6	
	insufficient	52	83	58		28	72	93	
		26.9	43.0	30.1		14.5	37.3	48.2	
Family history of hypertension	yes	220	193	72	< 0.001	114	234	137	< 0.001
		45.4	39.8	14.8		23.5	48.2	28.2	
	no	120	122	103		42	133	170	
		34.8	35.4	29.9		12.2	38.6	49.3	
Duration of hypertension	≤ 6 years	177	162	107	0.085	84	193	169	0.815
		39.7	36.3	24.0		18.8	43.3	37.9	
	> 6 years	163	153	68		72	174	138	
		42.4	39.8	17.7		18.8	45.3	35.9	
Chronic diseases	yes	156	114	50	< 0.001	77	142	101	0.003
		48.8	35.6	15.6		24.1	44.4	31.6	
	no	184	201	125		79	225	206	
		36.1	39.4	24.5		15.5	44.1	40.4	
Smoking status	current smoker	284	243	147	0.123	128	288	258	0.010
		42.1	36.1	21.8		19.0	42.7	38.3	
	never smoked	23	35	16		8	34	32	
		31.1	47.3	21.6		10.8	45.9	43.2	
	previous smoker	33	37	12		20	45	17	
		40.2	45.1	14.6		24.4	54.9	20.7	
Health insurance	yes	130	126	50	0.034	63	159	84	< 0.001
		42.5	41.2	16.3		20.6	52.0	27.5	
	no	210	189	125		93	208	223	
		40.1	36.1	23.9		17.7	39.7	42.6	
Medication used for hypertension (n = 458)	one drug	146	94	40	0.533	77	144	59	0.674
		52.1	33.6	14.3		27.5	51.4	21.1	
	two drugs	66	46	18		40	61	29	
		50.8	35.4	13.8		30.8	46.9	22.3	
	three drugs	22	22	4		10	25	13	
		45.8	45.8	8.3		20.8	52.1	27.1	

Discussion

The measurement of blood pressure provides critical information to aid in the diagnosis and monitoring of hypertension, allowing for a prompt response and appropriate treatment. Nonetheless, accurate measurement is required. Different organisations around the world have different recommendations at present for measuring blood pressure in an outpatient setting. As a result, clinical practice is unclear and lacking in standards. The majority of guidelines advise ambulatory and at-home blood pressure monitoring to confirm diagnoses outside of the clinic [4].

Our study aimed to evaluate the knowledge, attitudes and practices among hypertensive patients concerning home blood pressure monitoring in Saudi Arabia.

The results of the present study revealed that the knowledge related to BP measurements was moderate to high, whereas the practices were not satisfactory.

The gold standard for blood pressure measurement is office blood pressure monitoring (OBPM) [15]. However, HBPM provides better BP control and drug compliance [16]. In our study, only 47.7% of the participants mentioned they compared HBPM

with OBPM, and more than half checked their BP at least once daily. Patients with uncontrolled HTN may benefit from the use of HBPM in their daily care.

Evidence has shown that compared with OBPM, the use of HBPM is associated with significant reductions in systolic and diastolic BP and a reduced intake of antihypertensive drugs, as well as therapeutic resistance [17, 18]. However, it was surprising to note that only 51% of the participants identified normal BP values, which shows a wide gap between knowledge and current practices. A recent study done by Wake et al. reported that only 7.75% of hypertensive patients monitored their BP at home [19]. Our findings showed that 64.7% of HTN patients home-monitored BP, which is much higher than other studies done in the Czech Republic (40%), the United States (41.6%) and Canada (50%) [20–22]. Studies carried out in nearby Middle Eastern countries, such as Oman and Jordan, had reported a home-monitored BP prevalence of 40% and 82%, respectively [10, 23]. This variation may be the result of different sample sizes and sampling techniques. Our study used an online survey, and patients in the low-income category may not have participated due to service inaccessibility, which could underestimate the amount of blood pressure self-monitoring in our study.

The knowledge and practices related to BP measurement were comparatively better in participants who had a sufficient salary, which is similar to the findings by Tan et al. [24], which showed that BP home monitoring was higher in patients who had a higher income. This might be because patients who have higher incomes might be able to pay for their equipment fees, have access to media and can learn more about their medical conditions.

In our study, hypertensive patients who had associated comorbidities had better awareness of BP-related practices. This could be explained on the basis that having an awareness of HTN-related complications and a combined risk from comorbidities may increase the patient's consciousness concerning the seriousness of the disease, which could make the patient focus on HTN control through HBPM. This finding is supported by similar studies [14, 25].

The knowledge and practices among patients who had a family history of HTN were also comparatively better compared to others. This may be because these patients had already seen or had become acquainted with BP monitoring methods from their parents or other relatives.

Additionally, this study found that participants with health insurance had better knowledge and practice scores. These results are comparable to a study done in Ethiopia in which patients who had health insurance were almost four times as likely to self-monitor their blood pressure (AOR = 3.56, 95% CI [1.39, 10.53]) [5]. An American study that was undertaken backs up this conclusion [14]. This is likely to be due to the fact that medical expenses are covered, the patient may have access to the device through a health insurance system, and the patient may self-monitor their blood pressure.

HBPM is critical for HTN home management and has significant potential for enhancing the benefits of prevention of cardiovascular diseases [26]. However, the effective adoption of

HBPM demands a supportive system of education and communication [27].

We believe that various approaches may be needed for educational initiatives aimed at the general population to improve the knowledge and practices related to HBPM.

Strengths and limitations of the study

The strengths of this study include the large sample size of 830 individuals and that the general public's knowledge, attitudes and practices were all evaluated together. To our knowledge, this is the first research done in Saudi Arabia to assess the knowledge, attitudes and practices of the general population regarding HBPM. The primary limitation of this study is that it is subjected to response bias. Likely, non-responders' attitudes and practices differ greatly from those of the respondents. Secondly, there was selection bias due to the exclusion of participants who were unable to access the online survey and did not participate. Thirdly, the respondents to this survey tended to be educated, had smartphones and had email addresses, and thus the findings of our study might not match the knowledge, attitudes and behaviours of uneducated people. Finally, since this study was cross-sectional, causation was not addressed.

Conclusions

The knowledge of hypertensive patients related to HBPM was found to be moderate, while their practices were poor. Hypertensive patients > 60 years of age showed better practices. Both knowledge and practices were comparatively better in patients who were married, those who had a sufficient monthly income, those with a family history of HTN and those who had associated comorbidities.

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