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Original Research Article

Correlation Between Ambulatory Blood Pressure Monitoring and Left Ventricular Hypertrophy

Narukurthi Yaswanth [1], Siddharth Singh [2], Agarwal Saurabh Pawankumar [3]

1. MBBS MD, Postgraduate , Department of General Medicine, Sapthagiri Institute of Medical Sciences & Research Centre, Bengaluru, Karnataka, India
2. MBBS MD, Postgraduate , Department of General Medicine, Sapthagiri Institute of Medical Sciences & Research Centre, Bengaluru, Karnataka, India
3. MBBS MD, Postgraduate , Department of General Medicine, Sapthagiri Institute of Medical Sciences & Research Centre, Bengaluru, Karnataka, India

Correspondence: Dr Narukurthi Yaswanth

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Abstract

Background: Left ventricular hypertrophy (LVH) is an important manifestation of hypertension-mediated organ damage and is associated with increased cardiovascular morbidity and mortality. Ambulatory blood pressure monitoring (ABPM) provides a more comprehensive assessment of blood pressure than office measurements and may better predict cardiac target-organ damage.

Methods: This hospital-based observational cross-sectional study included 90 adult patients with systemic hypertension. All participants underwent 24-hour ABPM and transthoracic echocardiography. Ambulatory blood pressure parameters were compared between patients with and without LVH. Correlation analysis was performed between ABPM indices and left ventricular mass index (LVMI), and multivariable logistic regression was used to identify independent predictors of LVH.

Results: LVH was present in 46 (51.1%) patients. Individuals with LVH had significantly higher 24-hour, daytime and nighttime systolic blood pressure (SBP), pulse pressure and blood pressure load than those without LVH (all $p<0.05$). Nighttime SBP showed the strongest correlation with LVMI ($r=0.76$, $p<0.001$). Multivariable analysis identified nighttime SBP ≥130 mmHg (adjusted OR 4.26, 95% CI 1.82–9.96), non-dipping blood pressure pattern (adjusted OR 3.18, 95% CI 1.37–7.36), 24-hour SBP ≥140 mmHg (adjusted OR 2.91, 95% CI 1.24–6.83), and hypertension duration >10 years (adjusted OR 2.64, 95% CI 1.10–6.31) as independent predictors of LVH.

Conclusion: ABPM-derived parameters, particularly nighttime SBP and abnormal nocturnal dipping, demonstrated a strong association with LVH and were superior to office blood pressure measurements in identifying hypertension-mediated cardiac damage. Routine use of ABPM may improve cardiovascular risk stratification and facilitate earlier intervention in patients with systemic hypertension.

Keywords: Ambulatory blood pressure monitoring; systemic hypertension; left ventricular hypertrophy; left ventricular mass index; nocturnal hypertension; non-dipping pattern.

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Introduction

Systemic arterial hypertension (SAH) is the leading modifiable risk factor for cardiovascular disease and remains a major cause of morbidity, disability and premature mortality worldwide. Approximately 1.28 billion adults aged 30–79 years are affected globally, with hypertension accounting for nearly 10.8 million deaths annually[1]. Despite advances in diagnosis and treatment, blood pressure control remains suboptimal, particularly in low- and middle-income countries [1]. In Latin America, hypertension affects approximately 20–40% of adults, with reported prevalence rates of 27–29% in urban Ecuador, underscoring its major public health burden [3].The adverse consequences of hypertension are largely attributable to hypertension-mediated organ damage (HMOD), involving the heart, kidneys, brain, retina and vasculature. Among these, left ventricular hypertrophy (LVH) is one of the earliest and most clinically significant manifestations. Initially an

adaptive response to chronic pressure overload, persistent hypertrophy eventually becomes maladaptive, leading to myocardial fibrosis, impaired diastolic function, ventricular dysfunction, arrhythmias and heart failure, thereby substantially increasing cardiovascular morbidity and mortality [4,5]. Echocardiography remains the standard non-invasive modality for assessing left ventricular mass index (LVMI) and ventricular geometry, and echocardiographically confirmed LVH is an established independent predictor of adverse cardiovascular outcomes [5,6].Accurate blood pressure assessment is essential for identifying patients at risk of developing LVH. Although office blood pressure measurement is widely used, it reflects only a single time-point and is influenced by observer bias, white-coat effect and masked hypertension. It also fails to assess circadian blood pressure variation, limiting its ability to predict target-organ damage [4,7]. In contrast, 24-hour ambulatory blood pressure monitoring (ABPM) provides repeated measurements during routine daily activities and sleep, allowing assessment of mean 24-hour, daytime and nighttime blood pressure, blood pressure load, circadian dipping pattern and morning blood pressure surge. Consequently, ABPM is considered the reference standard for out-of-office blood pressure assessment and offers superior reproducibility and prognostic value compared with office measurements [8].

Evidence indicates that ABPM-derived parameters correlate more closely with LVH and other manifestations of HMOD than conventional clinic blood pressure. Elevated nighttime systolic blood pressure, nocturnal hypertension, increased blood pressure load, and non-dipping or reverse-dipping patterns have consistently been associated with increased left ventricular mass and a higher prevalence of LVH. Moreover, nocturnal blood pressure has emerged as a stronger predictor of cardiovascular events than daytime or office blood pressure, highlighting the importance of nocturnal haemodynamic stress in hypertensive cardiac remodelling [9–11].Despite its proven clinical utility, routine use of ABPM remains limited in many developing countries because of restricted availability, cost and limited awareness. Furthermore, regional variations in ethnicity, cardiovascular risk factors and treatment patterns necessitate population-specific evidence regarding the relationship between ABPM parameters and target-organ damage [3,12]. Therefore, the present study aimed to evaluate the correlation between ambulatory blood pressure monitoring parameters and echocardiographic left ventricular hypertrophy in adults with hypertension.

Methodology:

A hospital-based, observational, cross-sectional study was conducted in the Department of medicine at a tertiary care teaching hospital The study included adult patients with previously diagnosed or newly diagnosed systemic arterial hypertension who attended the cardiology outpatient department or were admitted to the hospital during the study period. Eligible participants underwent comprehensive clinical evaluation, ambulatory blood pressure monitoring (ABPM), and transthoracic echocardiography.A total of 90 consecutive hypertensive patients fulfilling the eligibility criteria were included in the study by consecutive sampling during the study period.

Eligibility Criteria

Inclusion Criteria

Patients fulfilling all of the following criteria were included:

- Age ≥18 years.
- Diagnosed systemic arterial hypertension according to current international guidelines or receiving antihypertensive treatment.
- Ability to undergo 24-hour ambulatory blood pressure monitoring.
- Willingness to provide written informed consent.
- Exclusion Criteria
- Patients were excluded if they had:
- Secondary hypertension.
- Significant valvular heart disease.
- Hypertrophic, restrictive, or dilated cardiomyopathy.
- Previous myocardial infarction with significant left ventricular systolic dysfunction.
- Congenital heart disease.
- Persistent atrial fibrillation or other arrhythmias interfering with ABPM interpretation.
- Chronic kidney disease requiring dialysis.
- Pregnancy.
- Inadequate or technically unacceptable ABPM recordings.
- Poor echocardiographic image quality preventing accurate assessment of left ventricular mass.

Data Collection

After enrolment, demographic and clinical information including age, sex, body mass index (BMI), duration of hypertension, smoking status, diabetes mellitus, dyslipidaemia, antihypertensive medications, and relevant medical history were recorded using a structured case record form. Height and weight were measured using standard

techniques, and body mass index was calculated as weight (kg) divided by height squared (m^2).

Office Blood Pressure Measurement

Office blood pressure was measured using a validated automated sphygmomanometer following standard recommendations. Patients were instructed to avoid caffeine, smoking, and strenuous physical activity for at least 30 minutes before measurement. Blood pressure was recorded after the patient had rested for five minutes in the seated position with the arm supported at heart level. Three readings were obtained at one-minute intervals, and the average of the final two measurements was considered for analysis.

Ambulatory Blood Pressure Monitoring

Twenty-four-hour ambulatory blood pressure monitoring was performed using a validated portable ABPM device. The monitor was fitted on the non-dominant arm, and patients were instructed to continue their usual daily activities while avoiding excessive arm movement during cuff inflation.Blood pressure measurements were programmed at 15–20-minute intervals during daytime (06:00–22:00 hours) and 30-minute intervals during nighttime (22:00–06:00 hours). Participants maintained a diary documenting sleeping and waking times, medication intake, and significant physical activities.ABPM recordings were considered acceptable when at least 70% of the scheduled readings were successfully recorded, including a minimum of 20 daytime and 7 nighttime measurements.

The following ABPM parameters were analysed:

- Mean 24-hour systolic blood pressure (SBP)
- Mean 24-hour diastolic blood pressure (DBP)
- Mean daytime SBP and DBP
- Mean nighttime SBP and DBP
- Pulse pressure
- Blood pressure load
- Nocturnal dipping percentage
- Morning blood pressure surge

Patients were classified according to nocturnal blood pressure pattern as:

- Normal dipper (10–20% nocturnal fall)
- Non-dipper (<10% nocturnal fall)
- Reverse dipper (nighttime blood pressure higher than daytime)
- Extreme dipper (>20% nocturnal fall)

Echocardiographic Assessment

Two-dimensional transthoracic echocardiography was performed by an experienced cardiologist using a standard ultrasound system according to the recommendations of the American Society of Echocardiography.Left ventricular dimensions, interventricular septal thickness, posterior wall thickness, left ventricular internal diameter, left ventricular ejection fraction, and left ventricular mass were measured. Left ventricular mass (LVM) was calculated using the Devereux formula and indexed to body surface area to obtain the left ventricular mass index (LVMI).Left ventricular hypertrophy (LVH) was defined as:

- LVMI >115 g/m^2 in men.
- LVMI >95 g/m^2 in women.

Left ventricular geometry was also classified as normal geometry, concentric remodelling, concentric hypertrophy, or eccentric hypertrophy based on LVMI and relative wall thickness.

Outcome Measures

Primary Outcome

The primary outcome was the correlation between ambulatory blood pressure monitoring parameters and left ventricular mass index.

Secondary Outcomes

The secondary outcomes included:

- Association between ABPM-derived blood pressure indices and the presence of left ventricular hypertrophy.
- Relationship between nocturnal blood pressure patterns and left ventricular hypertrophy.
- Correlation between office blood pressure and left ventricular mass index.
- Comparison of ABPM parameters between patients with and without left ventricular hypertrophy.

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA).Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR) according to data distribution. Categorical variables were presented as frequencies and percentages.Normality of data was assessed using the Shapiro–Wilk test. Comparisons between two independent groups were performed using the independent samples Student's t-test for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate.The relationship between ambulatory blood pressure parameters and left ventricular mass index was evaluated using Pearson's correlation coefficient for normally distributed variables or Spearman's rank correlation coefficient for skewed

variables. Multivariable logistic regression analysis was performed to identify independent predictors of left ventricular hypertrophy after adjustment for potential confounding variables. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.A two-tailed p-value <0.05 was considered statistically significant.

Results:

A total of 90 hypertensive patients were included in the study. The mean age of the participants was 56.8 ± 10.9 years, with the majority belonging to the 50–59 years age group (31.1%). Males constituted 60.0% of the study population. The mean body mass index was 28.3 ± 4.6 kg/m², while the average duration of hypertension was 8.6 ± 5.4 years. Diabetes mellitus and dyslipidaemia were present in 37.8% and 42.2% of patients, respectively. Most participants (86.7%) were receiving antihypertensive therapy. The mean office systolic and diastolic blood pressures were 148.5 ± 15.8 mmHg and 89.6 ± 10.2 mmHg, respectively (Table 1).Twenty-four-hour ambulatory blood pressure monitoring demonstrated a mean 24-hour systolic blood pressure of 138.6 ± 12.8 mmHg and a mean 24-hour diastolic blood pressure of 83.5 ± 8.4 mmHg. The mean daytime systolic and diastolic blood pressures were 141.7 ± 13.4 mmHg and 85.1 ± 8.8 mmHg, whereas the corresponding nighttime values were 129.2 ± 13.1 mmHg and 76.4 ± 7.9 mmHg, respectively. The mean pulse pressure, blood pressure load, and morning blood pressure surge were 55.1 ± 10.2 mmHg, 42.5 ± 18.4%, and 24.8 ± 8.1 mmHg, respectively. Regarding nocturnal dipping status, 42.2% of patients were normal dippers, 34.4% were non-dippers, 15.6% were reverse dippers, and 7.8% were extreme dippers (Table 2). The distribution of major ambulatory blood pressure parameters is illustrated in Figure 1.Echocardiographic evaluation revealed a mean interventricular septal thickness of 11.4 ± 1.8 mm, posterior wall thickness of 10.9 ± 1.5 mm, and left ventricular mass index of 118.7 ± 28.6 g/m². The mean left ventricular ejection fraction was 59.8 ± 6.3%. Concentric hypertrophy was the most common geometric pattern (33.3%), followed by normal geometry (31.1%). Overall, 46 patients (51.1%) had echocardiographic evidence of left ventricular hypertrophy, whereas 44 (48.9%) did not (Table 3).Patients with left ventricular hypertrophy exhibited significantly higher ambulatory blood pressure values than those without hypertrophy. Mean 24-hour systolic blood pressure (145.6 ± 11.4 vs. 131.3 ± 10.2 mmHg), 24-hour diastolic blood pressure (86.7 ± 8.1 vs. 80.2 ± 7.6 mmHg), daytime systolic blood pressure (148.5 ± 11.8 vs. 134.3 ± 10.9 mmHg), nighttime systolic blood pressure (137.4 ± 11.6 vs. 120.7 ± 9.8 mmHg), pulse pressure (58.4 ± 9.5 vs. 51.7 ± 8.6 mmHg), and blood pressure load (55.8 ± 16.2% vs. 28.5 ± 12.4%) were all significantly greater among patients with LVH (all $p \leq 0.002$) (Table 4). These differences are graphically represented in Figure 2.Correlation analysis demonstrated significant positive relationships between ambulatory blood pressure monitoring parameters and left ventricular mass index. The strongest correlation was observed for nighttime systolic blood pressure ($r = 0.76$, $p < 0.001$), followed by 24-hour systolic blood pressure ($r = 0.71$, $p < 0.001$) and blood pressure load ($r = 0.69$, $p < 0.001$). Moderate positive correlations were also identified for daytime systolic blood pressure, 24-hour diastolic blood pressure, pulse pressure, office systolic blood pressure, and morning blood pressure surge. Office diastolic blood pressure demonstrated the weakest, although statistically significant, correlation with left ventricular mass index (Table 5).Multivariable logistic regression analysis identified nighttime systolic blood pressure ≥130 mmHg as the strongest independent predictor of left ventricular hypertrophy (adjusted OR = 4.26, 95% CI: 1.82–9.96, p = 0.001). A non-dipping blood pressure pattern (adjusted OR = 3.18, 95% CI: 1.37–7.36, p = 0.007), 24-hour systolic blood pressure ≥140 mmHg (adjusted OR = 2.91, 95% CI: 1.24–6.83, p = 0.014), and duration of hypertension >10 years (adjusted OR = 2.64, 95% CI: 1.10–6.31, p = 0.029) were also independently associated with the presence of left ventricular hypertrophy. In contrast, diabetes mellitus and age ≥60 years were not significant independent predictors after adjustment for confounding variables (Table 6). The adjusted odds ratios with their corresponding 95% confidence intervals are presented in Figure 3.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (N = 90)

Variable	Value
Age (years), mean ± SD	56.8 ± 10.9
Age group, n (%)	
<50 years	22 (24.4)

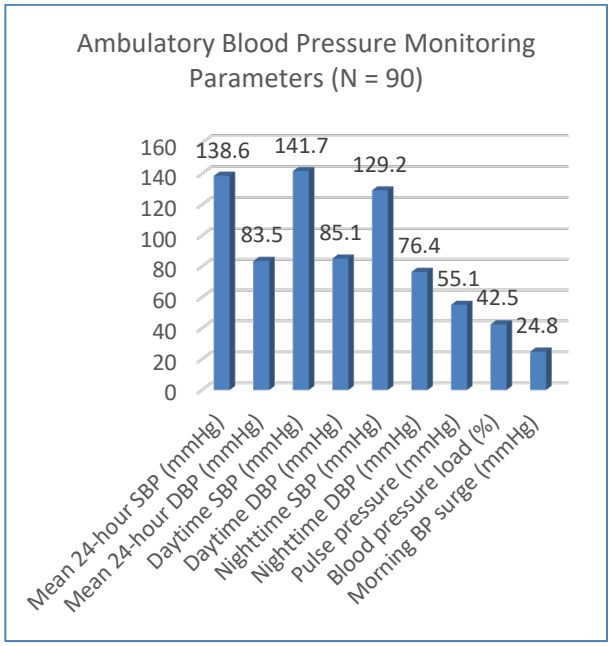
50–59 years	28 (31.1)
60–69 years	26 (28.9)
≥70 years	14 (15.6)
Male sex, n (%)	54 (60.0)
Female sex, n (%)	36 (40.0)
Body mass index (kg/m²), mean ± SD	28.3 ± 4.6
Duration of hypertension (years), mean ± SD	8.6 ± 5.4
Diabetes mellitus, n (%)	34 (37.8)
Dyslipidaemia, n (%)	38 (42.2)
Current smoker, n (%)	24 (26.7)
Antihypertensive treatment, n (%)	78 (86.7)
Office SBP (mmHg), mean ± SD	148.5 ± 15.8
Office DBP (mmHg), mean ± SD	89.6 ± 10.2

Table 2. Ambulatory Blood Pressure Monitoring Parameters (N = 90)

Parameter	Mean ± SD
Mean 24-hour SBP (mmHg)	138.6 ± 12.8
Mean 24-hour DBP (mmHg)	83.5 ± 8.4
Daytime SBP (mmHg)	141.7 ± 13.4
Daytime DBP (mmHg)	85.1 ± 8.8
Nighttime SBP (mmHg)	129.2 ± 13.1
Nighttime DBP (mmHg)	76.4 ± 7.9
Pulse pressure (mmHg)	55.1 ± 10.2
Blood pressure load (%)	42.5 ± 18.4
Morning BP surge (mmHg)	24.8 ± 8.1

Nocturnal Dipping Pattern

Pattern	n (%)
Normal dipper	38 (42.2)
Non-dipper	31 (34.4)
Reverse dipper	14 (15.6)
Extreme dipper	7 (7.8)



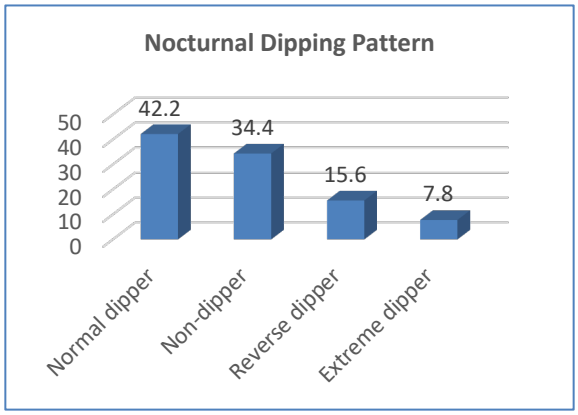


Figure 1 Ambulatory Blood Pressure Monitoring Parameters (N = 90)

Table 3. Echocardiographic Findings (N = 90)

Variable	Mean ± SD
Interventricular septal thickness (mm)	11.4 ± 1.8

Posterior wall thickness (mm)	10.9 ± 1.5
LV end-diastolic diameter (mm)	49.8 ± 4.9
Left ventricular mass (g)	206.5 ± 47.3
Left ventricular mass index (g/m²)	118.7 ± 28.6
Relative wall thickness	0.44 ± 0.08
Left ventricular ejection fraction (%)	59.8 ± 6.3

Left Ventricular Geometry

Geometry	n (%)
Normal geometry	28 (31.1)
Concentric remodelling	16 (17.8)
Concentric hypertrophy	30 (33.3)
Eccentric hypertrophy	16 (17.8)

Presence of LVH

Variable	n (%)
LVH Present	46 (51.1)
LVH Absent	44 (48.9)

Table 4. Comparison of Ambulatory Blood Pressure Parameters According to Presence of Left Ventricular Hypertrophy

Variable	LVH Present (n=46)	LVH Absent (n=44)	p-value
24-hour SBP (mmHg)	145.6 ± 11.4	131.3 ± 10.2	<0.001
24-hour DBP (mmHg)	86.7 ± 8.1	80.2 ± 7.6	<0.001
Daytime SBP (mmHg)	148.5 ± 11.8	134.3 ± 10.9	<0.001
Nighttime SBP (mmHg)	137.4 ± 11.6	120.7 ± 9.8	<0.001
Blood pressure load (%)	55.8 ± 16.2	28.5 ± 12.4	<0.001
Pulse pressure (mmHg)	58.4 ± 9.5	51.7 ± 8.6	0.002

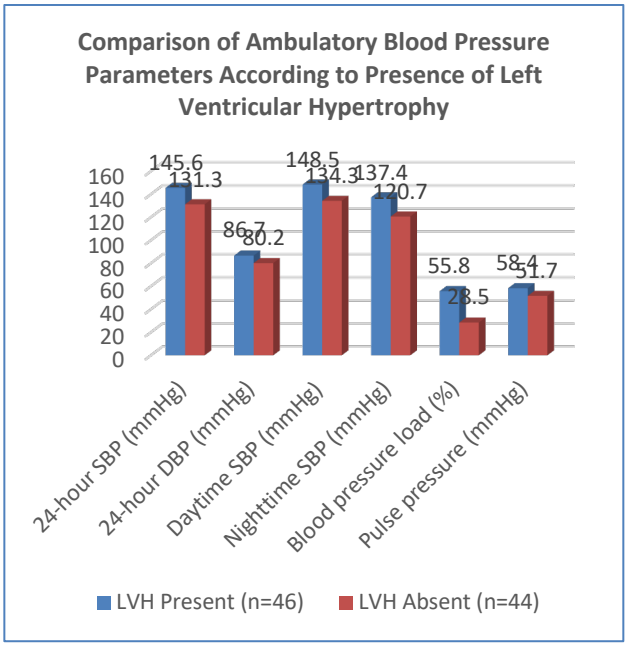


Figure 2 Comparison of Ambulatory Blood Pressure Parameters According to Presence of Left Ventricular Hypertrophy

Table 5. Correlation Between ABPM Parameters and Left Ventricular Mass Index

Variable	Correlation coefficient (r)	p-value
Office SBP	0.42	<0.001
Office DBP	0.28	0.008
24-hour SBP	0.71	<0.001
24-hour DBP	0.54	<0.001
Daytime SBP	0.63	<0.001
Nighttime SBP	0.76	<0.001
Pulse pressure	0.48	<0.001
Blood pressure load	0.69	<0.001

Morning BP surge	0.37	0.001

Table 6. Multivariable Logistic Regression Analysis for Predictors of Left Ventricular Hypertrophy

Variable	Adjusted OR	95% CI	p-value
Nighttime SBP ≥130 mmHg	4.26	1.82–9.96	0.001
Non-dipping blood pressure pattern	3.18	1.37–7.36	0.007
24-hour SBP ≥140 mmHg	2.91	1.24–6.83	0.014
Duration of hypertension >10 years	2.64	1.10–6.31	0.029
Diabetes mellitus	1.88	0.81–4.39	0.142
Age ≥60 years	1.73	0.76–3.94	0.192

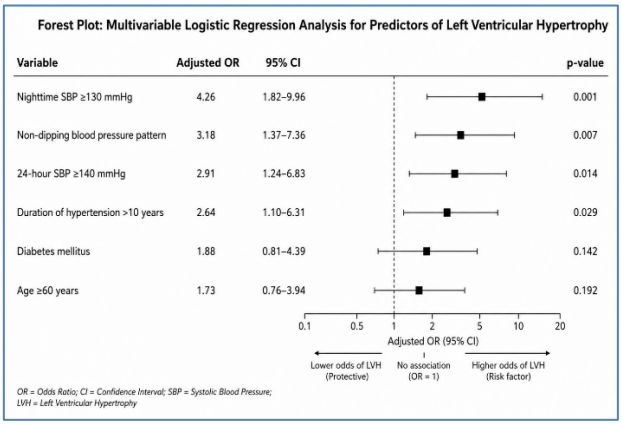


Figure 3 Multivariable Logistic Regression Analysis for Predictors of Left Ventricular Hypertrophy

Discussion

The present study evaluated the relationship between ambulatory blood pressure monitoring (ABPM) parameters and left ventricular hypertrophy (LVH) among 90 patients with systemic hypertension. The principal findings were that LVH was present in 51.1% of patients; individuals with LVH had significantly higher 24-hour, daytime, and nighttime systolic blood pressure (SBP), pulse pressure, and blood pressure load; nighttime SBP showed the strongest correlation with left ventricular mass index (LVMI); and elevated nighttime SBP, non-dipping blood pressure pattern, elevated 24-hour SBP, and longer duration of hypertension independently predicted LVH. These findings reinforce the superiority of ABPM-derived parameters, particularly nocturnal blood pressure, over office blood pressure in identifying hypertension-mediated cardiac damage.The demographic profile of our cohort was comparable with previous ABPM studies. The mean age was 56.8 ± 10.9 years, and 60.0% of participants were male, consistent with the predominantly middle-aged and older hypertensive populations reported in the PAMELA study and the Athens nocturnal hypertension cohort. These studies similarly identified advancing age as an important determinant of left ventricular remodelling.LVH was detected in 46 of 90 patients (51.1%), a prevalence slightly higher than the 43.7% reported by Feola et al.[13]. This difference may be attributed to the longer duration of hypertension (8.6 ± 5.4 years), higher proportion of treated patients (86.7%), and greater burden of comorbidities such as diabetes (37.8%) and dyslipidaemia (42.2%) in our cohort. Nevertheless, both studies confirm that LVH is a frequent manifestation of hypertension-mediated organ damage.Patients with LVH had significantly higher ambulatory blood pressure values than those without LVH, including 24-hour SBP (145.6 ± 11.4 vs. 131.3 ± 10.2 mmHg), daytime SBP (148.5 ± 11.8 vs. 134.3 ± 10.9 mmHg), nighttime SBP (137.4 ± 11.6 vs. 120.7 ± 9.8 mmHg), and blood pressure load (55.8 ± 16.2% vs. 28.5 ± 12.4%; all $p<0.001$). Similar findings by Feola et al.[13] demonstrated that ambulatory SBP, particularly nighttime SBP, correlates more closely with cardiac structural changes than office blood pressure.Among all ABPM variables, nighttime SBP showed the strongest correlation with LVMI (r=0.76), followed by 24-hour SBP (r=0.71), blood pressure load (r=0.69), and daytime SBP (r=0.63), whereas office SBP showed only a moderate correlation (r=0.42).

These observations agree with the PAMELA study and the WISDOM-HMOD study (2025), both of which identified nocturnal SBP as an independent determinant of increased LVMI and prevalent LVH, even after adjustment for daytime blood pressure.

Multivariable analysis further demonstrated that nighttime SBP ≥130 mmHg was the strongest independent predictor of LVH (adjusted OR 4.26, 95% CI 1.82–9.96, p=0.001), consistent with findings from the Athens cohort and PAMELA study. A non-dipping blood pressure pattern also independently increased the odds of LVH more than threefold (adjusted OR 3.18, p=0.007). In our cohort, 34.4% of patients were non-dippers and 15.6% were reverse dippers. These results are supported by the systematic review by Cuspidi et al.[14], which demonstrated a significant association between persistent non-dipping status and LVH across 26 studies.Similarly, 24-hour SBP ≥140 mmHg independently predicted LVH (adjusted OR 2.91, p=0.014), confirming previous evidence that ambulatory systolic blood pressure better reflects cumulative haemodynamic burden than office blood pressure.[13] Hypertension duration exceeding 10 years was also an independent predictor (adjusted OR 2.64, p=0.029), emphasising the cumulative effect of chronic pressure overload on myocardial hypertrophy. Although diabetes mellitus and age ≥60 years were associated with increased odds of LVH, these relationships were not statistically significant after adjustment, likely because of the modest sample size.

Conclusion

Ambulatory blood pressure monitoring parameters, particularly nighttime systolic blood pressure, demonstrated a strong association with left ventricular hypertrophy in patients with systemic hypertension. Elevated nighttime SBP, a non-dipping blood pressure pattern, increased 24-hour SBP, and longer duration of hypertension were independent predictors of LVH. These findings highlight the superior value of ABPM over office blood pressure measurement in detecting hypertension-mediated cardiac damage and improving cardiovascular risk stratification. Routine incorporation of ABPM into the evaluation of hypertensive patients may facilitate earlier identification of high-risk individuals and guide more targeted antihypertensive therapy to reduce long-term cardiovascular complications.

Limitations

The present study had several limitations. First, it was a single-centre study with a relatively small sample size, which may limit the generalisability of the findings. Second, the cross-sectional study design precluded assessment of causal relationships between ambulatory blood pressure parameters and the development of left ventricular hypertrophy. Finally, the study evaluated a single 24-hour ABPM recording, and serial ambulatory blood pressure measurements were not performed to assess long-term changes in blood pressure profiles and cardiac remodelling.

Ethical approval

Ethical approval for this study was obtained from the Institutional Ethics Committee prior to the commencement of the study. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and applicable institutional guidelines.

Informed Consent

Written informed consent was obtained from all participants prior to their enrolment in the study.

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Conflict of Interest Declaration

The authors declare no conflict of interest.Data Availability Statement. All data generated or analysed during this study are available from the corresponding author upon reasonable request..

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