Original Article

Evaluation of White Coat Office Hypertension By Using 24-Hours Ambulatory Blood Pressure Monitoring in Healthy Young Adults in Lahore, Pakistan; A Cross-Sectional Study

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Abstract

Objective: To determine the white coat office hypertension by using 24-hours ambulatory blood pressure monitoring in healthy young adults in Lahore, Pakistan

Material and Methods: This was an analytical cross-sectional study with non-probability convenience sampling conducted at the for six months from 11-06-2021 to 11-12-2021, among healthy adults meeting the selection criteria (>18 years), with Ambulatory Blood Pressure Monitoring (ABPM) recordings taken using an oscillometric portable monitor. Office blood pressure (BP) measurements were taken using a validated electronic sphygmomanometer and a standard cuff in a quiet environment. Participants rested briefly before the cuff was inflated. BP was measured multiple times during clinic visits, with the average taken if significant differences were found. Data was analyzed using SPSS 24.0 software, with a p-value less than 0.05 considered significant.

Results: Out of 112 patients, the average age was 28.85±3.157 years. BMI, systolic office blood pressure, diastolic office blood pressure, systolic ambulatory blood pressure, and diastolic ambulatory blood pressure distributions were calculated as 27.24±3.720 kg/m^2, 111.43±9.164 mmHg, 79.36±6.888 mmHg, 122.56±10.273 mmHg, and 73.72±5.401 mmHg, respectively. Out of 112 cases, 49 (43.8%) were males and 63 (56.3%) were females. The prevalence of smoking was 15 (13.4%), whereas obesity was 35 (31.3%). The mean office systolic and diastolic blood pressure were compared with ABP and indicated (p=0.606) and (p=0.338), respectively.

Conclusion: The study found that healthy young adults have average ambulatory blood pressure and office BP, suggesting that the use of Ambulatory Blood Pressure (ABP) monitoring is likely to increase in adolescents and young adults for various purposes, including detecting hypertension, assessing antihypertensive drug effectiveness, and analyzing disease risks.

Keywords: Ambulatory Blood Pressure Monitoring, Hypertension, Office Blood Pressure.

How to cite: Baig MTI, Mazhar SM, Junaid K, Siddiqui M, Mahmood Z, Haleem I. Evaluation of White Coat Office Hypertension By Using 24-Hours Ambulatory Blood Pressure Monitoring in Healthy Young Adults In Lahore, Pakistan; A Cross-Sectional Study. Esculapio - JSIMS 2024;20(04): 467-472

DOI: https://doi.org/10.51273/esc24.25132044

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Submission Date:	08-08-2024
1st Revision Date:	13-09-2024
Acceptance Date:	12-12-2024

Introduction

Ambulatory blood pressure (ABP) monitoring is widely used in adults to determine office hypertension and confirm antihypertensive treatment efficacy. It provides deeper insight into an individual's blood pressure pattern, which is crucial for hypertension management and treatment.[1] Ambulatory blood pressure (ABP) will help 24-hour monitoring is used to provide personal risk stratification in patients presenting with coronary artery disease, diabetes and dysautonomia.[2] This method has not been as widely used in adolescent and young adult populations because there are few reference data outlining a normal range of ABP values for this age group. The lack of normative data has limited the acceptance of 24-h ABPM, and consequently personalized risk profiling for younger subjects.[3]

Hypertension is a major risk factor for cardiovascular disease and stroke, with factors like age, smoking, alcoholism, low physical activity, high salt diet, family history of hypertension, and obesity. Ambulatory blood pressure monitoring (ABPM) is being used for hypertension diagnosis, prognosis, and management. ABPM can evaluate blood pressure at multiple time points and calculate average BP, including 24-hour, daytime, and nighttime average BP.[4] It can also evaluate the circadian rhythm of BP, enabling the detection of masked hypertension. This could lead to targeted public health interventions to prevent cardiovascular issues at an early age, potentially improving health outcomes for high-risk individuals.[5]

In a study of 24-hour ambulatory blood pressure monitoring (AOM) on healthy young subjects, it was found that the mean 24-hour systolic and diastolic office values for the entire group were 115 ±9.0 mmHg and 74 ±9.0 mmHg, respectively.[2] The office SBP and DBP levels in all transport modes were significantly higher for males than females ($p < 0.001$). The average 24-hour systolic and diastolic ABP values for the entire cohort were 117±7.0/70±6. Significant differences were reported for both means of 24-hour systolic ABP ($p<0.01$) and diastolic ABP ($p<0.001$).[6]

Current studies show that masked hypertension, morning hypertension, and nocturnal hypertension are more prevalent in Asian countries than in Western countries.[4,6] However, ABPM use is limited in Asian countries, including Pakistan, especially in tertiary health care. This study aimed to detect white coat office hypertension by using 24-hours ambulatory blood pressure monitoring in healthy young adults in Lahore, Pakistan. BP measurements collected in a clinical setting with ambulatory monitoring during daily activities provide unique insights into these people' blood pressure trends.

Material and Methods

It was a 6-month cross-sectional study conducted at the Department of Cardiology, utilizing non-probability convenience sampling from June 11th to December 11th, 2021. Acceptance letter of this study was taken from CPSP/REU/CRD-2019-070-2201dated:10-06-2021. This study included 112 healthy people who met the established inclusion criteria. The cardiology outpatient study included healthy people who had no history of hypertension, diabetes, smoking, excessive coffee consumption, myocardial infarction, cardiogenic shock, valvular heart disease, arrhythmias, abnormal heart rhythms, high creatinine levels, or dyslipidemias. Participants were aged 20 to 40 years old and were screened using specific exclusion criteria such as certain medical disorders and abnormal laboratory findings.

Written informed consent was obtained. The participants' demographic information, such as name, age, gender, smoking history (more than 5 pack years), and BMI, were recorded. An oscillometric portable automated monitor was used to measure ambulatory blood pressure (ABP). The office blood pressure was taken with an electronic sphygmomanometer that had been confirmed for accuracy and used a cuff with a 13cm wide bladder and 22-24 cm length, which satisfied industry requirements. This measurement took place in a peaceful and appropriate atmosphere at room temperature, following a few minutes of relaxation in a seated position with uncrossed legs and no discussion. The arm cuff was retained at the level of the heart while being rapidly pumped up, with a gradual release of pressure at a rate of 2-3mmHg per pulse/second. During the clinic appointment, blood pressure was taken at least twice, with a 1 to 2 minute delay between each measurement. When there was a considerable difference between the two readings, an extra measurement was performed. The clinic blood pressure measurement was calculated as the average of two readings with reliable values. The oscillometric portable automatic monitor (type 90207, Space Labs; Redmond, WA) was used for ABP monitoring. This gadget took blood pressure readings every 30 minutes throughout the day from 0600 to 2200 and every hour at night from 2200 to 0600. After 24 hours, the patient would return and the acquired data would be downloaded. The data included the 24-hour average blood pressure, the average daytime blood pressure, the average nighttime blood pressure, and the computed percentage drop in blood pressure at night. Office/ workplace blood pressure measurements were taken in the clinic using a sphygmomanometer, with systolic and diastolic readings recorded in mmHg. An average of two readings was then calculated. .The data gathered was statistically analyzed using SPSS version 24. Quantitative information such as age, BMI, systolic and diastolic blood pressure were reported as means and standard deviations. Gender, smoking, and obesity (BMI > 30) were represented as frequency and percentages. An independent samples t-test was used to compare mean office blood pressure and ABP at a significance level of P-value ≤0.05. The data was categorized according to age, gender, smoking status, and BMI (obesity), and additional analysis was performed using independent samples t-tests within each group. Statistical significance was determined using a P-value of less than 0.05.

Results

Total of 112 patients fulfilling inclusion and exclusion criteria were selected to find the mean ambulatory blood pressure and office/workplace BP of healthy young adults. Gender distribution of the patients was done, it showed that 49(43.8%) were male whereas 63(56.3%) were females. Mean age was 28.85±3.157 years. Age distribution of the patients was revealed that out of 112 patients, 84(75.0%) were in age group of 20-30 years and 28(25.0%) were in age group of 31-40 years. Mean BMI, systolic office blood pressure, diastolic office blood pressure, systolic ambulatory blood pressure and diastolic ambulatory blood pressure was calculated as 27.24±3.720 kg/m2, 111.43±9.164 mmHg, 79.36 ± 6.888 mmHg, 122.56±10.273 mmHg and 73.72 ± 5.401 mmHg respectively. Distribution of smoking was 15 (13.4%) and obesity was 35(31.3%). Mean office systolic and diastolic BP were compared with ABP and showed (p=0.606) and (p=0.338) respectively. The data was stratified for age, gender, BMI and obesity.

Table 3: *Frequency distribution and Mean & standard deviation of different variables (n=112)*

Variables	N(%) / Mean±S.D
Gender	
Male	49(43.8)
Female	63(56.3)
Age	
20-30 years	84 (75)
31-40 years	28 (25)
Smoking	
Yes	15 (13.4)
No	97(86.6)
Obesity	
Yes	35(31.3)
No	77(68.7)
BMI (kg/m^2)	27.24±3.72
Systolic office blood pressure (mmHg)	111.43±9.16
Diastolic office blood pressure (mmHg)	79.6±6.89
Systolic ambulatory blood pressure (mmHg)	122.56±10.27
Diastolic ambulatory blood pressure (mmHg)	73.72±5.40

Table 2: *Comparison of mean systolic and diastolic office blood pressure with mean ambulatory systolic and diastolic blood pressure using independent sample t-test (n=112)*

Mean systolic office blood pressure	Systolic ambulatory blood pressure group	n	Mean	Std. Deviation	p-value
	100-120 mmHg	63	111.83	9.346	0.606
	>120 mmHg	49	110.92	8.995	
Mean diastolic office blood pressure	**Diastolic ambulatory blood pressure group**	**n**	**Mean**	**Std. Deviation**	**p-value**
	60-80 mmHg	110	79.27	6.874	0.338
	>80 mmHg	2	84.00	8.485	

Discussion

As individuals age, their blood pressure increases due to factors like excessive body weight, obesity, dyslipidemia, insulin resistance, and metabolic syndrome. The proximity of these risk factors to an individual's blood pressure significantly influences their actual readings. Understanding these interconnected factors is crucial for assessing and managing cardiovascular health, as they contribute to a complex web of influences on blood pressure regulation.[7] The current study analyzed the gender distribution of patients, with 49 males and 63 females. The mean age was 28.85±3.157 years. The mean BMI, systolic and diastolic office blood pressure, ambulatory blood pressure, and ambulatory blood pressure were calculated. The mean office systolic and diastolic BP were compared with ABP, showing significant differences. A study by Chuwa G et al. found that 24-hour systolic blood pressure is a more accurate indicator of cardiovascular risk factors than other ambulatory and office blood pressure. This finding is consistent with previous research in Brazil and a population-based study involving participants from Europe, Asia, and South America.[8] The study underscores the importance of 24-hour systolic blood pressure in clinical practice and risk assessment strategies. Yang and colleagues' study found that 24-hour systolic blood pressure has the most robust hazard ratio in forecasting cardiovascular

Table 3: *Stratification for mean systolic and diastolic office blood pressure with respect to gender, age, BMI and obesity using independent sample t-test (n=112)*

Variables	Variables	category	n	Mean	S.D.	p-value
Mean systolic office blood pressure	Gender	Male	49	110.61	10.085	0.408
		Female	63	112.06	8.407	
Mean diastolic office blood pressure	Gender	Male	49	80.24	7.677	0.231
		Female	63	78.67	6.180	
Mean systolic office blood pressure	Age (years)	20-30	84	111.31	8.819	0.813
		31-40	28	111.79	10.293	
Mean diastolic office blood pressure	Age (years)	20-30	84	79.79	6.876	0.256
		31-40	28	78.07	6.885	
Mean systolic office blood pressure	BMI	17-25 kg/m^2	28	110.54	9.363	0.554
		>25 kg/m^2	84	111.73	9.134	
Mean diastolic office blood pressure	BMI	17-25 kg/m^2	28	78.46	6.239	0.431
		>25 kg/m^2	84	79.65	7.101	
Mean systolic office blood pressure	Obese	Yes	35	113.71	8.689	0.075
		No	77	110.39	9.240	
Mean diastolic office blood pressure	Obese	Yes	35	77.71	5.834	0.089
		No	77	80.10	7.229	

Table 4: *Stratification for mean systolic and diastolic ambulatory blood pressure with respect to gender, age, BMI and obesity using independent sample t-test (n=112)*

Variables	Variables	category	n	Mean	S.D.	p-value
Mean systolic ambulatory blood pressure	Gender	Male	49	128.67	9.616	0.0001
		Female	63	117.81	8.054	
Mean diastolic ambulatory blood pressure	Gender	Male	49	74.16	4.230	0.450
		Female	63	73.38	6.173	
Mean systolic ambulatory blood pressure	Age (years)	20-30	84	112.11	10.657	0.419
		31-40	28	123.93	9.063	
Mean diastolic ambulatory blood pressure	Age (years)	20-30	84	73.81	5.245	0.771
		31-40	28	73.46	5.941	
Mean systolic ambulatory blood pressure	BMI	17-25 kg/m^2	28	121.50	10.383	0.530
		>25 kg/m^2	84	122.92	10.274	
Mean diastolic ambulatory blood pressure	BMI	17-25 kg/m^2	28	74.36	3.664	0.476
		>25 kg/m^2	84	73.51	5.871	
Mean systolic ambulatory blood pressure	Obese	Yes	35	119.71	9.151	0.047
		No	77	123.86	10.547	
Mean diastolic ambulatory blood pressure	Obese	Yes	35	73.89	3.969	0.831
		No	77	73.65	5.962	

events compared to other ambulatory blood pressure monitoring profiles, suggesting it may be a more reliable predictor of cardiovascular outcomes.[9]

A study in Japan found that individuals with masked hypertension had a twofold increase in the likelihood of experiencing their first stroke, indicating a significant association between the condition and stroke risk.[10] Given the increasing prevalence of cardiovascular diseases and stroke in African populations, it is crucial to proactively identify concealed hypertension in individuals with an elevated cardiovascular risk profile to prevent further complications and improve overall health outcomes.[11]

A study found that a significant percentage (66.7%) of individuals in a study showed nocturnal non-dipping, where blood pressure levels do not significantly decrease during sleep. This is linked to higher likelihood of target organ impairment and increased incidence of cardiovascular events, particularly cerebrovascular events.[12] The study also found that anxiety induced by the presence of a blood pressure monitoring device during sleep could contribute to the high prevalence of non-dipping. Further investigation is needed to explore the potential impact of psychological factors on nocturnal blood pressure regulation and its implications for overall cardiovascular health.[13] White et al. study revealed significant differences in white matter hyper intensities (WMH) and functional indices in individuals with abnormal ambulatory systolic blood pressure. High 24-hour systolic BP increased WMH volume, slower stair descent and walks times, and slower gait speed, suggesting WMH is a slowly-progressing process.[14]

Ambulatory blood pressure monitoring (ABPM) is used to identify patients with raised office blood pressure who do not have persistent hypertension. The goal is to prevent unnecessary treatment for this subset. ABPM may lead to better health outcomes by avoiding unnecessary pharmacological interventions. However, this assumption depends on the assumption that individuals with white coat hypertension do not face an elevated risk of cardiovascular events and therefore do not benefit from antihypertensive therapy. The study's small sample size and cross-sectional nature make it difficult to generalize its results to the entire population.

Conclusion

The study analyzed ambulatory blood pressure and workplace blood pressure in healthy individuals in the younger age group. It suggests that ambulatory blood pressure monitoring will increase in adolescents and young adults, potentially aiding in assessing 'white coat' hypertension, examining ethnic predispositions, evaluating antihypertensive medication effectiveness, and conducting risk assessments for specific medical conditions. The findings provide a foundation for comparison.

Conflict of Interest: None

Funding Source: None

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Authors Contribution

MTIB, SMM: Conceptualization of Project
MS: Data Collection
IH, ZM: Literature Search
KJ: Statistical Analysis
KJ: Drafting, Revision
MTIB: Writing of Manuscript