

Original Research Article

Correlation between ambulatory blood pressure monitoring and office blood pressure monitoring in healthcare professionals

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ABSTRACT

Background: Hypertension is a leading global risk factor for cardiovascular morbidity and mortality. Accurate blood pressure (BP) measurement is crucial for effective diagnosis and management. Office blood pressure monitoring (OBPM) is commonly used but may be influenced by the white coat effect and masked hypertension, leading to misdiagnosis. Ambulatory blood pressure monitoring (ABPM), which records BP over 24 hours, provides a more comprehensive assessment, particularly in high-stress populations like healthcare professionals.

This study aimed to assess the prevalence of hypertension, white coat hypertension, and masked hypertension among healthcare professionals and evaluate the concordance between OBPM and ABPM.

Methods: A cross-sectional study was conducted at Maharani Laxmi Bai Medical College, Jhansi, involving 300 healthcare professionals, including doctors, nursing staff, and paramedical personnel. Participants underwent both OBPM under standardized conditions and 24-hour ABPM during routine activities. The data were analyzed to compare BP readings and identify discrepancies between the two methods.

Results: OBPM underestimated the prevalence of hypertension compared to ABPM. Among 300 participants, ABPM detected 26 individuals (8.67%) with masked hypertension and 17 (5.67%) with white coat hypertension. Significant discrepancies were observed, particularly in identifying nocturnal hypertension and BP variability.

Conclusions: The findings highlight the limitations of OBPM in diagnosing hypertension among healthcare professionals. ABPM provides a more accurate assessment, improving hypertension detection and management. Routine use of ABPM may help mitigate cardiovascular risk by identifying undiagnosed cases of hypertension.

Keywords: Hypertension, Ambulatory blood pressure monitoring, Office blood pressure monitoring, White coat hypertension, Masked hypertension

INTRODUCTION

High blood pressure (hypertension) is one of the leading causes of heart disease, stroke, and other serious health problems worldwide.^{1,2} Accurately measuring blood pressure is crucial for early diagnosis and proper management. Traditionally, doctors rely on office blood pressure monitoring (OBPM), where blood pressure is measured during a clinical visit.³ However, this method has limitations. Some individuals may experience higher readings due to stress in a clinical setting (white coat

hypertension), while others may have normal readings in the clinic but high blood pressure throughout the day (masked hypertension).⁴ These variations can lead to misdiagnosis and inappropriate treatment.

Ambulatory blood pressure monitoring (ABPM) offers a more comprehensive approach by measuring blood pressure over 24 hours during a person's regular daily activities and sleep.⁵ This method provides a better picture of how blood pressure fluctuates throughout the day and

night, helping to detect hidden hypertension and nighttime blood pressure abnormalities, which OBPM might miss.^{6,7}

Healthcare professionals work in high-stress environments, often with long hours and irregular schedules.⁸ These factors can affect their blood pressure, making them a unique group to study. Understanding the differences between OBPM and ABPM in this population can help identify hidden hypertension cases and improve blood pressure management strategies.

METHODS

Study design

This cross-sectional study was conducted in the Department of Medicine at Maharani Laxmi Bai Medical College, Jhansi. A total of 300 healthcare professionals participated in the study, which was carried out over a period of 18 months, from March 2023 to August 2024.

Inclusion criteria

Healthcare professionals (doctors, nursing staff, paramedical staff and class IV healthcare workers) working at M.L.B. Medical College, Jhansi, who gave consent for the study were included.

Exclusion criteria

Subjects who were unable to provide consent/refused to provide consent were excluded.

Data collection procedure

Office blood pressure measurements

In all cases, the blood pressure measurements were taken with due precaution i.e., individual were seated quietly in a chair with feet on the floor for 5 min in a private, quite setting with a comfortable room temperature. No caffeine for preceding hour, no smoking for preceding 30 min and appropriate size cuff bladder was used. Office blood pressure was staged according to JNC8 classification.

Ambulatory blood pressure measurements

The portable ambulatory blood pressure monitor was programmed to measure the blood pressure at 15 min intervals from 06:00 hours to 22:00 hours and at 30 min intervals from 22:00 hours to 06:00 hours.

Subjects were categorized based on OBPM and ABPM in four categories - true normotension: normal OBPM + normal 24-hour + normal daytime + normal night-time BP; true hypertension: elevated OBPM + elevated 24-hour or elevated daytime or elevated night-time BP; white-coat hypertension (WCH): elevated OBPM + normal 24-hour + normal daytime + normal night-time BP; and masked

hypertension (MH): normal OBPM + elevated 24-hour or elevated daytime or elevated night-time BP.

Plan for data analysis

Data analysis was done with the help of using statistical package for the social sciences (SPSS) software. Using this software, range, frequencies, percentage, and mean, standard deviation and p values were calculated. Chi-square was used to test the significance.

RESULTS

The study included 300 healthcare professionals, meeting both inclusion and exclusion criteria.

Among participants, there were 145 interns (48.33%), 63 PG students (21%), 54 UG students (18%), 12 nursing staff (4%), 3 consultants (1%), 10 senior residents (3.33%), 10 ward boys (3.33%), and 3 sweepers (1%). The mean age was 27.04 ± 3.13 , with a male-to-female ratio of 182:118. Consultants had the highest mean age of 38.67 ± 5.51 , while undergraduates were the youngest at 24.17 ± 0.70 . The average weight, height, and body mass index (BMI) of the sample were 67.92 ± 10.31 kg, 170.3 ± 6.21 cm, and 23.35 ± 2.82 , respectively. Consultants had the highest averages: weight of 87.33 ± 2.08 kg, height of 176.00 ± 5.56 cm, and BMI of 28.22 ± 1.12 ; undergraduates had the lowest averages: weight of 64.02 ± 10.25 kg, height of 170.31 ± 5.04 cm, and BMI of 22.03 ± 3.16 (Table 1).

Out of all subjects on OBPM, 131 had normal blood pressure, 145 were pre-hypertensive, 23 had stage I hypertension, and 1 had stage II hypertension. Consultants exhibited the highest mean systolic (131.33 ± 12.05 mmHg) and diastolic (81.00 ± 8.54 mmHg) office blood pressures; interns had the lowest mean values (119.10 ± 12.22 mmHg systolic and 70.65 ± 8.04 mmHg diastolic). While on ABPM 250 subjects were normotensive (true normotensive) and 7 were hypertensive (true hypertensive) on both OBPM as well as ABPM. While OBPM falsely diagnosed hypertension in 17 subjects (whitecoat hypertension) and failed to diagnose hypertension in 26 subjects (masked hypertension). We also calculated distribution of nocturnal dipping patterns across different professional groups. A statistically significant number of interns were dippers, reflecting normal nocturnal blood pressure behaviour. However, the presence of non-dippers and reverse dippers in groups like consultants, PG students and senior residents may suggest the influence of occupational stress on blood pressure regulation (Table 2).

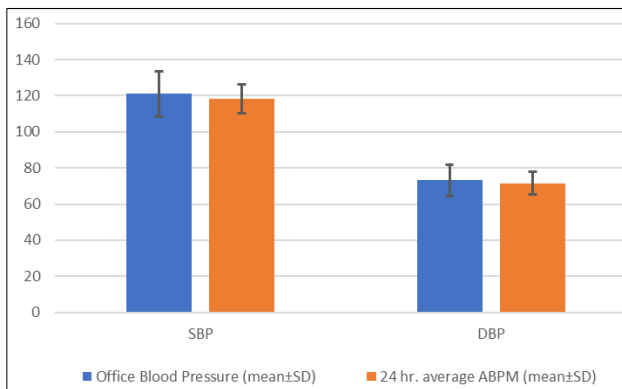
In our study, we compared office blood pressure (OBP) measurements with 24-hour average ambulatory blood pressure (ABPM) for systolic blood pressure (SBP) and diastolic blood pressure (DBP). Both SBP and DBP measurements showed statistically significant differences between office and 24-hour average ambulatory readings, with office BP being higher (Figure 1).

Table 1: Demographic profile of the subjects.

Groups	Percentage	Mean age (in years)	Sex		BMI (kg/m ²)
			Male	Female	
Consultant	1.00	38.67±5.50	3	0	28.22±1.12
Senior resident	3.33	30.2±0.63	5	5	23.17±1.91
PG student	21.00	27.76±1.48	47	16	24.30±2.99
Intern	48.33	26.19±0.71	76	69	23.20±2.43
UG student	18.00	24.17±0.70	34	20	22.03±3.16
Nursing staff	4.00	34.09±4.32	4	8	25.07±2.10
Ward boy	3.33	33.44±1.67	10	0	23.82±3.19
Sweeper	1.00	37.5± 0.70	3	0	21.44±1.54
Total	100	27.04±3.13	182	118	23.35±2.82

Table 2: Distribution of dipping status of all groups.

Nocturnal dipping status	Consultant	Senior resident	PG student	Intern	UG student	Nursing staff	Ward boy	Sweeper	X ² value	P value
Dipper	0	4	48	129	42	9	8	3	74.967	0.005
Non dipper	1	4	9	9	9	3	2	0		
Revers dipper	1	1	2	0	0	0	0	0		
Extreme dipper	1	1	4	7	3	0	0	0		


Figure 1: Comparison of office blood pressure and 24-hour average ambulatory blood pressure (mean±SD) of all subjects.

DISCUSSION

In our study demographic characteristics of the various professional groups highlight significant differences in age, sex distribution where consultants had the highest mean age (38.67±5.508 years) and consist entirely of males, while the youngest group, undergraduate students, has a mean age of 24.17±0.70 years and a nearly even distribution of males and females. Older age, as seen in consultants and senior residents, is associated with a higher likelihood of hypertension, as supported by research indicating increased blood pressure with advancing age.⁹ The gender disparity, particularly the higher representation of males in most groups, may also influence the study's findings since males generally have a higher prevalence of hypertension and related complications.¹⁰

The distribution of office blood pressure (OBP) among the 300 subjects showed that a significant portion (145) of the participants fall into the prehypertension category (48.33%), with 23 participants (7.67%) classified as having stage 1 hypertension and only one participant (0.33%) classified as having stage 2 hypertension. The high prevalence of prehypertension is concerning, as it indicates a substantial proportion of individuals who are at an increased risk of developing hypertension and associated cardiovascular diseases if timely interventions are not implemented.¹¹ This distribution aligns with broader epidemiological data, which suggests that prehypertension is prevalent in both general and healthcare populations, often serving as a precursor to more severe forms of hypertension.¹²

The distribution of nocturnal dipping patterns across different professional groups revealed that the majority of interns (129 out of 145) were classified as "dippers," indicating a normal nocturnal decline in blood pressure. However, a concerning number of postgraduate (PG) students and senior residents exhibit non-dipping (9 PG students and 4 senior residents) and reverse dipping (2 PG students and 1 senior resident) patterns. These abnormal dipping patterns are associated with a higher risk of cardiovascular events particularly among those in high-stress professions.¹³

We found significant variations in blood pressure patterns among medical staff, with a notable prevalence of normotension among interns and postgraduate students, while nursing staff and ward boys exhibited higher rates of hypertension. A study by Choxi et al found that anaesthesiology residents faced high levels of stress, which correlated with elevated blood pressure, suggesting

that the demanding nature of medical training and work environments can adversely affect cardiovascular health.¹⁴

On comparing OBPM and 24-hour average ABPM, it was found that in the normal ambulatory blood pressure group, both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were significantly higher in office measurements compared to 24-hour averages, indicating that office readings may overestimate actual blood pressure levels in individuals with normal ambulatory BP. This observation corroborates previous studies, such as that by Kearney et al, which emphasize that office measurements are often influenced by the white-coat effect, leading to artificially elevated readings.¹⁵ Conversely, in the abnormal ambulatory BP group, no significant differences were found between office and 24-hour average readings, suggesting that both measurements may provide similar results in individuals with elevated blood pressure.

Our study is limited by its single-centre design, low participation of female subjects, and the predominance of younger individuals among the participants. As a result, the findings may not adequately represent the target population. These limitations can be addressed in future studies.

CONCLUSION

The findings of this study demonstrate significant discrepancies between office blood pressure measurements and 24-hour ABPM, highlighting the limitations of office blood pressure monitoring in accurately diagnosing hypertension. It is recommended that ABPM be routinely used, particularly in healthcare professionals, to capture a more accurate blood pressure profile, including detecting masked hypertension and nocturnal hypertension that may not be evident in office settings.

Specific healthcare groups were found to have higher instances of hypertension. Tailored interventions, including stress management programs, lifestyle modifications, and regular monitoring, should be implemented for these groups.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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