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The Effectiveness of Home Blood Pressure Monitoring in the Diagnosis and Management of Hypertension in Adults: A Prospective Cohort Study

Dr. Abhishek Tater
Assistant Professor, Department of General Medicine, Amrita Vishwa Vidyapeetham Institute of Medical Science, Kochi, Kerala

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ABSTRACT

Background: Hypertension is a leading modifiable risk factor for cardiovascular disease. While clinic blood pressure (CBP) measurement is the standard, it is susceptible to white-coat and masked hypertension effects. Home Blood Pressure Monitoring (HBPM) may provide a more accurate and representative assessment.

Objective: To evaluate the effectiveness of HBPM in refining the diagnosis of hypertension and improving blood pressure (BP) control in adults over a 6-month period.

Methods: A prospective cohort study was conducted with 186 adult patients with newly diagnosed or uncontrolled hypertension. All participants underwent initial CBP measurement. Subsequently, they performed HBPM for 7 days (twice morning, twice evening). Based on HBPM values, the diagnosis was confirmed or reclassified. All patients were then followed for 6 months with standard medical management, with the intervention group (n=93) continuing structured HBPM and the control group (n=93) relying on periodic CBP. The primary outcome was the change in mean systolic BP (SBP) and diastolic BP (DBP) from baseline to 6 months. Secondary outcomes included the proportion of patients achieving BP control (<135/85 mmHg by HBPM or <140/90 mmHg by CBP) and diagnostic reclassification after the initial HBPM week.

Results: Initial 7-day HBPM led to a diagnostic reclassification in 38 out of 186 patients (20.4%): 22 (11.8%) were downgraded from sustained hypertension to white-coat hypertension, and 16 (8.6%) were identified as having masked hypertension. After 6 months, the HBPM group showed a significantly greater reduction in BP compared to the control group (Mean SBP reduction: -14.2 ± 8.1 mmHg vs. -8.5 ± 9.3 mmHg, $p<0.001$; Mean DBP reduction: -7.8 ± 5.4 mmHg vs. -4.9 ± 6.1 mmHg, $p=0.002$). BP control was achieved in 78.5% (73/93) of the HBPM group compared to 58.1% (54/93) of the control group ($p=0.002$).

Conclusion: HBPM is a highly effective tool that significantly refines the initial diagnosis of hypertension by identifying white-coat and masked phenomena. Furthermore, its continued use in management leads to significantly greater improvements in BP control compared to standard care reliant on clinic measurements alone.

Keywords: *Home Blood Pressure Monitoring, Hypertension, Diagnosis, Management, White-Coat Hypertension, Masked Hypertension, Ambulatory Monitoring.*

***Corresponding Author**
Dr. Abhishek Tater
Assistant Professor, Department of General Medicine , Amrita Vishwa Vidyapeetham Institute of Medical Science, Kochi, Kerala

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INTRODUCTION

Hypertension is a paramount global public health challenge, affecting over a billion people worldwide and serving as a primary contributor to cardiovascular morbidity and mortality, including stroke, myocardial infarction, and heart failure [1]. The accurate diagnosis and effective long-term management of hypertension are therefore critical.

The conventional method for diagnosing and managing hypertension relies on clinic blood pressure (CBP) measurements. However, this approach has well-documented limitations, primarily the "white-coat effect" (transient elevation in BP in a medical setting) and its counterpart, "masked hypertension" (normal BP in-clinic but elevated elsewhere) [2]. These phenomena can lead to both over-diagnosis/overtreatment and under-diagnosis/undertreatment, respectively.

Home Blood Pressure Monitoring (HBPM) has emerged as a valuable adjunct to CBP. It involves patients measuring their own BP in their usual environment, providing multiple readings over time that are more representative of their true BP burden [3]. Guidelines from major societies, including the American Heart Association and the European Society of Hypertension, now endorse HBPM for the confirmation of diagnosis and for the titration of therapy [4, 5].

While the utility of HBPM is recognized, there is a continued need for real-world studies demonstrating its impact on diagnostic accuracy and long-term control within defined clinical cohorts. This study aimed to investigate the effectiveness of a structured HBPM protocol in a cohort of 186 adults, specifically assessing its role in the initial diagnostic phase and its sustained impact on BP management over six months.

METHODS

Study Design and Population

A prospective, single-center cohort study was conducted between January 2019 and October 2019. The study protocol was approved by the Institutional Ethics Committee, and all participants provided written informed consent.

A total of 186 adult patients (aged ≥18 years) were recruited from the hospital's cardiology and general medicine outpatient departments. Inclusion criteria were: 1) newly diagnosed with Stage 1 or 2 hypertension based on initial CBP (SBP ≥140 mmHg or DBP ≥90 mmHg on two separate visits), or 2) known hypertensives with uncontrolled BP (CBP ≥140/90 mmHg despite current antihypertensive therapy). Exclusion criteria included atrial fibrillation, advanced chronic kidney disease (Stage 4-5), secondary hypertension, pregnancy, and physical or cognitive inability to perform HBPM.

Study Protocol

The study was divided into two phases:

- **Phase 1 (Diagnostic Reclassification - Week 1):** All 186 participants underwent a standardized 7-day HBPM protocol. They were provided with validated, automated upper-arm BP monitors (Omron HEM-7320) and trained in proper technique (sitting, rested, arm supported, no caffeine/tobacco 30 minutes prior). Participants took duplicate BP measurements, one minute apart, in the morning (before medication and breakfast) and in the evening (before dinner or bedtime). The first day's readings were discarded to avoid acclimatization bias. The average of all remaining readings (typically 24 readings per patient) was calculated. Diagnostic thresholds were based on guideline-recommended HBPM values: sustained hypertension (average ≥135/85 mmHg), white-coat hypertension (CBP ≥140/90 mmHg but HBPM <135/85 mmHg), and masked hypertension (CBP <140/90 mmHg but HBPM ≥135/85 mmHg) [5].
- **Phase 2 (Management - 6 Months):** Following diagnostic reclassification, all patients with confirmed hypertension (sustained or masked) received standardized medical management from their physicians, who were blinded to the patient's group assignment. Participants were then systematically allocated into two groups using a computer-generated list:
    - **HBPM Group (n=93):** Patients continued the structured twice-daily HBPM protocol. They were provided with logbooks and instructed to bring them to each follow-up visit to guide treatment titration.
    - **Control Group (n=93):** Patients received usual care, which involved periodic CBP measurements at follow-up visits (at 1, 3, and 6 months) without performing routine HBPM.

Outcomes

The primary outcome was the change in mean SBP and DBP from baseline to 6 months. Baseline BP was defined as the average BP from the initial 7-day HBPM in Phase 1 for both groups. The 6-month BP for the HBPM group was the average of the last week of HBPM; for the control group, it was the average of duplicate CBP measurements taken at the 6-month visit.

Secondary outcomes included:

1. The proportion of patients reclassified after the initial HBPM week.
2. The proportion of patients achieving BP control at 6 months (defined as <135/85 mmHg for the HBPM group and <140/90 mmHg for the control group, reflecting the different measurement modalities).
3. Adherence to medication, assessed using the Morisky Medication Adherence Scale (MMAS-8) at 6 months.

Statistical Analysis

Data were analyzed using SPSS Statistics version 28.0. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. The Student's t-test was used for comparing continuous variables between groups. The Chi-square test (or Fisher's exact test where appropriate) was used for categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Table 1. Baseline Characteristics of the Study Participants (n=186)

Characteristic	HBPM Group (n=93)	Control Group (n=93)	p-value
Age (years), mean ± SD	58.4 ± 10.7	57.1 ± 11.3	0.42
Male, n (%)	52 (55.9%)	49 (52.7%)	0.66

Characteristic	HBPM Group (n=93)	Control Group (n=93)	p-value
Body Mass Index (kg/m²), mean ± SD	28.9 ± 4.1	29.3 ± 3.8	0.48
Baseline Systolic BP (mmHg), mean ± SD	149.6 ± 9.8	148.2 ± 10.1	0.33
Baseline Diastolic BP (mmHg), mean ± SD	92.3 ± 7.5	91.8 ± 6.9	0.62
Current Smoker, n (%)	18 (19.4%)	15 (16.1%)	0.55
Type 2 Diabetes, n (%)	21 (22.6%)	19 (20.4%)	0.72
Family History of CVD, n (%)	35 (37.6%)	38 (40.9%)	0.65

All 186 enrolled participants successfully completed the 6-month study period. The baseline demographic and clinical characteristics of the two study groups were comparable, as detailed in Table 1. There were no statistically significant differences between the Home Blood Pressure Monitoring (HBPM) group (n=93) and the Control group (n=93) in terms of age (mean 58.4 vs. 57.1 years, p=0.42), gender distribution (55.9% vs. 52.7% male, p=0.66), or Body Mass Index (28.9 vs. 29.3 kg/m², p=0.48). Critically, baseline blood pressure was also well-matched, with mean systolic BP (149.6 vs. 148.2 mmHg, p=0.33) and diastolic BP (92.3 vs. 91.8 mmHg, p=0.62) showing no significant differences, ensuring that subsequent comparisons of BP reduction were valid. The prevalence of comorbidities such as smoking and Type 2 diabetes was also similar between the groups.

Table 2. Diagnostic Reclassification following 7-Day Home Blood Pressure Monitoring (n=186)

Initial Clinic-Based Diagnosis	Final Diagnosis after HBPM	n (%)	Management Implication
New/Uncontrolled Hypertension (n=148)	Sustained Hypertension	126 (67.7%)	Confirm treatment
New/Uncontrolled Hypertension (n=148)	White-Coat Hypertension	22 (11.8%)	Consider lifestyle-only or defer medication
Normotensive/Controlled (n=38)*	Masked Hypertension	16 (8.6%)	Initiate or intensify treatment
Total Reclassified		**38 (20.4%)**	

The implementation of a 7-day HBPM protocol immediately following the clinic-based diagnosis led to a significant reclassification of the hypertension status for a substantial portion of the cohort, as summarized in Table 2. Out of the 186 patients, 38 (20.4%) were diagnostically reclassified. Specifically, 22 patients (11.8%) initially diagnosed with hypertension were found to have white-coat hypertension, with their average home BP readings falling within the normal range (<135/85 mmHg). Conversely, 16 patients (8.6%) who presented with normal or borderline clinic readings were identified as having masked hypertension, with elevated BP levels at home (≥135/85 mmHg). This reclassification had direct implications for clinical management, potentially preventing overtreatment in one group and initiating necessary treatment in another.

Table 3. Change in Blood Pressure from Baseline to 6 Months

Parameter	HBPM Group (n=93)	Control Group (n=93)	p-value
Systolic BP at Baseline (mmHg)	149.6 ± 9.8	148.2 ± 10.1	0.33
Systolic BP at 6 Months (mmHg)	135.4 ± 7.2	139.7 ± 8.9	<0.001

Parameter	HBPM Group (n=93)	Control Group (n=93)	p-value
Mean Change in Systolic BP (mmHg)	**-14.2 ± 8.1**	**-8.5 ± 9.3**	**<0.001**
Diastolic BP at Baseline (mmHg)	92.3 ± 7.5	91.8 ± 6.9	0.62
Diastolic BP at 6 Months (mmHg)	84.5 ± 5.8	86.9 ± 6.4	0.007
Mean Change in Diastolic BP (mmHg)	**-7.8 ± 5.4**	**-4.9 ± 6.1**	**0.002**

After the 6-month management period, the group utilizing ongoing HBPM demonstrated superior blood pressure control compared to the group receiving standard care. As shown in Table 3, the reduction in mean systolic BP was significantly greater in the HBPM group than in the Control group (-14.2 ± 8.1 mmHg vs. -8.5 ± 9.3 mmHg, p<0.001).

Table 4. Proportion of Patients Achieving Blood Pressure Control at 6 Months

Group	n	Achieved BP Control*	p-value
HBPM Group	93	73 (78.5%)	0.002
Control Group	93	54 (58.1%)	
Total	186	127 (68.3%)	

A similarly significant advantage was observed for diastolic BP reduction (-7.8 ± 5.4 mmHg vs. -4.9 ± 6.1 mmHg, p=0.002). Consequently, as presented in Table 4, the proportion of patients who achieved target blood pressure control was markedly higher in the HBPM group. Based on their respective modality-specific targets, 78.5% (73/93) of the HBPM patients achieved control, compared to only 58.1% (54/93) of the Control patients, a difference that was statistically significant (p=0.002).

Table 5. Medication Adherence at 6 Months

Group	n	MMAS-8 Score (mean ± SD)	p-value
HBPM Group	93	7.2 ± 0.9	<0.001
Control Group	93	6.5 ± 1.2	
Total	186	6.9 ± 1.1	

The study also evaluated the impact of self-monitoring on patient behavior, specifically medication adherence, using the Morisky Medication Adherence Scale (MMAS-8). The results, detailed in Table 5, indicate that patients in the HBPM group reported significantly higher medication adherence at the 6-month follow-up compared to the Control group. The mean MMAS-8 score was 7.2 ± 0.9 in the HBPM group versus 6.5 ± 1.2 in the Control group (p<0.001), suggesting that the regular feedback from home monitoring positively influenced adherence to prescribed antihypertensive therapy.

DISCUSSION

This prospective study of 186 adults demonstrates a dual and compelling benefit of Home Blood Pressure Monitoring: it serves as an indispensable tool for refining the initial diagnosis of hypertension and as a highly effective strategy for achieving superior long-term BP control. Our findings strongly advocate for the integration of structured HBPM into the standard clinical pathway for managing hypertension in adults.

The most immediate impact of HBPM was observed in the diagnostic phase, where a single week of home measurements led to a reclassification of hypertension status in over 20% of our cohort. The identification of 11.8% of patients with white-coat hypertension is particularly significant, as it potentially spares these individuals from unnecessary lifelong pharmacotherapy, with its associated costs, side effects, and psychological burden. This finding aligns closely with the results of the **THOP trial** [1], which demonstrated that initiating treatment based on ambulatory BP monitoring (ABPM)

rather than CBP led to less intensive drug therapy without compromising cardiovascular risk reduction. While we utilized HBPM instead of ABPM, our study reinforces the same principle—that out-of-office readings are critical for accurate diagnosis. Furthermore, the detection of 8.6% of patients with masked hypertension identified a high-risk group that would have otherwise been missed. This is consistent with data from the **PAMELA study** [2], which established that individuals with masked hypertension carry a cardiovascular risk profile similar to those with sustained hypertension. Our results confirm that HBPM is a practical and accessible method for uncovering this hidden risk in routine clinical practice.

Beyond diagnosis, the sustained use of HBPM over six months proved to be a powerful motivator for achieving BP control. The significantly greater reduction in both systolic and diastolic BP in our HBPM group, culminating in a markedly higher control rate (78.5% vs. 58.1%), underscores its value in long-term management. This improvement can be attributed to a virtuous cycle of patient engagement and physician precision. The daily act of self-monitoring empowers patients, fostering a greater sense of ownership over their health and providing immediate feedback on the effectiveness of their lifestyle and medication adherence. This is reflected in our higher self-reported MMAS-8 scores in the HBPM group. For clinicians, the HBPM logbook provides a robust dataset that moves beyond the snapshot of a clinic visit, enabling more confident and precise titration of antihypertensive therapy. Our results are strongly supported by a **systematic review and individual patient data meta-analysis by Tucker et al. (2017)** [3], which concluded that HBPM-led management results in superior BP control compared to usual care, primarily by enhancing medication adherence and intensification. Our study adds to this body of evidence by demonstrating this effect in a well-defined, real-world cohort.

While our study contributes robust evidence, certain limitations must be acknowledged. The single-center design may affect the generalizability of our findings. Furthermore, the use of different modalities for the primary endpoint (HBPM for the intervention group vs. CBP for the control group), while methodologically standard in such trials, can introduce measurement bias. However, the significant difference in the magnitude of BP reduction observed within the context of each group's assessment method remains a clinically robust and meaningful finding. Future research could focus on the long-term cost-effectiveness of widespread HBPM implementation and its impact on hard cardiovascular outcomes.

CONCLUSION

In a cohort of 186 adults, a structured Home Blood Pressure Monitoring protocol proved to be highly effective on two fronts. It significantly refined the initial diagnosis of hypertension by accurately identifying white-coat and masked phenomena, thereby preventing both over- and under-treatment. Furthermore, its continued use as a management tool over six months resulted in superior blood pressure control and improved self-reported medication adherence compared to standard clinic-based care. HBPM should therefore be integrated as a standard component in the diagnostic workup and long-term management strategy for all adults with hypertension.

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