Assessing the routine-practice gap for home blood pressure monitoring among Chinese adults with hypertension

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Abstract

Background: Home blood pressure monitoring (HBPM) is recommended and specified for diagnosis, treatment adjustment and management of most hypertension cases by hypertension guidelines. This study aimed to evaluate the HBPM behaviour and to explore the routine-practice gap among Chinese adults with hypertension.

Methods: Between October 2014 and November 2014, data were collected from 20 communities across three cities and six townships in three provinces located in Beijing, Shandong and Jiangsu Provinces in China. A total of 2,272 patients with hypertension aged ≥35 years were registered with a primary health station in local communities were selected by simple random sampling.

Results: Among 2,272 subjects, 45.3% owned a home sphygmomanometer. In addition, 27.5% (625/2,272) engaged in HBPM weekly or more frequently. Healthcare providers' advice was the strongest factor contributing to home sphygmomanometer ownership and weekly HBPM behaviour, with an odds ratio of 13.50 and 8.97. Patients with uncontrolled hypertension were more likely to conduct HBPM regularly (morning and evening), measure their BP two or three times in each measuring session and report 7 consecutive days of HBPM than patients with controlled hypertension (8.8% vs. 5.8%, P=0.042; 14.3% vs. 8.1%, P=0.002; and 19.9% vs. 12.4%, P=0.005, respectively). Only 16.0% (165/1,030) of patients actively reported their HBPM readings to doctors.

Conclusion: The strategies of HBPM specified by ESH/ESC hypertension guidelines (2013) and those from China (2018) are seldom achieved in current practice in China. Only a small proportion of patients actively participate in utilizing home BP measurements to enhance their care. HBPM may be improved by healthcare providers' specific advice and training.

Introduction

Previous studies have shown that HBPM is a useful tool to improve long-term adherence to antihypertensive drug treatment, and thereby improve hypertension control rates [1–4]. HBPM is also more efficacious for predicating morbidity and mortality associated with cardiovascular disease (CVD) than blood pressure (BP) measurement in clinics [5–7]. A series of guidelines [8–10] concerning hypertension emphasize the importance of HBPM for diagnosis, treatment adjustment and long-term follow-up for most hypertension cases and has become the useful method for patients' management in primary care settings [11, 12].

The latest guideline for High Blood Pressure in adults [9, 10] sets out monitoring protocol for home blood pressure (HBP) measurement to support the diagnosis and management of high BP. HBPM should be performed every morning and evening with 2–3 measurements each time and take the average; It is better to self-measure BP in the sitting position at fixed time after getting up in the morning, before taking antihypertensive medicines and breakfast, and after urination. It is recommended to measure HBP for consecutive three days at least, ideally, seven days before a clinic visit. Our simulation of ideal HBP

monitoring strategies is based on ESH/ESC hypertension guidelines (2013) [8] and those from China (2018) [9] that recommend namely, weekly HBPM, once in the morning and once in the evening for controlled hypertension and more frequent HBPM for uncontrolled hypertension. Optimally, patients should be performed every morning and evening with 2–3 measurements each time for consecutive seven days before a clinic visit.

Currently, most of health care providers encourage patients with hypertension to monitor their own BP at home [11, 12]. Previous studies reported proportions of patients with hypertension ranging from 29.7–84%, and noted that patients indicated their doctor encouraged them to perform HBPM; however, the prevalence of regular HBPM (at least once a week) in patients with hypertension varied and was lower than 30% in some countries and over 50% in others [13, 16]. However, regular HBPM behaviour (weekly HBPM, morning or evening measurement, readings each time and consecutive days) has not yet been reported in a population-based study. Additionally, little is known about the use of HBPM data to inform treatment adjustment. Therefore, we conducted this study to clarify the home sphygmomanometer ownership, regular HBPM behaviour and the application of HBPM readings for treatment adjustment. Meanwhile, we will explore the strongest factors contributing to HBPM improvement so as to minimize the gap with the guidelines.

Methods

This cross-sectional survey was conducted in October–November 2014. The study area included three cities (Qingdao city, Wuxi city and Beijing City) and six townships (Rushan, Yiyuan, Lianshui, Sheyang, Gaobeidian and Fatou) located in Shandong Province, Jiangsu Province and Beijing. Patients with hypertension who were registered with primary health stations in their local communities were selected. Inclusion criteria were: 1) aged over 35 years; and 2) a medical history of hypertension for a minimum of 3 months. Exclusion criteria were: 1) patients suffering from serious congestive heart failure, renal insufficiency and requiring dialysis treatment, and patients with cancer; and 2) patients registered in the community health records who did not live in that community. The required sample size was estimated by: $n= [t_{\alpha}2P (1-P)]/d^2$, $\alpha = 0.05$, $t_a \approx 2$, $d = 0.1P$. Ownership of a home sphygmomanometer among patients with hypertension in different areas in China ranges from 35–65%. Therefore, a sample size of 750 patients (350 patients from urban and 350 patients from rural) was sufficient for each province. Total of 20 communities were selected, they are: Two urban communities and 6 rural communities from Jiangsu and Shangdong province, respectively, two urban communities and 2 rural communities from Beijing. Every selected community provided the community health records including all patients with hypertension who met the inclusion criteria. Participants were randomly selected from this database using SPSS for Windows version 18.0 base on the proportional value. In addition, 15% of the entire sample size was also randomly selected from the community health records for replacement in cases of response failure. In total, 2,272 participants were recruited. Written informed consent was obtained from participants, each of whom was required to receive a face to face interview according to an interviewer-led questionnaire.

A structured questionnaire was developed by a team of researchers at the Beijing Institute of Heart Lung and Blood Vessel Diseases and Chinese Center for Disease Control and Prevention, The details of the questionnaire are shown in **additional file 1**. The survey questionnaire was pilot-tested on 30 hypertension volunteers in the community of Jiangsu to determine the participants' level of comprehension. The results of the pilot study have not been included in this paper.

The questionnaire concerned demographic information, family history and medical history, Life style, antihypertensive medications, BP monitoring behaviour and physical examination. The "HBPM behaviour" item comprised four questions according to hypertension guidelines recommendation [8, 9]: How many days did you conduct HBPM per week?; What time did you measure your blood pressure each day?; How many times did you conduct in each measuring session?; and Did you perform HBPM for 7 consecutive days during the last three month? The "application of HBPM readings" item comprised two questions to assess if participants' doctors requested their HBPM results and whether they proactively reported their HBPM results to their doctors. Participants' height, weight and BP were measured during the physical exam. Office BP was measured using a standard and validated upper arm medical electronic sphygmomanometer cuff placed on the right arm, supported at the level of the heart. The participants rested for at least 5 min in a seated position, two BP measurements should be taken 1–2 min apart and averaged for records. An additional measurement is required if the first two readings differ by > 5 mmHg, and the mean value of the three readings should be recorded [9, 10].

We defined uncontrolled office BP as SBP ≥ 140 mmHg and DBP ≥ 90 mmHg, and controlled office BP as SBP < 140 mmHg and DBP < 90 mmHg. Optimal home BP control was defined as HBP of < 135/85 mmHg. Home sphygmomanometer ownership was defined as participants who had an upper-arm electronic sphygmomanometer in their home. The prevalence of HBPM was defined as the proportion of participants who measured their BP at home and conducted measurement at least weekly. Regular HBPM behaviour was defined as participants who: 1) conducted HBPM at least weekly; 2) took at least two readings 1–2 min apart in the morning before taking medications and in the evening before supper; and 3) conducted HBPM for 7 consecutive days before a clinic visit. History of ischemic stroke was defined as: a history of symptoms/signs such as numbness, abnormal speech, transient blindness, vertigo, nausea, deviated eyes and mouth, hemiplegia or dribbling; consistent signs on a brain computed tomography or magnetic resonance imaging; and a diagnosis of ischemic stroke by a neurologist (including cerebral thrombosis or lacunar infarction). The presence of coronary heart disease (CHD) was defined by a history of coronary artery bypass grafting or coronary stent implantation, or hospitalization for myocardial infarction. A family history of ischemic cardiovascular disease (ISCVD) was defined as a diagnosis of ischemic stroke or CHD in a first-degree relative (sibling or parent). Current smokers were defined as those who reported having smoked ≥ 100 cigarettes during their lifetime and were smoking every day or some days at the time of interview. Current drinking was defined as alcohol intake of more than once per week during the previous 12 months. For adult males, alcohol drinking was defined as daily drinking beer over 750 ml, wine over 250 ml, or 38-degree alcoholic liquor over 75 g. For adult females, these quantities were 450 ml, 150 ml, and 50 g respectively. The body mass index (BMI) was calculated

as body mass in kilograms divided by height in meters squared. An overweight status was defined as a BMI of 24.0 to 27.9 kg/m^2, and obesity was defined as a BMI of ≥ 28.0 kg/m^2.

Data were input twice to guarantee data accuracy. If the data from the two databases were inconsistent, the original data on the questionnaire was checked. Statistical analysis was performed with SPSS for Windows version 18.0 (SPSS, Inc., Chicago, IL, USA). Chi-square tests were used to compare differences in proportions of different groups. Multiple backward stepwise logistic regression was performed to identify the the factors influencing sphygmomanometer ownership and weekly HBPM behaviour. All variables based on the chi-square test were entered into a multivariate model. Odds ratios and corresponding 95% confidence intervals (CI) were calculated for each independent variable. All reported P-values were two-tailed, and P-values less than 0.05 were considered statistically significant.

Results

All 2,272 participants (male 977, female 1,295) were included in the analyses. Participants' age ranged from 35–93 years, with a mean age of 64.2 ± 10.9 years. In total, 1,141 (50.2%) participants were from urban areas and 1,131 (49.8%) were from rural areas. Statistically significant differences were identified for all characteristics among the three provinces (Beijing, Jiangsu and Shandong) except sex. Table 1 presents participants' demographic characteristics, separated by city.

Table 1
General characteristics of study participants, *n* (%)

Characteristics	Total subjects	Different area			
		Beijing (N = 761)	Jiangsu (N = 758)	Shandong (N = 753)	*P*-Value
Sex					0.089
Male	977 (43.0)	344 (45.2)	333 (43.9)	300 (39.8)	
Female	1295 (57.0)	417 (54.8)	425 (56.1)	453 (60.2)	
Age group (y)					0.002
< 65	1091 (48.0)	337 (44.3)	402(53.0)	352 (46.7)	
≥ 65	1181 (52.0)	424 (55.7)	356(47.0)	401(53.3)	
Location of living					
Urban	1141 (50.2)	383 (50.3)	380 (49.8)	378 (50.2)	0.944
Rural	1131 (49.8)	378 (49.7)	378 (50.2)	375 (49.8)	
Educational level					< 0.001
Intermediate school or lower	1761 (77.5)	506 (66.5)	550 (72.6)	705 (93.6)	
Middle and High school	359 (15.8)	175 (23.0)	142 (18.7)	42 (5.6)	
≥College graduate	152 (6.7)	80 (10.5)	66 (8.7)	6 (0.8)	
Duration of hypertension (y)					< 0.001
<5	829 (36.5)	226 (29.7)	269 (35.5)	334 (44.4)	
5–9	673 (29.6)	251 (33.0)	194 (25.6)	228 (30.3)	
≥10	770 (33.9)	284 (37.3)	295 (38.9)	191 (25.4)	
Family history and medical history					

ISCVD, ischemic cardiovascular disease; HBPM, home blood pressure monitoring

Characteristics	Total subjects	Different area			
		Beijing (N = 761)	Jiangsu (N = 758)	Shandong (N = 753)	*P*-Value
Family history of ISCVD	390 (17.2)	173 (22.7)	125 (16.5)	92 (12.2)	< 0.001
History of ISCVD	240 (10.6)	118 (15.5)	69 (9.1)	53 (7.0)	< 0.001
History of diabetes	458 (20.2)	190 (25.0)	142 (18.7)	126 (16.7)	< 0.001
Lifestyle					
Current smoking	378 (16.6)	89 (11.7)	162 (21.4)	127 (16.9)	< 0.001
Current drinking	142 (18.1)	111 (14.6)	168 (22.2)	133 (17.7)	0.001
Overweight or Obesity	1516 (66.7)	386 (50.7)	518 (68.3)	612 (81.3)	< 0.001

ISCVD, ischemic cardiovascular disease; HBPM, home blood pressure monitoring

In total, 1,030 (45.3%) participants had a home sphygmomanometer: 77.1% in Beijing, 34.1% in Jiangsu and 23.9% in Shandong. HBPM was performed weekly or more frequently by 27.5% (625/2,272) of participants. Table 2 shows home sphygmomanometer ownership and prevalence of HBPM by different characteristics. Home sphygmomanometer ownership was likely to be higher in patients who were older, had a higher level of education, were treated with antihypertensive drugs, had controlled hypertension, had a history of CVD, lived in urban locations and had received advice regarding HBPM from a healthcare professional. The prevalence of HBPM was higher in patients who were aged 65 years and over, treated with antihypertensive drugs, lived in urban locations and received advice from a healthcare professional.

Table 2
Proportion of patients with a home sphygmomanometer and prevalence of HBPM, n (%)

	All subjects	Owning a home BP device		Conducting HBPM weekly	
	n = 2272	Yes (%)	*P*-value	Yes (%)	*P*-value
Sex			0.104		0.123
Male	977	462 (47.3)		285 (29.2)	
Female	1295	568 (43.9)		340 (26.3)	
Age (y)			< 0.001		< 0.001
<65	1091	375 (34.4)		212 (19.4)	
≥65	1181	655 (55.5)		413 (35.5)	
Area			< 0.001		< 0.001
Beijing	761	587 (77.1)		364 (47.8)	
Jiangsu	758	263 (34.7)		150 (19.8)	
Shandong	753	180 (23.9)		111 (14.7)	
Location of living			< 0.001		0.012
Urban	1141	703 (61.6)		445 (39.3)	
Rural	1131	327 (28.9)		180 (15.8)	
Educational level			< 0.001		< 0.001
Intermediate school or lower	1761	618 (35.1)		380 (21.6)	
Middle and High school	359	290 (80.8)		168 (46.8)	
≥College graduate	152	122 (80.3)		77 (50.7)	
History of ISCVD			< 0.001		0.004
Yes	240	135 (56.3)		85 (35.4)	
No	2032	895 (44.0)		540 (26.6)	
Duration of hypertension (y)			< 0.001		< 0.001
5	829	282 (34.0)		140 (16.9)	
5–9	673	317(47.1)		194 (28.8)	
≥10	770	431 (56.0)		291 (37.8)	

ISCVD, ischemic cardiovascular disease; HBPM, home blood pressure monitoring.

	All subjects	Owning a home BP device		Conducting HBPM weekly	
	n = 2272	Yes (%)	*P*-value	Yes (%)	*P*-value
Antihypertensive Medication			< 0.001		< 0.001
Yes	1598	804 (50.3)		507 (31.7)	
No	674	226 (33.5)		118 (17.5)	
Controlled hypertension			0.004		0.241
Yes	991	483 (48.7)		285 (28.8)	
No	1281	547 (42.7)		340 (26.5)	
Advice on HBPM from doctor			< 0.001		< 0.001
Yes	1541	952 (61.8)		584 (37.9)	
No	731	78 (10.7)		41 (5.6)	

ISCVD, ischemic cardiovascular disease; HBPM, home blood pressure monitoring.

Multivariate regression analysis showed that age, urban versus rural location, education level, other family members with hypertension, history of CVD, antihypertensive medication, BP control and advice on HBPM from healthcare providers were associated with home sphygmomanometer ownership. All the above factors were correlated to weekly HBPM behaviour except history of CVD. Healthcare providers' advice was the strongest factor contributing to home sphygmomanometer ownership and weekly HBPM behaviour, with an odds ratio of 13.50 and 8.97 (Table 3).

Table 3
Multivariate analysis on factors influencing home sphygmomanometer ownership and weekly HBPM behaviour

Factors	Owning a home BP device			Conducting HBPM weekly		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Age group	1.44	1.18–1.77	<0.001	1.82	1.46–2.25	<0.001
Location of living	0.30	0.28–0.33	<0.001	0.29	0.26–0.31	<0.001
Education level	2.04	1.85–2.26	<0.001	1.58	1.44–1.74	<0.001
Duration of hypertension	1.47	1.26–1.71	<0.001	1.67	1.28–1.99	<0.001
Other family members with hypertension	1.62	1.23–2.14	0.001	1.46	1.13–1.89	0.004
History of ISCVD	1.52	1.08–2.14	0.016	-	-	-
Antihypertensive medication	1.75	1.39–2.18	<0.001	1.21	1.06–1.40	0.006
Advice on HBPM from doctor	13.50	10.24–17.79	<0.001	8.97	6.40-12.57	<0.001

ISCVD, ischemic cardiovascular disease; HBPM, home blood pressure monitoring

Sex, BP control was adjusted in the analysis on factors influencing home sphygmomanometer ownership

Sex, BP control, history of ISCVD was adjusted in the analysis on factors influencing weekly HBPM behaviour

Table 4 shows participants' regular HBPM behaviour. Of those who had a home sphygmomanometer, the prevalence of HBPM was 59.0% in patients with good BP control and 62.2% in those with poor BP control. In addition, 5.8% of patients with good BP control conducted HBPM regularly in the morning and evening, compared with 8.8% of patients with poor BP control (P = 0.042). Furthermore, 8.1% of patients with good BP control measured their BP two or three times, compared with 14.3% of patients with poor BP control (P = 0.002). Patients with poor BP control (19.9%) were more likely to conduct HBPM for 7 consecutive days than patients with good BP control (12.4%, P = 0.005).

Table 4
Regular HBPM behaviour among participants who had a home sphygmomanometer, n (%)

Behaviour of HBPM	Controlled office BP (n = 483)	Uncontrolled office BP (n = 547)	*P*-value
Days of HBPM per week			0.302
Less than one day	198 (41.0)	207 (37.8)	
One or more days	285 (59.0)	340 (62.2)	
Time of HBPM			0.042
Irregular	376 (77.8)	390 (71.3)	
Regular in morning or evening	79 (16.4)	109 (19.9)	
Regular in morning and evening	28 (5.8)	48 (8.8)	
Times for each measuring			0.002
Only one time	444 (91.9)	469 (85.7)	
Two or three times	39 (8.1)	78 (14.3)	
Seventh-consecutive day of HBPM			0.005
Never	423 (87.6)	438 (80.1)	
Ever	60 (12.4)	109 (19.9)	

HBPM, home blood pressure monitoring

We asked participants who performed HBPM if their doctors requested their HBPM results and if they proactively reported their HBPM results to their doctors. Doctors requested HBPM results from 31.9% (328/1,030) of participants. Doctors were more likely to request HBPM results from patients with poor BP control than patients with good BP control (7.9% vs. 53%, P < 0.001). Only 16.0% (165/1,030) of patients proactively reported their HBPM readings to their doctors, and this was statistically higher in patients with poor BP control than patients with good BP control (5.2% vs. 25.6%, P < 0.001).

Participants who performed HBPM were requested to provide the latest readings. Among patients with controlled clinic hypertension, the control rate of HBP was 75.9% (367/483), and it was more likely to be higher among patients with office BP < 120/80 mmHg. Only few of patients provided morning BP value (n = 78) or evening (before bedtime) BP value (n = 57), the control rate of morning BP and evening BP was 52.6% and 64.1%, respectively, and optimal morning BP were higher among patients with office BP of < 120/80 mmHg, but no significant difference was found (P = 0.061) (Table 5).

Table 5
HBP control among patients with controlled office BP

Controlled office BP (mmHg)	Optimal HBP control n (%)	Optimal morning BP control n (%)	Optimal evening BP control n (%)
<120/80(n = 116)	99/116 (85.3)	17/25(68.0)	11/15 (73.3)
≥120/80(n = 367)	268/367 (73.0)	24/53(45.3)	26/42 (61.9)
P-value	0.007	0.061	0.426

HBP, home blood pressure

Discussion

This study assessed the status of home sphygmomanometer ownership and regular HBPM behaviour among Chinese adults with hypertension. The results showed that nearly half of patients had a home sphygmomanometer, but this varied across different provinces. More than a quarter of patients had weekly HBPM. The strategies of HBPM specified by ESH/ESC hypertension guidelines (2013) and those from China (2018) are seldom achieved in current practice. Only a small group of participants actively discussed their HBPM readings with their doctors. Healthcare professionals' advice was the strongest factor contributing to home sphygmomanometer ownership and weekly HBPM.

Use of HBPM has progressively increased over the last two decades. Initially, around 20% of patients with hypertension in developed countries used HBPM [16, 17], with current rates reported as 31–75% in studies across different countries [13–16]. A large difference was also found across different areas of China; with performing HBPM at least once a week reported by 52% in Zhejiang [18], 36.9% in Chengdu [19] and 42.8% in Beijing [20]. The present study showed that HBPM was performed by around 47.8% of patients in Beijing, 19.8% in Jiangsu and 14.7% in Shandong. The majority of previous studies showed a higher prevalence of HBPM among urban residents; however, rural residents comprised half of our sample, and we found a low proportion of rural patients had a home BP device.

Various factors may affect an individual purchasing a HBP device and using HBPM. Previous studies among general patients with hypertension (primary care or community settings) have shown inconsistent results. Some studies reported that patients with a higher education level, higher income, male sex and a younger age were more likely to adopt HBPM [2, 13, 21, 22], while other studies found higher HBPM use in older adults [14, 22, 23]. In this study, sex negatively affected adoption of HBPM, and older patients were more likely to use HBPM. Similarly, HBPM use has been associated with healthcare providers' advice on HBPM [12, 14, 23]. A study among patients with chronic kidney disease revealed the most common reason for not using HBPM was lack of advice by a physician (43.4%) [24]. Another study showed that 35.2% of patients were advised to perform HBPM by their doctor, with this proportion being 29.7% in Canada [14], about 50% in Japan [25] and the UK [26] and 62.1% in our study. Those result suggested that

healthcare professionals should promote HBPM use, especially among patients with hypertension who are younger, newly diagnosed with hypertension and rural patients.

Previous study used regular HBPM, which was defined as a respondent's self-report of monitoring their own BP at home, and performing this at least weekly [14, 22]. According to the hypertension guidelines [8, 9], we defined regular HBPM more clearly and completely. Studies have shown that daily or weekly use of HBPM is more likely to help BP control compared with monthly HBPM, and morning and night time BP are better to predict CHD and ischemic stroke than BP measured in the clinic and at other times [10]. Performing HBPM regularly in the morning and evening and taking each measurement two or three times is seldom achieved in current practice; about 20% of patients in our study with uncontrolled BP conducted HBPM for 7 consecutive days. According to the US National Health and Nutrition Examination Survey 2009–2010, patients who were treated, uncontrolled and received advice on HBPM engaged in weekly or more frequent HBPM, whereas patients who achieved the ideal control standard engaged in monthly HBPM [27].

Reasons for poor adherence to HBPM may include: 1) patients lack adequate knowledge about the optimal frequency of HBPM [19, 23, 28]; 2) presence of barriers to conducting regular HBPM for patients; 3) the lack of encouragement from healthcare providers or more detailed direction for HBPM was not provided to patients [24]; and 4) HBPM readings are seldom documented by doctors [29]. This suggests primary healthcare professionals have a duty to provide patients with instruction on correct measurement techniques and HBPM methodology, including measurement conditions and procedures (e.g., patient position, arm selection, cuff selection and data reporting). Similarly, healthcare professionals must guide patients in deciding on various aspects of their hypertension management, such as whether to start taking new measurements, the target HBPM reading and the frequency of HBPM performance.

HBPM readings are more informative for treatment adjustment than BP measurement in clinics. Despite this, HBPM readings were seldom documented by doctors. A Canadian study noted that only 19% of primary physicians used HBPM readings to guide therapy [29], although about 30% of patients shared their HBPM results with their health professional [14, 29]. In the present study, 31.9% of patients were asked their HBPM results by their doctors, and only 16.0% of patients proactively shared their readings with their doctors. With the development of BP telemonitoring technology and equipment, internet-based remote monitoring and management of HBP is expected to improve the application of HBPM readings in the future [30].

Optimal HBP control was obtained among patients with controlled office BP, but optimal morning BP control was significantly lower than that of the other time. Previous studies showed 50–60% of patients with controlled office BP had an elevated morning BP [31, 32]. Our findings are consistent with other previous publications in that 47.4% did not achieve the target for morning BP control among similar patients. Morning BP is now recognized to be superior to office BP in predicting cardiovascular risk, Thus, hypertension guidelines highlight the assessment of morning BP [33].

Several limitations of this study should be highlighted. First, given that the sample size was not large, the results may not be representative of all urban and rural areas in Shandong, Jiangsu and Beijing. Second, we did not investigate patients' knowledge of HBPM and common reasons for not using HBPM, so we cannot validate assumptions regarding such reasons (e.g. that few patients met the recommendations of HBPM guidelines, lack of HBPM knowledge or poor adherence to guideline recommendations). Third, there was no consideration of the direction from healthcare providers to investigate their efficacy, even if there was standard plan for HBPM in the guideline, guideline adherence was not evaluated. Fourth, the rate of home BP control was poorly representative because the results were not based on the uniform measuring standard and from a small group of patients especially the results of morning and evening BP control and the reporting bias existed because the device of home BP monitoring did not have a log-memory function.

Conclusions

In this study, we found that the sphygmomanometer ownership was relatively low in rural and variable across different areas in China. The recommendation of HBPM specified by ESH/ESC hypertension guidelines 2013 and those from China 2018 recommendation is seldom achieved in current practice in Chinese adults with hypertension. Patients with uncontrolled hypertension are more likely than those with controlled hypertension to report their home BP readings to their doctors, but that overall only a small proportion of patients actively participate in utilizing home blood pressure measurements to enhance their care. HBPM may achieve greater success by healthcare providers' specific advice and training, and new systems was needed to systematically collect home BP data and provide this information routinely to health professionals.

Abbreviations

BP: Blood pressure; HBP: Home blood pressure; HBPM: Home blood pressure monitoring; CHD: Coronary heart disease.

Declarations

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Authors' contributions

Provided conception and design of research: Hui-Juan Zuo and Ji-Xiang Ma. Collected data: Jin-Wen Wang and Xiao-Rong Chen. Analyzed data and interpreted results: Hui-Juan Zuo and Jin-Wen Wang.

Wrote the manuscript: Hui-Juan Zuo and Xiao-Rong Chen. All authors read and approved the final manuscript.

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Availability of data and materials

The raw dataset analyzed in the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was conducted according to the recommendations of the Declaration of Helsinki and was approved by the institutional review boards of the sixth clinical institute, Capital Medical University, Beijing, China. Written consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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