




REVIEW PAPER

Current status of home blood pressure monitoring in Asia: Statement from the HOPE Asia Network

Yook-Chin Chia MBBS, FRCP^{1,2} | Peera Buranakitjaroen MD, MSc, DPhil³ |
 Chen-Huan Chen MD⁴ | Romeo Divinagracia MD, MHSA⁵ | Satoshi Hoshide MD, PhD⁶  |
 Sungha Park MD, PhD⁷ | Jinho Shin MD⁸ | Saulat Siddique MBBS, MRCP(UK), FRCP(Lon)⁹ |
 Jorge Sison MD¹⁰ | Arieska Ann Soenarta MD¹¹ | Guru Prasad Sogunuru MD, DM^{12,13} |
 Jam Chin Tay MBBS, FAMS¹⁴ | Yuda Turana MD, PhD¹⁵ | Ji-Guang Wang MD, PhD¹⁶  |
 Lawrence Wong MD¹⁷ | Yuqing Zhang MD¹⁸ | Kazuomi Kario MD, PhD⁶  On behalf of the
 HOPE Asia Network

¹Department of Primary Care Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

²Sunway Institute for Healthcare Development, Sunway University, Selangor Darul Ehsan, Malaysia

³Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

⁴Department of Medicine, Faculty of Medicine, National Yang-Ming University, Taipei, Taiwan

⁵University of the East Ramon Magsaysay Memorial Medical Center Inc, Quezon City, Philippines

⁶Division of Cardiovascular Medicine, Department of Medicine, Jichi Medical University School of Medicine, Tochigi, Japan

⁷Division of Cardiology, Cardiovascular Hospital, Yonsei Health System, Seoul, Korea

⁸Faculty of Cardiology Service, Hanyang University Medical Center, Seongdong, Seoul, Korea

⁹Punjab Medical Center, Jail Road, Lahore, Pakistan

¹⁰Department of Medicine, Medical Center Manila, Ermita, Manila, Philippines

¹¹Department Cardiology and Vascular Medicine, Faculty of Medicine, Harapan Kita, University of Indonesia-National Cardiovascular Center, Jakarta, Indonesia

¹²Apollo Hospitals, Chennai, India

¹³College of Medical Sciences, Kathmandu University, Bharatpur, Nepal

¹⁴Department of General Medicine, Tan Tock Seng Hospital, Singapore, Singapore

¹⁵Department of Neurology, Faculty of Medicine, Atma Jaya Catholic University of Indonesia, North Jakarta, Jakarta, Indonesia

¹⁶Department of Hypertension, Centre for Epidemiological Studies and Clinical Trials, The Shanghai Institute of Hypertension, Shanghai Key Laboratory of Hypertension, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China

¹⁷Department of Medicine & Therapeutics, Division of Neurology, Chinese University of Hong Kong, Hong Kong

¹⁸Divisions of Hypertension and Heart Failure, Fu Wai Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Correspondence

Kazuomi Kario, Division of Cardiovascular Medicine, Jichi Medical University School of Medicine, Shimotsuke, Tochigi, Japan.
 Email: kkario@jichi.ac.jp

Hypertension represents a major burden in Asia, with a high prevalence rate but poor level of awareness and control reported in many countries in the region. Home blood pressure monitoring has been validated as an accurate and reliable measure of blood pressure that can help guide hypertension treatment as well as identify masked and white-coat hypertension. Despite its benefits, there has been limited research into home blood pressure monitoring in Asia. The authors reviewed the current evidence on home blood pressure monitoring in Asia, including but not limited to published literature, data presented at congresses, and national hypertension management

guidelines to determine the current utilization of home blood pressure monitoring in clinical practice in the region. Public policies to enable greater access to home blood pressure monitoring and its use in clinical care would add considerably to improving hypertension outcomes in Asia.

1 | BURDEN OF HYPERTENSION IN ASIA

Hypertension is the leading preventable cause of premature death worldwide.^{1,2} Globally, an estimated 1.4 billion persons in 2010 had hypertension, with the majority residing in low- and middle-income countries. Disparities in hypertension prevalence, awareness, treatment, and control rates are particularly evident in Asia, a diverse region that has seen significant increases in hypertension prevalence during the past 30 years.³ A systematic review of data from 33 Asian countries reported an overall hypertension prevalence of 27% (range, 13.6%–47.9%).⁴ Despite age-standardized hypertension prevalence rates having recently shown a slight downward trend in almost all Asian countries,⁵ there is still enormous variability in the rates of awareness, treatment, and control of hypertension in the region (Table 1).

Several factors contribute to the current hypertension burden in Asia, including acculturation to Western lifestyle, modernization, and urbanization.³ Other characteristics of hypertension in Asia that may contribute to the overall burden of disease include high salt intake with high salt sensitivity and an epidemic of obesity with concomitant metabolic syndrome.⁶

There is growing acknowledgment for the role of home blood pressure monitoring (HBPM) to evaluate and guide management of hypertension.⁷ HBPM is a simple tool for measuring blood pressure (BP) at home and is recommended by guidelines to obtain reliable

BP recordings because of its potential to improve hypertension control.⁸ Home systolic BP (SBP) <135 mm Hg and diastolic BP (DBP) <85 mm Hg are typically considered normal.⁹ In patients with hypertension and other risk factors, a more strict SBP level of <130 mm Hg can be recommended.¹⁰ In this article, the HOPE Asia (Hypertension Cardiovascular Outcome Prevention and Evidence in Asia) Network review the current evidence on HBPM in Asia, including but not limited to the key published literature from the region, data presented at congresses, and national hypertension management guidelines to determine the current utilization of HBPM in clinical practice in Asia.

2 | VALUE OF HBPM IN THE MANAGEMENT OF HYPERTENSION

Home BP monitoring (HBPM) has been heralded as a useful and reliable measure of BP. Rather than replacing clinic BP measurements and ambulatory BP monitoring (ABPM), HBPM is a complementary tool that helps to eliminate the white-coat effect and identify masked hypertension.⁸ HBPM can also improve patient awareness and treatment adherence by giving all patients with hypertension and their family members a more active role in the management of the disease.

The evidence supporting the use of out-of-clinic monitoring in general and HBPM in particular has increased substantially in recent

TABLE 1 Prevalence, awareness, treatment, and control of hypertension by country/region

	Prevalence, %	Awareness, %	Treated, %	Controlled, %	Reference
China	25.2	46.5	41.1	13.8	16
Hong Kong	31.6	46.2	69.7	25.8	22
India	29.8	25.1 (rural) 41.9 (urban)	24.9 (rural) 37.6 (urban)	10.7 (rural) 20.2 (urban)	26
Indonesia	26.5	35.8	NR	NR	29
Japan	60.0 (men) 45.0 (women)	NR	52.8 (men) 52.8 (women)	31.7 (men) 42.0 (women)	33
Korea	32.9 (men) 23.7 (women)	58.5 (men) 76.1 (women)	51.7 (men) 71.3 (women)	36.9 (men) 49.4 (women)	37
Malaysia	30.3	43.2	81.2	26.3	44, 60
Pakistan	50.3	29.6	18.0	5.5	49
Philippines	28.0	67.8	75.0	27.0	51
Singapore	23.5	73.7	NR	69.1	53
Taiwan	20.8	72.1	89.4	70.2	NHANES, 2013–2016, unpublished data
Thailand	24.7	55.3	49.2	60.4	NHES, 2014–2015, unpublished data

Abbreviations: NHANES, National Health and Nutrition Examination Survey; NHES, National Health Examination Survey; NR, not reported.

years and a systematic review found that clinic BP measurements yield higher BP levels than HBPM.¹¹ In the case of SBP, differences between clinic BP and HBPM increase with age and tend to be greater in men than women and in patients not receiving antihypertensive treatment.¹¹ HBPM can diagnose normotension with more certainty and the measurements correlate better with target organ damage and cardiovascular outcomes than clinic BP.¹¹⁻¹³ HBPM shows diagnostic agreement with ABPM in this regard and has also demonstrated superiority to clinic BP in terms of diagnosing uncontrolled hypertension, assessing antihypertensive drug effects, and improving patient adherence and hypertension control.¹¹⁻¹³ It is also more likely to yield reductions in antihypertensive medications and less likely to be associated with therapeutic inertia.¹⁴

3 | CURRENT STATUS OF HBPM IN ASIA

Recent findings from the Edvantage 360° multinational mixed-methods observational study suggest that despite a good understanding of the causes and consequences of hypertension among persons with high BP in Asia, there is a lack of urgency to control BP.¹⁵ Furthermore, doctors and patients have different expectations of one another, with a different view of what constitutes successful hypertension management and who is most responsible for achieving this goal. These findings suggest that doctors may provide better care for their patients by ensuring a common understanding of successful disease management. Moreover, the inclusion of HBPM in a person's care may be a useful strategy to ensure patients play a more active role in disease management.

The following country/region scenarios aim to illustrate the current status of HBPM utilization throughout Asia. The evidence was gathered and discussed during a meeting of the authors, who represent key figures among the national hypertension societies in Asia. Where published evidence was limited, the authors provided their own expert opinion on the current status in their country.

3.1 | China

3.1.1 | Hypertension prevalence

Figures published by the National Health and Family Planning Commission in 2015 revealed that the prevalence of hypertension in China is 25.2%, with 46.5%, 41.1%, and 13.8% of patients with hypertension aware of their condition, treated, and controlled, respectively.¹⁶

3.1.2 | Current status of HBPM in hypertension management

A number of studies involving HBPM have been conducted in China, including the ongoing ABPR (China Ambulatory and Home Blood Pressure Registry) in patients with hypertension. One study involving 3547 patients from the China ABPR utilized both 24-hour ABPM and 7-day HBPM to investigate the size of the morning BP surge in

TABLE 2 Key recommendations on home BP monitoring of the China consensus²¹

Recommendations
Home BP should be measured with validated automated upper-arm cuff devices that operate through the oscillometric technique
Home BP should be measured twice with an interval of 1 min, and the mean value used as the BP value for that occasion
The morning measurement should be taken within a few hours of waking up, after urination, before drug intake, and before breakfast, after 5 min of rest in a sitting position; the evening measurement should be taken before going to bed, after a meal, after drug intake, and after shower or bath (if any), after 5 min of rest in a sitting position. The legs should not be crossed when sitting
For the diagnosis and treatment of hypertension based on home BP, the mean of the values measured for 5 to 7 consecutive days should be used
Home BP $\geq 135/85$ mm Hg indicates hypertension, and $<130/80$ mm Hg indicates normotension. The presence of home BP in the range 130–134/80–84 mm Hg requires ambulatory BP monitoring
Antihypertensive treatment strategies should target a home BP level of $<135/85$ mm Hg

Abbreviation: BP, blood pressure.

Chinese patients.¹⁷ Approximately half of the patients had morning hypertension based on HBPM readings. An additional analysis of 1774 patients from the China ABPR found that HBPM had high specificity but low sensitivity in the diagnosis of white-coat and masked hypertension, and may therefore serve as a complementary tool to ABPM.¹⁸ One cross-sectional survey conducted in 1915 patients with hypertension in Shanghai found that 1011 (52.8%) individuals used HBPM.¹⁹ However, only 46.5% of HBPM users performed it using arm-cuff electronic devices, and the authors concluded that patient education is needed to improve the accuracy of HBPM in China.

3.1.3 | Hypertension and HBPM guidelines

Physicians in China currently follow the 2010 Chinese guidelines for the management of hypertension,²⁰ as well as the China consensus on the use of HBPM in the management of hypertension whose recommendations are summarized in Table 2.²¹

3.2 | Hong Kong

3.2.1 | Hypertension prevalence

A family cohort study from 2009–2011 reported a hypertension prevalence rate of 31.6% among adults aged 20 years and older in Hong Kong.²²

3.2.2 | Current status of HBPM in hypertension management

There has been limited investigation into the role of HBPM in Hong Kong, but two studies have been reported in recent years. The first

was a cluster randomized controlled trial in which half of 240 patients with hypertension received an education intervention focused on HBPM device use, with the other half receiving usual care.²³ A non-significant SBP drop of 1.88 mm Hg and a significant DBP drop of 3.84 mm Hg were observed in the intervention group at 3 months, indicating that a structured HBPM education program has the potential to improve BP control at least over the short term. The second study, a cross-sectional survey, found that 59% of patients with hypertension from a regional primary care clinic performed HBPM, with no significant difference in BP levels between users and nonusers of HBPM.²⁴

3.2.3 | Hypertension and HBPM guidelines

The Food and Health Bureau released their latest framework for hypertension management in primary care in 2013.²⁵ This briefly highlighted the advantages of HBPM in providing information on response to treatment and improving adherence, but raises the potential issue of unsupervised alteration of medication.

3.3 | India

3.3.1 | Hypertension prevalence

A 2014 meta-analysis found that the prevalence rate of hypertension in India was 29.8%, with the prevalence in the urban population significantly higher than the rural population.²⁶

3.3.2 | Current status of HBPM in hypertension management

There are limited data for India on home BP and HBPM. Although HBPM is referenced in local guidelines,²⁷ lack of awareness and poor compliance among patients contribute to a lack of uptake and impact, respectively. A single observational study of 30 treatment-naïve patients found that nocturnal BP measurement using an HBPM device may be a reliable and cost-effective method for detecting the early signs of end organ damage, such as left ventricular hypertrophy.²⁸

3.3.3 | Hypertension and HBPM guidelines

The Association of Physicians of India published their latest guidelines on hypertension management in 2013.²⁷ As part of maintenance and follow-up therapy, they recommend BP to be measured at least once every 2 weeks either at home or in the clinic.

3.4 | Indonesia

3.4.1 | Hypertension prevalence

Data from the 2013 Basic Health Research Survey showed a hypertension prevalence rate of 26.5% among adults aged 18 years and older.²⁹

3.4.2 | Current status of HBPM in hypertension management

Among patients with hypertension, HBPM is not routinely performed in Indonesia, with lack of awareness, device availability, and the perception that digital instruments lack accuracy for the measurement of BP seen as the main barriers to uptake. Data presented at congresses showed that SBP and DBP assessed using HBPM were significantly correlated with left ventricular mass index.³⁰ Another study found that HBPM is a reliable measure of BP variability, with a tendency towards a positive correlation to arterial stiffness.³¹

3.4.3 | Hypertension and HBPM guidelines

Several guidelines are in place in Indonesia to optimize BP control, including those issued by the Indonesian Society of Hypertension (INASH) and the Indonesian Heart Association, both in 2015. The INASH guidelines in particular were adopted based on the European Society of Hypertension (ESH)/European Society of Cardiology (ESC) 2013 guidelines.³²

3.5 | Japan

3.5.1 | Hypertension prevalence

Hypertension prevalence increases steeply with age in Japan and a national survey in 2010 found that 60% of Japanese men and 45% of women older than 30 years have hypertension, equivalent to around 43 million people.³³

3.5.2 | Current status of HBPM in hypertension management

Although treatment and control rates have increased in recent years, only around 30% of men and 40% of women have controlled BP. In Japan, HBPM is popular in clinical practice, and, where barriers do exist to its uptake and impact, these likely reflect patients' abilities to manage home BP data and take steps accordingly.

A multitude of studies have evaluated the use of HBPM in Japan. Among these, the Ohasama study evaluated HBPM in 1702 people aged 40 years and older in the general population and found a linear relationship between home BP levels and the risk of hemorrhagic and ischemic stroke.³⁴ The J-HOP (Japan Morning Surge-Home Blood Pressure) study was intended to determine the optimal time schedule for HBPM to best predict stroke and coronary artery disease (CAD) in 4310 Japanese people with a history of or risk factors for cardiovascular disease.³⁵ During a mean follow-up of 4 years, morning SBP measured at home was shown to improve the discrimination of incident stroke beyond traditional risk factors that included clinic SBP, whereas the addition of evening SBP reduced the discrimination of incident stroke. Although neither morning nor evening SBP improved risk prediction of CAD in the J-HOP study, a larger study of more than 21 000 patients with treated hypertension did find a strong correlation between morning home BP and future CAD and stroke events.³⁶

TABLE 3 Key recommendations on home BP monitoring of the Japanese Society of Hypertension guidelines³³

Recommendations
Home BP should be measured with upper-arm cuff devices using the cuff-oscillometric method
Home BP should be measured twice and the mean value used as the BP value on that occasion
The morning measurement should be taken within 1 h of waking, after urination, before dosing in the morning, and before breakfast, after 1 to 2 min of rest in a sitting position; the evening measurement should be taken prior to retiring to bed, after 1 to 2 min of rest in a sitting position. The legs should not be crossed when sitting
To evaluate hypertension, normal BP, and the effects of antihypertensive drugs based on home BP, the mean of the values measured 5 to 7 d/wk should be used
Home BP of 135/85 mm Hg indicates hypertension
When there is a discrepancy of diagnosis between clinic and home BP, a home BP-based diagnosis should have priority
Antihypertensive treatment strategies should target a home BP level of <135/85 mm Hg for young, middle-aged, and early-phase elderly patients, <145/85 mm Hg for late-phase elderly patients (<135/85 mm Hg if tolerated), <125/75 mm Hg in patients with diabetes mellitus or chronic kidney disease, and <135/85 mm Hg in patients with cerebrovascular diseases

Abbreviation: BP, blood pressure.

Moreover, the data suggested that morning home BP might be superior to clinic BP in this regard.

3.5.3 | Hypertension and HBPM guidelines

Physicians in Japan follow the Japanese Society of Hypertension (JSH) 2014 guidelines to support optimal BP control in their patients.³³ These include formal recommendations for HBPM, which are summarized in Table 3.

3.6 | Korea

3.6.1 | Hypertension prevalence

The prevalence of hypertension in Korea in 2011 was 28.5% among adults older than 30 years, with a sharp increase in prevalence among

older adults.³⁷ Overall, less than half of the Korean population has normal BP.

3.6.2 | Current status of HBPM in hypertension management

HBPM is routinely used in Korea, but the results of a recent survey suggest barriers to use do exist. In particular, there is a lack of resources to both initiate and maintain HBPM. A total of 55% of physicians reported difficulties in recommending HBPM and only 6.6% fully explained the HBPM protocol to their patients during visits. Other barriers include a lack of trust in the accuracy of HBPM devices and the ability of patients to perform HBPM accurately, as well as a general low public awareness of HBPM.³⁸ Nonvalidated HBPM devices are routinely used in clinical practice, reinforcing this perception.³⁹

Considerable effort has been made to study HBPM in Korea. Local data have shown that HBPM is equivalent to ABPM and superior to clinic BP in predicting subclinical target organ damage in patients with untreated hypertension.⁴⁰ In a randomized controlled trial of patients with hypertension, usual clinic care plus HBPM was used as a control group to evaluate the effectiveness of remote patient monitoring with or without remote physician care in reducing clinic BP.⁴¹ All three interventions resulted in similar SBP at 24 weeks. Furthermore, HBPM was shown to be a useful tool for discriminating white-coat hypertension and masked hypertension in Korean patients with diagnosed hypertension who had not changed their oral antihypertensive medication in the past 6 months.⁴² In those with masked hypertension, mean clinic BP was 130/80 mm Hg compared with 137/86 mm Hg for home BP. Conversely, among patients with white-coat hypertension, the mean clinic BP was 149/86 mm Hg compared with a home BP of 124/75 mm Hg. A further study investigated the optimal duration of HBPM for the diagnosis of hypertension and found that a 3-, 5-, or 7-day protocol all had similar diagnostic accuracy when compared with ABPM.⁴³

3.6.3 | Hypertension and HBPM guidelines

Physicians refer to the 2013 Korean Society of Hypertension (KSH) guidelines,³⁷ as well as international hypertension guidelines when managing patients. The 2013 KSH guidelines include specific recommendations on HBPM and are summarized in Table 4.

TABLE 4 Korean Society of Hypertension guidelines for the measurement of home blood pressure

Requirement	Description
Upper arm cuff	Wrist device should only be used when extreme obesity can cause errors; the device should be kept at the level of the heart
Time of measurement	1. Morning: within 1 h after waking up, after urination, before taking any antihypertensive drugs, before breakfast, and after 5 min of rest in a seated position 2. Evening: before bedtime, after 5 min of rest in a seated position 3. Other conditions if necessary
Frequency of measurement	One to three times per occasion
Period of measurement	As long as possible; 1 wk or more for the diagnosis of hypertension; over at least 5 to 7 d immediately preceding the visit during follow-up of treatment

Adapted from Shin et al.³⁷

3.7 | Malaysia

3.7.1 | Hypertension prevalence

According to 2015 National Health and Morbidity Survey data, the prevalence of hypertension was 30.3% in adults 18 years and older.⁴⁴

3.7.2 | Current status of HBPM in hypertension management

HBPM is more commonly used in urban areas, where the prevalence of hypertension is highest, but is not routinely used in clinical practice. The major barriers to uptake of HBPM are a lack of awareness among physicians, the cost of devices, and a lack of patient education. A nationwide telephone survey of more than 2500 participants with hypertension found that although 94% of respondents were aware of the importance of controlling hypertension, around 20% were not currently taking anti-hypertensive medication, and the authors advocated for strategies that motivated patient adherence, including HBPM.⁴⁵ A qualitative study explored the influence of self-owned HBPM devices in primary care patients with hypertension and found that patients who self-initiated HBPM reported a higher level of self-efficacy in the management of hypertension.⁴⁶ Furthermore, a small study at a primary care clinic in Kuala Lumpur assessed patient acceptance of a home BP telemonitoring service and found that patients needed help to interpret the meaning of monitored BP readings, suggesting that the implementation of HBPM requires a degree of patient education to optimize uptake.⁴⁷

3.7.3 | Hypertension and HBPM guidelines

Currently, physicians follow the Malaysian 2013 hypertension guidelines,⁴⁸ as well as relevant guidelines from Europe and America.³² While the Malaysian guidelines do discuss the merits of HBPM and how it should be performed, they do not explicitly recommend its use in the management of hypertension.

3.8 | Pakistan

3.8.1 | Hypertension prevalence

The prevalence rate of hypertension in those aged 18 to 69 years was estimated to be around 50% in a population-based survey from November 2013 to April 2014, with 70.4% of patients with hypertension being unaware of its presence.⁴⁹

3.8.2 | Current status of HBPM in hypertension management

No studies are currently available on HBPM usage in Pakistan but a study is being conducted to compare HBPM with ABPM in 130 patients with known hypertension. Although HBPM is being used in Pakistan, its use is not routine, with cost as a major barrier to uptake. Other barriers include a lack of awareness of its utility among patients

and physicians, low education and literacy levels in the general population, variability of results obtained using HBPM as a result of a large number of nonvalidated monitors on the market, and a lack of awareness of correct methodology in the use of HBPM with a resultant lack of confidence in HBPM among physicians.

3.8.3 | Hypertension and HBPM guidelines

National guidelines published in 2009 by the Pakistan Hypertension League and Pakistan Cardiac Society are available to support the management of hypertension in Pakistan,⁵⁰ but many physicians also refer to more recent National Institute for Health and Care Excellence and ESH/ESC guidelines.

3.9 | Philippines

3.9.1 | Hypertension prevalence

Data from the nationwide PRESYON 3 survey indicated a hypertension prevalence rate of 28%, with 75% of patients receiving treatment and 27% of those achieving adequate BP control.⁵¹

3.9.2 | Current status of HBPM in hypertension management

HBPM is performed in the Philippines, but not routinely, and there are no published data on the use of HBPM in the country. HBPM is currently used to investigate the status of BP control in patients with known hypertension who are taking treatment but with uncontrolled BP on follow-up. Some specialists use HBPM to make a diagnosis of hypertension in conjunction with clinic BP. Barriers to the use of HBPM include the cost and availability of HBPM devices, with only around 25% of the population with hypertension currently having access to such devices. Another barrier is the lack of trust among patients regarding the accuracy of their digital BP devices.

3.9.3 | Hypertension and HBPM guidelines

The Philippine Society of Hypertension released guidelines in 2011,⁵² but international guidelines continue to be widely used. There is a tendency among physicians to use US guidelines more than any other, with greater recognition of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) guidelines despite the recent publication of the Eighth Joint National Committee (JNC 8) guidelines.

3.10 | Singapore

3.10.1 | Hypertension prevalence

Ministry of Health data last published in 2010 showed that the prevalence rate of hypertension is 23.5% in adults aged 30 to 69 years.⁵³ Among those with hypertension, 26.3% had not been previously

diagnosed. Encouragingly, 69.1% of patients with treated hypertension had good BP control.

3.10.2 | Current status of HBPM in hypertension management

A randomized cross-sectional survey was implemented to investigate the use of HBPM in a local, multiracial population of patients with hypertension. The factors associated with HBPM use were higher patient socioeconomic status and documented DBP.⁵⁴ Non-use of HBPM was associated with a failure to recognize the benefits of HBPM, lack of awareness of HBPM, lack of understanding of device operation, and perception of device inaccuracy. Overall, more than 60% of survey participants were aware of HBPM but only 24% of patients used it. In recent years, HBPM has been more routinely adopted in Singapore, with physicians willing to recommend its use to their patients, and patients increasingly electing to use HBPM. Potential barriers to further uptake of HBPM include reluctance among patients to perform HBPM and device costs.

3.10.3 | Hypertension and HBPM guidelines

Most physicians in Singapore follow international guidelines such as the ESH/ESC and JNC guidelines for BP control. The latest national guidelines were published by the Ministry of Health in 2005,⁵⁵ and new guidelines are pending release. HBPM is recommended in patients suspected of having white-coat or masked hypertension but not as a routine measurement for the diagnosis and control of hypertension.

3.11 | Taiwan

3.11.1 | Hypertension prevalence

The 2013–2016 National Health and Nutrition Examination Survey found that the hypertension prevalence (adjusted according to the World Health Organization standardized population) was 20.8% in adults 19 years and older (unpublished data).

3.11.2 | Current status of HBPM in hypertension management

HBPM is often performed in Taiwan, but there has been no formal survey on the availability of home BP monitors in households. Most cardiologists generally encourage their patients to measure BP at home. Some physicians may have the perception that HBPM is not a reliable measure of BP. A study comparing clinic BP and HBPM with ABPM in patients undergoing peritoneal dialysis concluded that clinic and home BP measurements were correlated with ABPM.⁵⁶ A hypertension registry involving more than 2000 people with treated hypertension is ongoing, with data on HBPM expected to be analyzed in the near future.

3.11.3 | Hypertension and HBPM guidelines

Physicians in Taiwan typically follow guidelines of the Taiwan Society of Cardiology and the Taiwan Hypertension Society.⁵⁷ HBPM is included within their diagnosis algorithm as a complementary tool to office BP to help confirm white-coat or masked hypertension.

3.12 | Thailand

3.12.1 | Hypertension prevalence

According to the unpublished findings of the fifth National Health Examination Survey (2014–2015), the prevalence rate of hypertension was 24.7%, with an awareness rate of 55.3%.

3.12.2 | Current status of HBPM in hypertension management

HBPM is used in Thailand mainly to detect white-coat and masked hypertension, and for self-BP monitoring where affordable. HBPM has also been used by health workers to monitor BP among villagers in remote rural areas. The main barriers to its use are ignorance of its value among physicians, availability, and cost of the device. A number of studies have evaluated HBPM in Thailand. Among these, one study used HBPM to determine the clinical characteristics of patients with hypertension whose BP could be normalized for at least 1 year on treatment and remain normal following drug withdrawal.⁵⁸ The only factor that was predictive of sustained normotensive outcome was male sex.

3.12.3 | Hypertension and HBPM guidelines

Physicians in Thailand refer to the local Thai Hypertension Society 2015 guidelines for optimizing the management of hypertension, which briefly highlight the advantage of HBPM in detecting white-coat and masked hypertension.⁵⁹ The ESH/ESC guidelines are also commonly used.

4 | CONCLUSIONS AND FUTURE PERSPECTIVES

Despite hypertension being the most common modifiable risk factor for cardiovascular disease,¹⁴ hypertension control remains a serious challenge throughout Asia. Clearly there is an imperative for finding local solutions to improve hypertension management and this is reinforced by the Edvantage 360° study, which points to a need for physicians to better align with their patients for a common understanding of successful hypertension management.¹⁵ One way to achieve this is through the use of HBPM, which has the potential to increase a person's involvement in the management of their own disease. Since its introduction, HBPM has gained in popularity for the diagnosis, monitoring, and treatment of hypertension because of its

lack of white-coat effect, its ability to provide information of prognostic value, the close relationship of derived BP values with cardiovascular risk, and its association with larger BP declines when used for treatment monitoring and adjustment. Despite this evidence, its adoption in Asia has been slow. Considerable research into HBPM has been conducted in Japan and Korea, but elsewhere in the region the data are lacking and this may be the result of vast differences in healthcare provision and research funding available across Asia, inhibiting research into HBPM. Even where local data are available, HBPM utilization may be limited because of cost constraints, lack of understanding on how to use the devices by patients, and the absence of formal recommendations on HBPM in national guidelines. As such, there is a need to drive further research on HBPM specifically in Asia to generate the local evidence base to support its uptake. As devices become more affordable and additional data are generated, a concerted effort should be made among healthcare professionals in Asia to promote the value of HBPM in improving hypertension control in patients and to incorporate its use into national hypertension management guidelines.

DISCLOSURES

CH Chen has received honoraria as a member of a speaker's bureau for Pfizer. YC Chia has received honoraria and sponsorship to attend conferences and CME seminars from Abbott, Bayer, GlaxoSmithKline, Menarini, Merck Sharp & Dohme, Novartis, Orient Europharma, Pfizer, and Sanofi; and a research grant from Pfizer. R Divinagracia has received honoraria as a member of speakers' bureaus for Bayer, Novartis, and Pfizer. K Kario has received research grants from A&D Co., Bayer Yakuhin, Boehringer Ingelheim, Daiichi Sankyo, EA Pharma, Fukuda Denshi, Medtronic, Mitsubishi Tanabe Pharma Corporation, Mochida Pharmaceutical Co., Omron Healthcare, Otsuka, Takeda, and Teijin Pharma Co.; and honoraria from Daiichi Sankyo, Omron Healthcare, and Takeda. S Park has received research grants and honoraria from Pfizer. S Siddique has received honoraria from Bayer, GlaxoSmithKline, Pfizer, and Servier; and travel, accommodation and conference registration support from Atco Pharmaceutical, Highnoon Laboratories, Horizon Pharma, and Pfizer. GP Sogunuru has received a research grant related to hypertension monitoring and treatment from Pfizer. JG Wang has received research grants from Bayer, Pfizer, and Phillips; and lecture and consulting fees from Bayer, Daiichi Sankyo, MSD, Pfizer, Sanofi, and Servier. L Wong has received honoraria from Bristol-Myers Squibb and Pfizer. Y Zhang has received research grants from Bayer, Novartis, and Shuanghe; and lecture fees from Bayer, Daiichi Sankyo, Novartis, Pfizer, Sanofi, Servier, and Takeda. All other authors report no potential conflicts of interest in relation to this article.

ACKNOWLEDGMENTS

Editorial and writing support was provided by Howard Christian and Chris Facey of MIMS (Hong Kong) Limited and was funded by Pfizer.

REFERENCES

- Lewington S, Clarke R, Qizilbash N, Peto R, Collins R, Prospective Studies Collaboration. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet*. 2002;360:1903-1913.
- Mills KT, Bundy JD, Kelly TN, et al. Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation*. 2016;134:441-450.
- Angeli F, Reboldi G, Verdecchia P. The 2014 hypertension guidelines: implications for patients and practitioners in Asia. *Heart Asia*. 2015;7:21-25.
- Neupane D, McLachlan CS, Sharma R, et al. Prevalence of hypertension in member countries of South Asian Association for Regional Cooperation (SAARC): systematic review and meta-analysis. *Medicine (Baltimore)*. 2014;93:e74.
- World Health Organization. Prevalence of raised blood pressure, ages 18+, 2010-2014 (age standardized estimate). http://gamapserver.who.int/gho/interactive_charts/ncd/risk_factors/blood_pressure_prevalence/atlas.html. Accessed November 2, 2016.
- Kario K. Proposal of a new strategy for ambulatory blood pressure profile-based management of resistant hypertension in the era of renal denervation. *Hypertens Res*. 2013;36:478-484.
- Sheppard JP, Schwartz CL, Tucker KL, McManus RJ. Modern management and diagnosis of hypertension in the United Kingdom: home care and self-care. *Ann Glob Health*. 2016;82:274-287.
- Bonafini S, Fava C. Home blood pressure measurements: advantages and disadvantages compared to office and ambulatory monitoring. *Blood Press*. 2015;24:325-332.
- Mallick S, Kanthety R, Rahman M. Home blood pressure monitoring in clinical practice: a review. *Am J Med*. 2009;122:803-810.
- Lee HY, Park JB. The Korean society of hypertension guidelines for the management of hypertension in 2013: its essentials and key points. *Pulse (Basel)*. 2015;3:21-28.
- Verberk WJ, Kroon AA, Kessels AG, de Leeuw PW. Home blood pressure measurement: a systematic review. *J Am Coll Cardiol*. 2005;46:743-751.
- Bliziotis IA, Destounis A, Stergiou GS. Home versus ambulatory and office blood pressure in predicting target organ damage in hypertension: a systematic review and meta-analysis. *J Hypertens*. 2012;30:1289-1299.
- Fuchs SC, Mello RG, Fuchs FC. Home blood pressure monitoring is better predictor of cardiovascular disease and target organ damage than office blood pressure: a systematic review and meta-analysis. *Curr Cardiol Rep*. 2013;15:413.
- Agarwal R, Bills JE, Hecht TJ, Light RP. Role of home blood pressure monitoring in overcoming therapeutic inertia and improving hypertension control: a systematic review and meta-analysis. *Hypertension*. 2011;57:29-38.
- Rahman AR, Wang JG, Kwong GM, Morales DD, Sritara P, Sukmawan R. Perception of hypertension management by patients and doctors in Asia: potential to improve blood pressure control. *Asia Pac Fam Med*. 2015;14:2.
- National Health and Family Planning Commission. 2015 Report on Chinese Nutrition and Chronic Disease. 2015.
- Guo QH, Kang YY, Song J, et al. Prevalence and determinants of exaggerated morning surge and morning hypertension in Chinese: the China ambulatory and home blood pressure registry (ABPR). *J Hypertens*. 2016;34(suppl 1):e70.
- Kang YY, Li Y, Huang QF, et al. Accuracy of home versus ambulatory blood pressure monitoring in the diagnosis of white-coat and masked hypertension. *J Hypertens*. 2015;33:1580-1587.
- Wang Y, Wang Y, Gu H, et al. Use of home blood pressure monitoring among hypertensive adults in primary care: Minhang community survey. *Blood Press Monit*. 2014;19:140-144.

20. Liu LS; Writing Group of 2010 Chinese Guidelines for the Management of Hypertension. Chinese Guidelines for the Management of Hypertension. *Zhonghua Xin Xue Guan Bing Za Zhi*. 2010;39:579-615.
21. Wang JG; for the China HBPM Consensus Expert Panel. Home blood pressure monitoring: a China consensus document. *Chin J Hypertens*. 2012;20:525-529.
22. Leung GM, Ni MY, Wong PT, et al. Cohort Profile: FAMILY Cohort. *Int J Epidemiol*. 2017;46:e1.
23. Fung CS, Wong WC, Wong CK, Lee A, Lam CL. Home blood pressure monitoring: a trial on the effect of a structured education program. *Aust Fam Physician*. 2013;42:233-237.
24. Chiang L, Ng L. Home blood pressure monitoring of hypertensive patients in a primary care clinic in Hong Kong: a cross-sectional survey. *Hong Kong Practitioner*. 2015;37:1-9.
25. Department of Health. Hong Kong reference framework for hypertension care for adults in primary care settings. 2013. http://www.pco.gov.hk/english/resource/files/RF_HT_full.pdf. Accessed November 2, 2016.
26. Anchala R, Kannuri NK, Pant H, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens*. 2014;32:1170-1177.
27. Association of Physicians of India. Indian guidelines on hypertension (I.G.H.) - III. 2013. *J Assoc Physicians India* 2013;2(suppl):6-36.
28. Pai AU, Chakrapani M, Bhaskaran U, Kamath P. Study of home-monitored night blood pressure and its correlation with left ventricular hypertrophy in treatment-naïve hypertensive patients. *Singapore Med J*. 2012;53:95-98.
29. RISKESDAS. 2013. <http://www.depkes.go.id/resources/download/general/Hasil%20Riskasdas%202013.pdf> Accessed November 2, 2016.
30. Wiryawan IN, Hersunarti N, Antara P, Zulkarnain E, Siswanto BB, Soerasarso R. Home blood pressure has a better correlation with left ventricle mass index than office blood pressure in treated hypertensive patients. Presented at the 8th Scientific Meeting of the Indonesian Society of Hypertension; March 7-9, 2014; Jakarta, Indonesia. Abstract.
31. Andy S, Hersunarti N, Dakota I. Association between blood pressure variability measurement using home blood pressure monitoring and arterial stiffness measurement using pulse wave velocity. Presented at the 11th Meeting of the Asia Pacific Congress of Hypertension; June 4-7, 2015; Bali, Indonesia. Abstract.
32. Mancia G, Fagard R, Narkiewicz K, et al. 2013 ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Eur Heart J*. 2013;34:2159-2219.
33. Shimamoto K, Ando K, Fujita T, et al. Japanese Society of Hypertension Committee for Guidelines for the Management of Hypertension. The Japanese Society of Hypertension guidelines for the management of hypertension (JSH 2014). *Hypertens Res*. 2014;37:253-390.
34. Ohkubo T, Asayama K, Kikuya M, et al. Prediction of ischaemic and haemorrhagic stroke by self-measured blood pressure at home: the Ohasama study. *Blood Press Monit*. 2004;9:315-320.
35. Hoshida S, Yano Y, Haimoto H, et al. J-HOP Study Group. Morning and evening home blood pressure and risks of incident stroke and coronary artery disease in the Japanese general practice population: the Japan Morning Surge-Home Blood Pressure study. *Hypertension*. 2016;68:54-61.
36. Kario K, Saito I, Kushiro T, et al. Morning home blood pressure is a strong predictor of coronary artery disease: the HONEST study. *J Am Coll Cardiol*. 2016;67:1519-1527.
37. Shin J, Park JB, Kim K, et al., Guideline Committee of the Korean Society of Hypertension. 2013 Korean Society of Hypertension guidelines for the management of hypertension: part I--epidemiology and diagnosis of hypertension. *Clin Hypertens* 2015; 21: 1.
38. Park S, Lee J, Shin J, Kim CH. Korean physician perceptions of home blood pressure monitoring (HBPM) for hypertension patients. *J Hypertens*. 2016;34(suppl 1):e530-e531.
39. Jung MH, Kim GH, Kim JH, et al. Reliability of home blood pressure monitoring: in the context of validation and accuracy. *Blood Press Monit*. 2015;20:215-220.
40. Her AY, Kim YH, Rim SJ, et al. Home blood pressure is the predictor of subclinical target organ damage like ambulatory blood pressure monitoring in untreated hypertensive patients. *Anadolu Kardiyol Derg*. 2014;14:711-718.
41. Kim YN, Shin DG, Park S, Lee CH. Randomized clinical trial to assess the effectiveness of remote patient monitoring and physician care in reducing office blood pressure. *Hypertens Res*. 2015;38:491-497.
42. Yoon HJ, Ahn Y, Park JB, et al. Korean Hypertension Research Network. Are metabolic risk factors and target organ damage more frequent in masked hypertension than in white coat hypertension? *Clin Exp Hypertens*. 2010;32:480-485.
43. Kim J, Lee MY, Kim J, et al. 3C.03: optimal duration of home blood pressure measurements for the diagnosis of arterial hypertension: a prospective multicenter study. *J Hypertens*. 2015;33(suppl 1):e37.
44. Ministry of Health Malaysia. National Health and Morbidity Survey, 2015: Non-communicable diseases, risk factors and other health problems. <http://www.iku.gov.my/images/IKU/Document/REPORT/nhmsreport2015vol2.pdf>. Accessed November 2, 2016.
45. Khoo KL, Liew YM, Tan H, Sambhi JS, Hatijah BA. Patients' knowledge and attitude towards treatment and control of hypertension: a nationwide telephone survey conducted in Malaysia. *Med J Malaysia*. 1999;54:37-46.
46. Abdullah A, Othman S. The influence of self-owned home blood pressure monitoring (HBPM) on primary care patients with hypertension: a qualitative study. *BMC Fam Pract*. 2011;12:143.
47. Abdullah A, Liew SM, Hanafi NS, et al. What influences patients' acceptance of a blood pressure monitoring service in primary care? A qualitative study. *Patient Prefer Adherence*. 2016;10:99-106.
48. Malaysian Society of Hypertension. *Clinical practice guidelines on management of hypertension*. 4th ed. 2013. <http://www.msh.org.my/article/397>. Accessed November 2, 2016.
49. *Non-communicable Diseases Risk Factors Survey--Pakistan*. Pakistan Health Research Council. 2016. Islamabad, Pakistan: World Health Organization. ISBN 978-969-499-008-8.
50. National Guidelines for Detection, Prevention, Control & Management of Hypertension: A Consensus Document of Pakistan Hypertension League & Pakistan Cardiac Society. 2009. <http://www.phlpc.org/guideline/National%20Guidelines.pdf>. Accessed December 15, 2016.
51. Sison JA. Philippine Heart Association--Council on Hypertension Report on Survey of Hypertension (PRESYON 3). A report on prevalence of hypertension, awareness and treatment profile. 2013. <http://philheart.org/44/images/sison.pdf>. Accessed December 15, 2016.
52. The Multisectoral Task Force Consensus on the Detection and Management of Hypertension in the Philippines. Philippine clinical practice guidelines on the detection and management of hypertension. 2011. Philippine Society of Hypertension. 2012:001-13. [http://www.thefilipinodoctor.com/cpm_pdf/CPM15th%20HYPERTENSION%20\(PSH\).pdf](http://www.thefilipinodoctor.com/cpm_pdf/CPM15th%20HYPERTENSION%20(PSH).pdf). Accessed December 15, 2016.
53. Singapore Ministry of Health. National Health Survey, 2010. https://www.moh.gov.sg/content/moh_web/home/Publications/Reports/2011/national_health_survey2010.html. Accessed November 2, 2016.
54. Tan NC, Khin LW, Pagi R. Home blood-pressure monitoring among hypertensive patients in an Asian population. *J Hum Hypertens*. 2005;19:559-564.
55. Ministry of Health Singapore. Clinical practice guidelines: hypertension. 2005. https://www.moh.gov.sg/content/dam/moh_web/HPP/Doctors/cpg_medical/withdrawn/cpg_Hypertension-Jun%202005.pdf. Accessed November 2, 2016.

56. Wang MC, Tseng CC, Tsai WC, Huang JJ. Blood pressure and left ventricular hypertrophy in patients on different peritoneal dialysis regimens. *Perit Dial Int*. 2001;21:36-42.
57. Chiang CE, Wang TD, Ueng KC, et al. 2015 Guidelines of the Taiwan society of cardiology and the Taiwan hypertension society for the management of hypertension. *J Chin Med Assoc*. 2015;78:1-47.
58. Buranakitjaroen P, Phoojaroenchanachai M, Thongma P, Wimonsohonkitti R. Effect of anti-hypertensive medication withdrawal in well-controlled treated hypertensive patients: preliminary results. *J Med Assoc Thai*. 2016;99:133-141.
59. Thai Hypertension Society. Guidelines for the treatment of hypertension, 2015. <http://www.thaihypertension.org/files/GL%20HT%202015.pdf>. Accessed November 2, 2016.
60. Ministry of Health Malaysia. National Health and Morbidity Survey, 2006: Non-communicable diseases, risk factors and other health problems. <http://www.iku.gov.my/images/IKU/Document/REPORT/2006/ExecutiveSummary.pdf>. Accessed November 2, 2016.

How to cite this article: Chia YC, Buranakitjaroen P, Chen CH, et al. Current status of home blood pressure monitoring in Asia: Statement from the HOPE Asia Network. *J Clin Hypertens*. 2017;19:1192–1201. <https://doi.org/10.1111/jch.13058>