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Review Article

Ambulatory blood pressure monitoring for Indian hypertensive patients-where we stand right now?

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ABSTRACT

Hypertension remains a leading cause of morbidity and mortality globally, with significant impacts on public health due to its role in cardiovascular disease and stroke. In India, hypertension prevalence is estimated at 35.5%, emphasizing the need for effective management strategies. Traditional office blood pressure (OBP) measurements are widely used for screening, but they may not fully capture the variability and true patterns of BP. Out-of-office monitoring methods, particularly ambulatory BP monitoring (ABPM), provide a more precise and immediate assessment of BP, as endorsed by international guidelines. This article highlights the value of ABPM in identifying unique BP phenotypes and improving hypertension management, with a focus on its relevance and application within Indian healthcare settings.
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Keywords: Hypertension, Ambulatory blood pressure monitoring, Out-of-office BP, Antihypertensive therapy, Cardiovascular risk, Hypertension phenotypes

INTRODUCTION

Hypertension is a prevalent global disease and a leading contributor to premature morbidity and mortality. It significantly exacerbates serious conditions such as cardiovascular disease and stroke, thereby representing a critical public health issue. In India, the prevalence of hypertension according to the INDIAB-17 study was 35.5%.[1-3]

BP is a dynamic reflection of the condition of the cardiovascular system and is subject to short-term and long-term variability, also been referred to as BP variability, (BPV) it underlines the fluid and adaptive nature of the regulation of hemodynamics.[2] Out-of-office BP monitoring is emphasized as a crucial tool in diagnosis and management in almost all international guidelines on hypertension.

This comprised of two main methods of BP measurement: 24-hour ABPM and home BP monitoring (HBPM).[4-6] This article will focus on the significance of ABPM and current standing in the management of hypertension in Indian settings.

OVERVIEW OF ABPM

While office BP measurements (OBPM) are predominantly utilized for screening and diagnosing hypertension, they are prone to inaccuracies, measurement errors, and observer bias, as they represent a solitary reading obtained during a consultation and fail to capture the subject's actual BP fluctuations in real-life contexts.[7]

ABPM is an external BP monitoring technique employing the oscillometric method for a duration of 24 hours or more, yielding a superior and more precise evaluation of actual BP in rather than OBPM, which is designed to record multiple readings every 15 to 30 minutes or less frequently (e.g., hourly) during sleep to minimize disturbances over the 24-hour period.[1,8]

DIAGNOSTIC APPROACH

Hypertension, a leading global risk factor, accounts for 13% of attributable deaths, necessitating urgent attention to improve control rates to reduce cardiovascular disease morbidity and mortality. To optimally treat hypertension an precise diagnosis is required. ABPM aids in identifying and categorizing patients into distinct BP phenotype groups by determining their BP profiles and variability.[2]

Collective use of OBPM and ABPM measurements can reveal specific BP patterns with varying levels of office and out-of-office BP (Figure 1). In treatment-naïve individuals, these phenomena may be categorized as white coat hypertension (WCH, elevated OBP and normal out-of-office BP) or masked hypertension (MH, normal OBP and elevated out-of-office BP), respectively. In treated patients, these state of illness can be defined as white coat uncontrolled hypertension (WCUH, with raised office and normalized out-of-office BP), and masked uncontrolled hypertension (MUCH, with Controlled office BP with elevated out-of-office BP despite treatment), respectively.[2,8] Previous studies have demonstrated that both WCH and MH in untreated individuals, as well as WCUH and MUCH in treated patients, pose risks for higher occurrences of major cardiovascular events and hypertension-related hospitalizations.[7] BP is generally elevated during the daytime (or periods of awake) and lowered at night (or during sleep). Normally, BP drops by more than 10% at night, a pattern known as "dipping." When the nighttime drop is less than 10%, it is referred to as "non-dipping." Some individuals experience a rise in BP during sleep, known as the "riser" or "reverse dipping" pattern, where nighttime BP may exceed daytime levels, indicating nocturnal hypertension. "Extreme dipping" describes a pronounced nighttime BP reduction of over 20% or a night-to-day systolic or diastolic BP ratio below 0.8.[2]

Nocturnal hypertension ≥ 120/70 mmHg may suggest underlying comorbid conditions such as obstructive sleep apnea (OSA). The riser pattern of nocturnal BP is a "red flag" for the increased risks of stroke and cardiac events. Another key aspect of BPV is the morning surge, often likened to a "wake-up call" for the cardiovascular system. This surge, defined as the difference between the lowest nighttime BP and the BP measured 2 hours after awakening, is associated with a higher risk of cardiovascular and cerebrovascular events, especially haemorrhagic stroke.[2] In Asians, even small increases in BP are linked to a disproportionately higher risk of cardiovascular events, especially stroke, compared to Western populations.[2,9,10] Besides phenotypic detection, ABPM can also identify BP variations in autonomic dysfunction and clinical hypotension, so verifying the diagnosis of resistant hypertension and the ambulatory arterial stiffness index.[11]

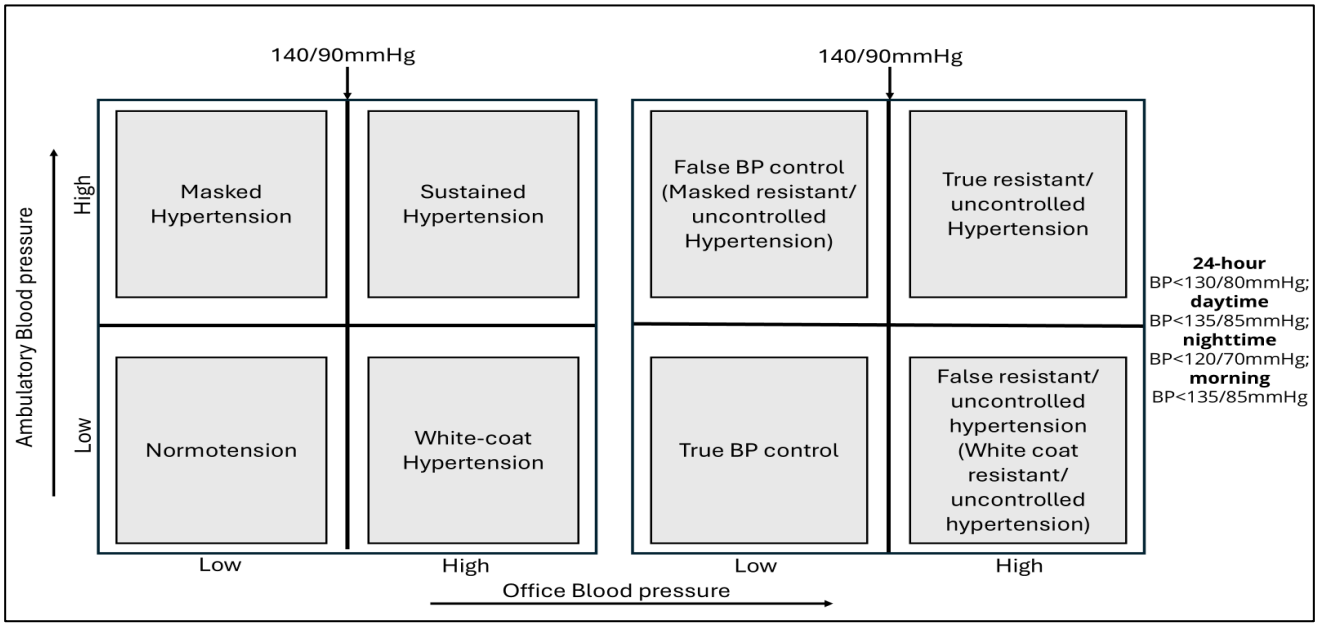

Figure 1: Differentiation of hypertension phenotypes.

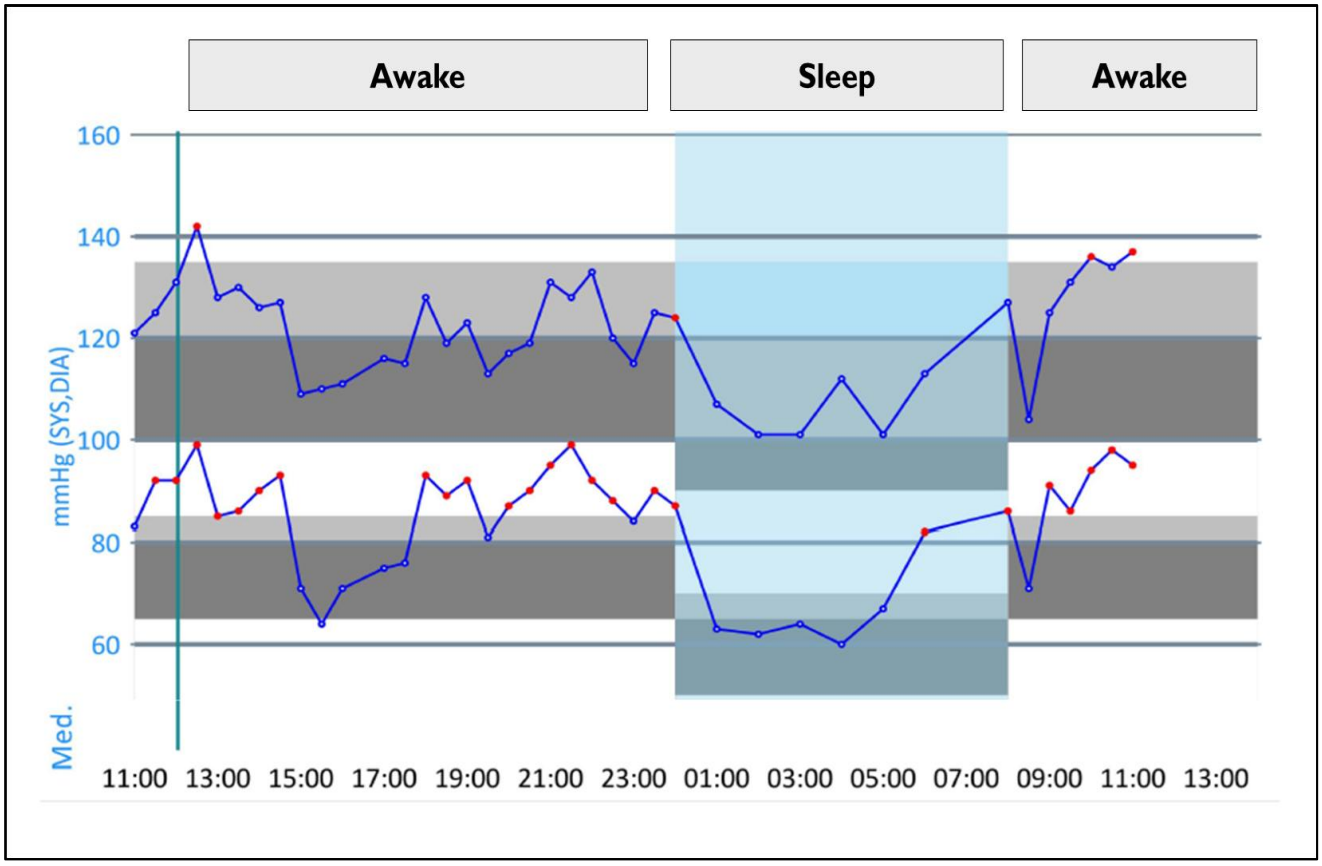

Figure 2: BP measures obtained using ABPM.

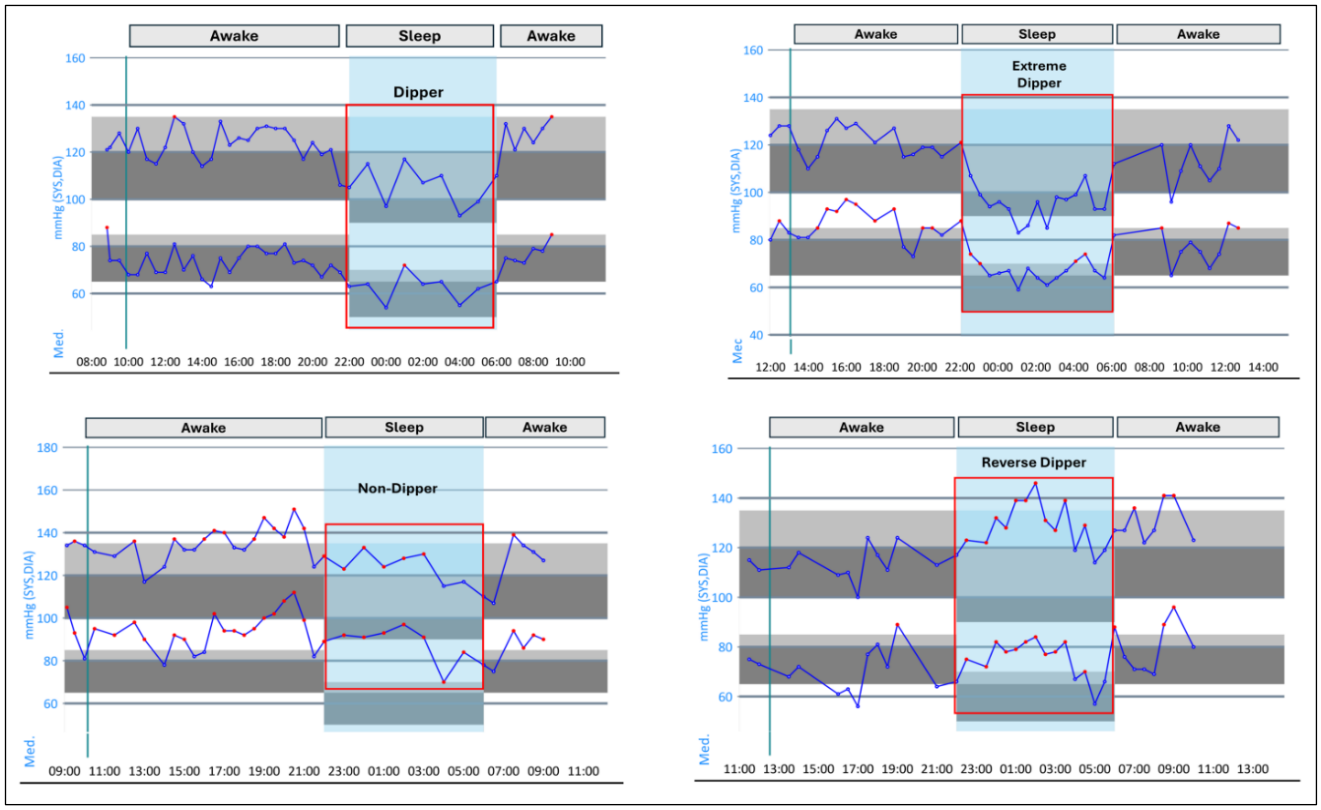

Figure 3: Hypertension phenotypes determined by ABPM.

GUIDELINE RECOMMENDED AND ABPM BP THRESHOLD FOR DIAGNOSIS

International guidelines from the national institute for health and care excellence (NICE), European society of hypertension (ESH), European society of cardiology (ESC), and American heart association (AHA) endorse the routine clinical application of ABPM, advocating its use alongside OBPM to enhance cardiovascular risk assessment, thereby providing superior reproducibility and prognostic significance.[4,5,12-14]

ABPM, which monitors BP during daily activities and sleep, establishes lower thresholds: an awake SBP of ≥135 mmHg or DBP of ≥85 mmHg, an asleep SBP of ≥120 mmHg or DBP of ≥70 mmHg, and a 24-hour average SBP of ≥130 mmHg or DBP of ≥80 mmHg.[15]

White coat hypertension (WCH) is characterized by elevated OBP (≥140/90 mmHg) with normal ABPM values, including 24-hour BP <130/80 mmHg, daytime BP <135/85 mmHg, nighttime BP <120/70 mmHg, and morning BP <135/85 mmHg. Conversely, MH occurs when office BP is normal (<140/90 mmHg), but ABPM detects elevated levels, such as 24-hour BP ≥130/80 mmHg, daytime BP ≥135/85 mmHg (masked daytime hypertension), nighttime BP ≥120/70 mmHg (masked nocturnal hypertension), or morning BP ≥135/85 mmHg (masked morning hypertension).[2,16,17]

A study conducted in India used ABPM to examine the prevalence of various types of hypertensions across different age groups. The results showed that the prevalence of WCH decreased from 12.4% in individuals under 30 years old to 6.9% in those over 80 years old. Additionally, the overall prevalence of MH was found to be 23%, with 14.8% of individuals with MH not receiving any treatment. The overall prevalence of sustained hypertension (SHT) was higher in treated patients than in untreated patients (65.3% vs 47.3%). These findings indicate that these patients require anti-hypertensive treatment, despite not currently receiving it.[18] The India ABPM study found that males aged 12-36 had higher office systolic and diastolic BP, while older males had lower SBP but higher DBP, with night-time SBP increasing more with age in both the genders. Further the same study revealed that among 27,472 patients, 8,597 (31.3%) would have been incorrectly diagnosed if only conventional OBPM had been used, highlighting a common issue in current Indian primary care practice. The misclassification rate was higher among untreated patients compared to those on treatment, with 35.2% and 26.7%, respectively. This is particularly concerning as a significant number of untreated patients with MH would not receive antihypertensive treatment based solely on OBP measurements, despite having the same cardiovascular risk as those receiving treatment.[12]

In an outpatient study that reviewed ABPM data, nearly 52% of patients on antihypertensive treatment had their therapy changed based on the records. For most patients with WUCH and sustained controlled hypertension, therapy was either deintensified or maintained. In contrast, therapy was intensified for those with MUCH and true uncontrolled hypertension (TUCH). Overall, ABPM demonstrated its value in enhancing clinical decision-making for antihypertensive treatment and optimizing BP management.[19]

THERAPY APPROACH

The guidelines unanimously advocate for ABPM in all patients being evaluated for BP-lowering medication.[20] Maintaining strict BP control throughout the 24-hour period is essential for all patients, but it is especially crucial for those of Asian descent, where the risk of cardiovascular events is heightened.[2] The hypertension profiles identified by ABPM in the illustrated cases (Figure 3) require significantly different therapy techniques compared to those based on OBP. The occurrence of nocturnal hypertension necessitates the evaluation of additional comorbidities, such secondary hypertension or OSA.[20] Considering the more significant impact of BP reduction on stroke and heart failure relative to coronary heart disease, along with the elevated incidence of these events among Asians, the advantageous effects of BP reduction may be more pronounced in Asian populations than in Western populations.[2] Consequently, regarding the commencement of treatment, there is general agreement that ABPM should be performed in all patients prior to the prescription of BP-lowering medicine.[20] Conventional BP targets using ABPM are <130/80 mmHg for the average 24-hour BP, <135/85 mmHg for daytime BP, <120/70 mmHg for nighttime BP, and <135/85 mmHg for morning BP. When applying more stringent threshold goals, the target BP would be <125/75 mmHg for the average 24-hour BP, <130/80 mmHg for daytime BP, <110/65 mmHg for nighttime BP, and <130/80 mmHg for morning BP.[2,16]

The best way to reliably evaluate the effects of antihypertensive treatment is through continuous ABPM. Upon achieving and documenting effective BP management, regular reassessment using ABPM will aid in sustaining 24-hour BP regulation.[16] When evaluating the efficacy of initial treatment in a treatment-naïve patient with varying BP profiles (Figure 3), 24-hour BP reductions are desirable, regardless of the patient's risk factors. However, when risk factors are present, achieving BP reductions becomes even more critical. Therefore, once treatment is initiated, it is reasonable to repeat ABPM within 2 to 3 weeks to assess whether adequate reductions have been achieved (Figure 2).[20]

Upon establishing control of daytime and overnight ABPM, assessments of long-term efficacy can be conducted every 6 to 12 months. The monitoring of systolic BP can provide confirmatory evidence that BP regulation is sustained, particularly during daytime hours.[20] In uncontrolled hypertension, it may be conducted

every 2-3 months until a normal 24-hour profile is achieved, however in managed hypertension, it may be performed annually.[11] Managing antihypertensive therapy based on 24-hour data from ABPM has demonstrated equivalent BP control with less intensive treatment compared to management based on OBP measurements. The percentage of patients reaching target BP in primary care was greater (by as much as 26%) when antihypertensive treatment was monitored with ABPM compared to OBP measurements.[2]

CV RISK ASSESSMENT

In addition to all the above phenotypes the guidelines suggest using absolute risk assessment for primary cardiovascular disease prevention, with BP being the most significant factor that can be modified. However, clinical inaccuracies can cause disparities between readings, highlighting the need for improved risk assessment methods. This can be accomplished by employing more rigorous techniques for measuring BP, such as the gold-standard ABPM. Real-world office BP may overestimate CVD risk due to higher systolic BP, which differ from research-grade protocols for BP measurements, causing a discrepancy in risk assessment.[21] Indeed the office BP has been shown to be 10 mmHg higher compared to standardized BP measurements protocols.[22] Additionally, studies have found that OBPM misclassified patients with high risk at twice the rate compared to ABPM or unobserved automatic office BP (AOBP).[21] Furthermore, another study revealed that about 10% of patients were reclassified after reassessment using HBPM and ABPM measurements.[23]

PROGNOSTIC VALUE OF ABPM

ABPM demonstrates greater reliability as a predictor of overall and cardiovascular mortality than OBPM.[12] Numerous ABPM investigations have revealed specific patterns and parameters as independent predictors of cardiovascular risk. Examples include dipping and early morning surge, as well as nocturnal and morning hypertension.[24] On the other hand, hypertension-related target-organ damage may indicate individual vulnerability to the detrimental effects of hypertension; specifically, elevated BP may be particularly harmful in individuals with target-organ damage. This could potentially contribute to a more pronounced association between 24-hour ABPM and cardiovascular outcomes in those with target-organ damage compared to those without.[25] Various indicators of target organ damage, such as cognitive impairment, left ventricular mass, coronary artery stenosis, microvascular disease, and arterial stiffness, have shown the strongest correlation with ABPM.[11] A study conducted among stroke patients in India revealed that both average OBPM and ABPM readings were significantly elevated in stroke patients compared to non-stroke patients. Furthermore, average morning BP showed a strong association with stroke, reinforcing previous findings that highlight it as a crucial cardiovascular risk factor.[24]

CHALLENGES IN IMPLEMENTING ABPM IN INDIA

Unfortunately, ABPM is a highly underutilized modality among physicians in India and the diagnosis of masked HT and white coat HT is missed in the routine OBPM.[11] In a cross-sectional, observational, questionnaire-based survey by Hiremath et al conducted at a cardiology conference (n=260), it was reported that 72% of physicians used ABPM in <5% of their patients, and 40% of them considered the use of ABPM in only 1% of patients.[26] The HOPE Asia network study reported that the use of ABPM in primary care settings is currently not an option in many Asian regions and it is used almost exclusively at referral centers.[2] Feasibility is limited mainly by the lack of device availability in primary care. Other barriers to its acceptance are cost, patient discomfort, and operational difficulties. Considering the benefit of avoiding misdiagnosis and mistreatment, preventing serious CV morbidity, the non-invasive nature, and the ease of procedure, there is an imminent need for more widespread utility of ABPM in India.[11] To overcome the limitations in ABPM availability and improve hypertension care in India, collaborative efforts are essential. Support can be sought from various healthcare organizations, government health programs, and pharmaceutical companies committed to advancing hypertension management. These stakeholders can assist by providing resources, funding, and technical support for ABPM access and training programs. This collaboration would enable broader reach and ensure that more healthcare facilities and practitioners have the tools and knowledge necessary to effectively utilize ABPM, ultimately enhancing patient outcomes in hypertension management across India.

CONCLUSION

In conclusion, ABPM is asset for managing hypertension in India. It provides superior insights into diagnosis, risk assessment, and treatment planning compared to traditional office-based readings. While ABPM offers significant advantages, its use in India is still limited due to factors like lack of awareness and accessibility. By addressing these challenges, we can significantly improve hypertension management in India, leading to better control rates and fewer complications. Research indicates that relying solely on office-based readings may not be enough to effectively manage cardiovascular risk. More comprehensive BP monitoring methods, like ABPM, are essential for accurate assessment.

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REFERENCES

1. Dadlani A, Madan K, Sawhney JPS. Ambulatory blood pressure monitoring in clinical practice. Indian Heart J. 2019;71(1):91-7.

2. Kario K, Hoshide S, Chia YC, Buranakitjaroen P, Siddique S, Shin J, et al. Guidance on ambulatory blood pressure monitoring: A statement from the HOPE Asia Network. J Clin Hypert. 2021;23(3):411-21.
3. Anjana RM, Unnikrishnan R, Deepa M, Pradeepa R, Tandon N, Das AK, et al. Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17). Lancet Diabetes Endocrinol. 2023;11(7):474-89.
4. McEvoy JW, McCarthy CP, Bruno RM, Brouwers S, Canavan MD, Ceconi C, et al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension: Developed by the task force on the management of elevated blood pressure and hypertension of the European Society of Cardiology (ESC) and endorsed by the European Society of Endocrinology (ESE) and the European Stroke Organisation (ESO). Eur Heart J. 2024;45(38):3912-4018.
5. Kreutz R, Brunström M, Burnier M, Grassi G, Januszewicz A, Muiesan ML, et al. 2024 European Society of Hypertension clinical practice guidelines for the management of arterial hypertension. Eur J Int Med. 2024;126:1-15.
6. Lee EM. When and how to use ambulatory blood pressure monitoring and home blood pressure monitoring for managing hypertension. Clin Hypertension. 2024;30(1):10.
7. Parati G, Lombardi C, Pengo M, Bilo G, Ochoa JE. Current challenges for hypertension management: From better hypertension diagnosis to improved patients' adherence and blood pressure control. Int J Cardiol. 2021;331:262-9.
8. Cepeda M, Pham P, Shimbo D. Status of ambulatory blood pressure monitoring and home blood pressure monitoring for the diagnosis and management of hypertension in the US: an up-to-date review. Hypertens Res. 2023;46(3):620-9.
9. Kario K, Chen CH, Park S, Park CG, Hoshide S, Cheng HM, et al. Consensus Document on Improving Hypertension Management in Asian Patients, Taking into Account Asian Characteristics. Hypertension. 2018;71(3):375-82.
10. Kario K, Wang JG. Could 130/80 mm Hg Be Adopted as the Diagnostic Threshold and Management Goal of Hypertension in Consideration of the Characteristics of Asian Populations? Hypertension. 2018;71(6):979-84.
11. Gupta P, Gupta A, Nagaraju SP, Penmatsa KR. The 5 Ws of Ambulatory Blood Pressure Monitoring. J Assoc Phys India. 2024;72(3):79-81.
12. Kaul U, Arambam P, Rao S, Kapoor S, Swahney JPS, Sharma K, et al. Usefulness of ambulatory blood pressure measurement for hypertension management in India: the India ABPM study. J Hum Hypertens 2020;34(6):457-67.
13. Recommendations | Hypertension in adults: diagnosis and management | Guidance | NICE. 2019. Available at: https://www.nice.org.uk/guidance/ng136/chapter/Recommendations#measuring-blood-pressure. Assessed on 18 October 2024.
14. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Hypertension. 2018;71(6):e13-115.
15. Mancia G, Kreutz R, Brunström M, Burnier M, Grassi G, Januszewicz A, et al. 2023 ESH Guidelines for the management of arterial hypertension The Task Force for the management of arterial hypertension of the European Society of Hypertension: Endorsed by the International Society of Hypertension (ISH) and the European Renal Association (ERA). J Hypertens. 2023;41(12):1874-2071.
16. Kario K, Shin J, Chen C, Buranakitjaroen P, Chia Y, Divinagracia R, et al. Expert panel consensus recommendations for ambulatory blood pressure monitoring in Asia: The HOPE Asia Network. J Clin Hypertens (Greenwich). 2019;21(9):1250-83.
17. Kario K, Park S, Chia Y, Sukonthasarn A, Turana Y, Shin J, et al. 2020 Consensus summary on the management of hypertension in Asia from the HOPE Asia Network. J Clin Hypertens (Greenwich) 2019;22(3):351-62.
18. Kaul U, Omboni S, Arambam P, Rao S, Kapoor S, Swahney JPS, et al. Blood pressure related to age: The India ABPM study. J Clin Hypertens (Greenwich). 2019;21(12):1784-94.
19. Nsutebu NS, Owusu IK, Buabeng KO, Bonsu KO. Ambulatory blood pressure monitoring and management of hypertension at a cardiac clinic in Kumasi Metropolis, Ghana. J Clin Hypert. 2020;22(4):605.
20. O'Brien E, Dolan E. Ambulatory Blood Pressure Monitoring for the Effective Management of Antihypertensive Drug Treatment. Clin Therapeut. 2016;38(10):2142-51.
21. Chapman N, Jayasinghe S, Moore MN, Picone DS, Schultz MG, Jose MD, et al. Absolute cardiovascular risk assessment using 'real world' clinic blood pressures compared to standardized unobserved and ambulatory methods: an observational study. Hypertens Res. 2024;47(10):2855-63.
22. Campbell NRC, Culleton BW, McKay DW. Misclassification of Blood Pressure by Usual Measurement in Ambulatory Physician Practices. Am J Hypert. 2005;18(12):1522-7.
23. Lay-Flurrie S, Stevens R, de Leeuw P, Kroon A, Greenfield S, Mohammed M, et al. Using out-of-office blood pressure measurements in established cardiovascular risk scores: a secondary analysis of data from two blood pressure monitoring studies. Brit J General Pract. 2019;69(683):E381-8.

24. Hegde SB, Aroor S, Anupama YJ, Hegde SN, Prajapati H, Verberk WJ. A comparative analysis of ambulatory blood pressure characteristics in acute stroke and non-stroke Indian patients. Blood Press Monit 2023;28(6):295-302.
25. Olesen TB, Stidsen JV, Blicher MK, Pareek M, Rasmussen S, Vishram-Nielsen JKK, et al. Impact of Age and Target-Organ Damage on Prognostic Value of 24-Hour Ambulatory Blood Pressure. Hypertension 2017;70(5):1034-41.
26. Hiremath JS, Katekhaye VM, Chamle VS, Jain RM, Bhargava AI. Current Practice of Hypertension in India: Focus on Blood Pressure Goals. J Clin Diagnost Res. 2016;10(12):OC25.

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