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Blood Pressure Pattern among Young Adults Using Ambulatory Blood Pressure Monitoring in South-South Nigeria

Chibuike Eze Nwafor [a*] and Crown Clement [b]

[a] Cardiology Unit, Department of Medicine, University of Port Harcourt and University of Port Harcourt Teaching Hospital, Nigeria.
[b] Research Unit, Good Heart Medical Consultants, Port Harcourt, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Hypertension (HTN) is a significant public health concern worldwide, including Nigeria, with its prevalence steadily rising. Although HTN has historically been associated with older adults, studies have revealed an increasing frequency of the condition in younger adults. This presents unique challenges and implications for long-term health outcomes. In Nigeria, HTN in young individuals is a problem that receives little attention because it is still mistakenly thought of as an illness that only affects the elderly. To dispel this myth, this study aims to identify hypertensive young persons and to investigate the levels and patterns of hypertension in young adults utilizing ABPM in southern Nigeria.
Method: A retrospective study was conducted among young adults aged 18-39 in Southern Nigeria. Participants underwent ABPM to assess their BP levels and patterns over 24 hours. Demographic data, lifestyle factors, and medical history were also collected. Descriptive statistics and multivariate analysis were employed to analyze the data.

**Corresponding author: E-mail: eze.nwafor@uniport.edu.ng, c.ezenwafor@gmail.com;*

Results: This study consisted of 111 participants, 53.2% males and 46.8% females, with a mean age of 32.9 years. Tobacco consumption was reported by 10% of respondents, while 43.2% reported alcohol consumption. Significant differences in blood pressure parameters between genders were observed during the wake period, with males showing higher average systolic, diastolic, and mean arterial pressures. During sleep, males exhibited higher average systolic and mean arterial pressures, but lower average heart rate compared to females. Good BP control was observed in 48.65% of participants, with the majority exhibiting a non-dipping pattern (48.65%) followed by good dipping (36.04%). Masked hypertension, white coat hypertension, and anxiety-related BP were observed in 1%, 1.80%, and 4.50% of cases, respectively.

Conclusion: The study revealed a majority with good blood pressure control, yet a substantial portion exhibited sub-optimal control, emphasizing the continued need for vigilance and interventions in cardiovascular health. Therefore, health practitioners should prioritize raising awareness of hypertension in young adults and promoting early lifestyle changes to mitigate future risks.

Keywords: Blood pressure pattern; blood pressure monitoring; hypertension; anxiety.

1. INTRODUCTION

Hypertension (HTN), one of the most common disorders worldwide, [1] has been rising, particularly in Nigeria [2,3]. Although HTN has historically been associated with older adults, recent epidemiological studies have revealed an increased frequency of the condition in younger adults, [4,5] presenting unique challenges and implications for long-term health outcomes.

Worldwide, it is estimated that 1.8% to 20% of young adults between the ages of 18 and 39 have HTN [6–8] In a cross-sectional study done in Uganda, 15% of young adults had HTN, while 40% of participants were pre-hypertensive [9] A different study carried out in Southeast Nigeria found that 12.3% of young adults (18 – 40) had HTN [10]

These newfound HTN statistics are extremely concerning. Because studies have indicated that young adults account for over half of the global HTN prevalence, healthcare providers must also be on the lookout for this condition in this population. Studies have also shown that untreated primary HTN in young adults often persists into adulthood. Therefore, early detection and treatment of HTN in youth may help prevent premature morbidity and mortality in later life [10].

While office blood pressure (OBP) measurement continues to be the global standard, it provides restricted information on the inherent biological rhythms associated with the disease process [11–13]. Ambulatory Blood Pressure Monitoring (ABPM) provides a more comprehensive and accurate assessment of blood pressure compared to in-office measurements. Studies have shown that it helps overcome the "white coat effect" where blood pressure readings may be elevated due to the stress of being in a medical setting [12] It also helps identify masked hypertension which is characterized by normal OBP readings but elevated ABPM readings [14] and it also allows for the detection of nocturnal hypertension, which is associated with an increased risk of cardiovascular events [15].

ABPM allows for assessing blood pressure variability, which has been recognized as an independent cardiovascular risk factor. Increased variability has been associated with a higher risk of target organ damage and adverse cardiovascular outcomes [16] and it is useful for assessing the efficacy of antihypertensive treatments over 24 hours, providing a more comprehensive evaluation compared to office-based measurements [17]. Understanding the variability in blood pressure patterns is clinically relevant as it provides important information for assessing cardiovascular health.

In Nigeria, HTN in young individuals (18–39 years old) is a problem that receives little attention because it is still mistakenly thought of as an illness that only affects the elderly. To dispel this myth, this study aims to identify hypertensive young persons and to investigate the patterns and long-term outcomes of hypertension in young adults utilizing ABPM in southern Nigeria.

2. MATERIALS AND METHODS

2.1 Study Design

This retrospective study was carried out at Goodheart Medical Consultants Hospital in Port

Harcourt, Nigeria. A total of 111 patients aged 18 to 39 participated in this study. These included individuals with various cardiovascular risk factors or established cardiac conditions.

2.2 Procedures

Socio-demographic information, height, weight, medical history (which included alcohol and tobacco consumption), and current medications of all participants were retrieved. Baseline office blood pressure reading was collected. ASPEL ABPM device was programmed to record blood pressure measurements at 20-minute intervals from 06:00hrs during the day and 30-minute intervals from 22:00hr at night over a 24-hour period. This device was then placed on the non-dominant arm of the patient and the patient was instructed to maintain their usual daily activities, avoid vigorous physical activities, and keep motionless at the time of measurement. The patients were also given a diary to note medication taken, and any symptoms they experienced during monitoring.

Hypertension was characterized by a Systolic Blood Pressure (SBP) of ≥140 mmHg, a Diastolic Blood Pressure (DBP) of ≥90 mmHg [18], or the use of antihypertensive medications. According to the European Society of Cardiology guidelines, elevated daytime BP was defined as a mean daytime SBP of ≥135 mmHg or a DBP of ≥85 mmHg, while elevated nighttime BP was characterized by a mean nighttime SBP of ≥120 mmHg or a DBP of ≥70 mmHg. Additionally, we applied the thresholds from the Jackson Heart Study specific to African Americans for 24-hour hypertension assessments [19]. Using both clinic/office BP and ABPM measurements, we assessed 3 phenotype domains: 1) Diurnal BP variations, 2) Nocturnal BP and 3) discrepancies observed between ABPM and clinic-based readings which includes masked hypertension, white-coat hypertension anxiety related BP.

2.3 Data Analysis

The data retrieved was analyzed using IBM Statistical Package for Social Science (SPSS) version 21.0. Mean blood pressure, standard deviation, and coefficient of variation for 24-hour, daytime, and nighttime periods were calculated. Dipping patterns was evaluated by comparing daytime and nighttime blood pressure.

3. RESULTS

Among 111 participants enrolled, 59 (53.2) were males and 52 (46.8) were female. The mean age of the population is approximately 32.9 years.10% of respondents reported tobacco consumption, while a larger proportion, accounting for 43.2%, reported alcohol consumption.

Table 1. Sociodemographic characteristics and lifestyle habits

Variable	Count (%)
Gender	
Male	59 (53.2)
Female	52 (46.8)
Total	111 (100)
Mean Age	32.9
Tobacco Consumption	11 (10)
Alcohol Consumption	48 (43.2)

During the wake period, significant differences were observed between males and females in various blood pressure parameters. Males exhibited higher average systolic, diastolic, and mean arterial pressures compared to females ($p < 0.0000$). Similarly, males had higher minimum systolic blood pressure than females ($p < 0.0001$). However, there was no significant difference in minimum diastolic blood pressure between the two genders. Males had higher minimum mean arterial pressure compared to females ($p = 0.014$). No significant gender differences were found in maximum systolic, diastolic, mean arterial pressures, and heart rate.

The table presents ambulatory blood pressure monitoring (ABPM) measurements during sleep period categorized by gender.

Average systolic blood pressure was higher in males compared to females, with a significant p-value of 0.0023. The average mean arterial pressure was higher in males with a p-value of 0.0227. However, no significant difference was found in average diastolic blood pressure between males and females.

Males had a lower average heart rate with a p-value of 0.0006. During the sleep period, males exhibited a lower minimum heart rate compared to females, with a significant p-value of 0.0005.

The chart illustrates the distribution of BP status among this study population.
Good BP level represented 48.65% of the population, indicating individuals with well-managed blood pressure levels. Suboptimal BP level accounted for 44.14% of the population, suggesting individuals with blood pressure levels

that are not ideally controlled but are not classified as high. High BP Level Represents 6.31% of the population, Low BP level consisted of 1.80% of the population, occasional Spike represents 9.90% of the population, and early Morning Surge accounts for 1.80% of the population.

The chart illustrates the distribution of different dipping patterns observed in this population. The majority exhibited a non-dipping pattern (48.65%) followed by a good-dipping pattern of 41.45%. Reverse dipping pattern was observed in 9.01% of the population while 1.80% had extreme dipping pattern.

Masked Hypertension accounts for 1% of cases, showing individuals with normal BP reading during the day but high BP reading at night. White Coat Hypertension/ Anxiety-related BP represents 1.80% and 4.50% respectively of cases, these individuals exhibit elevated BP readings in clinical settings but normal readings outside of these settings which may include moments of stress. These BP changes are transient.

Table 2. Office BP measurements (MEAN±SD)

BP Variable	Male	Female	P-value
Office BP systolic	136.20±18.75	134.89±18.84	0.7134
Office BP diastolic	86.51±12.98	85.5±13.91	0.6936

No significant difference was noted in both male and female systolic and diastolic OBP measurement.

Table 3. Abpm measurements during wake period according to gender (MEAN±SD)

Variables	Male	Female	P value
Avg Systolic	135.64±12.0	124.31±10.9	0.0000*
Avg Diastolic	84.10±10.18	78.39±8.31	0.0017*
Avg Map	101.12±10.50	93.48±9.23	0.0001*
Avg HR	77.58±8.69	80.65±7.62	0.0512*
Min Systolic	106.12±15.95	93.83±16.77	0.0001*
Min Diastolic	55.95±13.10	53.27±10.56	0.2420
Min Map	73.93±13.07	68.25±10.54	0.0139*
Min HR	58.10±9.12	59.15±8.83	0.5393
Max Systolic	167.34±31.58	160.67±21.99	0.2054
Max Diastolic	121.53±32.64	119.92±32.69	0.7970
Max MAP	137.54±29.54	133.77±28.95	0.4993
Max HR	121.20±36.14	124.83±30.47	0.5720

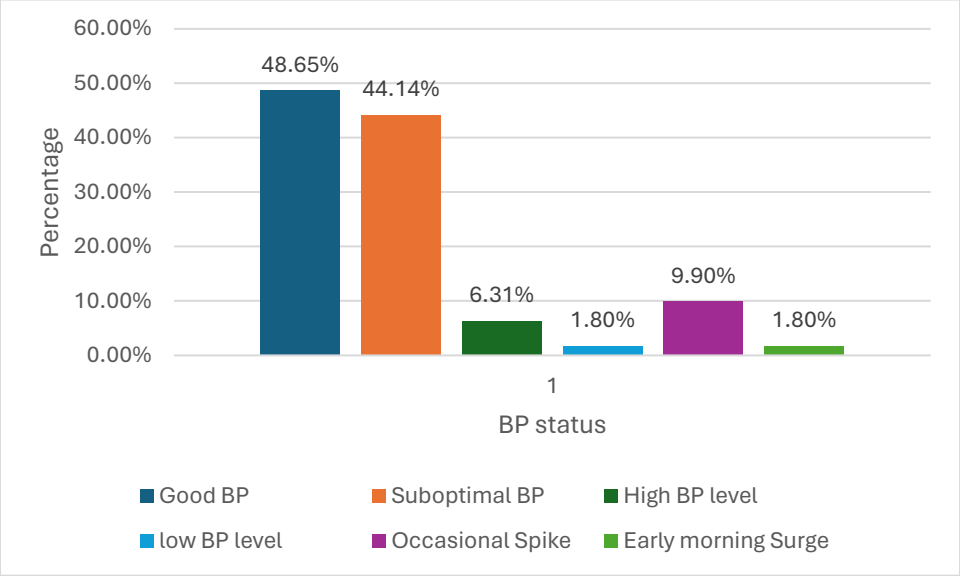

Fig. 1. Blood pressure levels

Table 4. abpm measurements during sleep according to gender (MEAN±SD)

Variables	Male	Female	P value
Avg Systolic	127.10±17.98	117.77±12.60	0.0023*
Avg Diastolic	74.20±10.52	71.02±12.60	0.0961
Avg Map	91.22±11.15	86.48±10.34	0.0227*
Avg HR	65.98±9.09	71.75±7.84	0.0006*
Min Systolic	107.41±16.81	101.48±14.80	0.0526*
Min Diastolic	59.80±11.64	57.69±8.95	0.2931
Min Map	76.12±11.59	73.13±10.18	0.1550
Min HR	55.63±9.23	61.77±8.60	0.0005*
Max Systolic	142.83±18.42	135.71±19.81	0.0524*
Max Diastolic	93.27±23.48	87.38±16.0	0.1308
Max Map	109.85±18.75	103.10±17.15	0.0514
Max HR	82.83±16.24	88.83±13.86	0.0401*

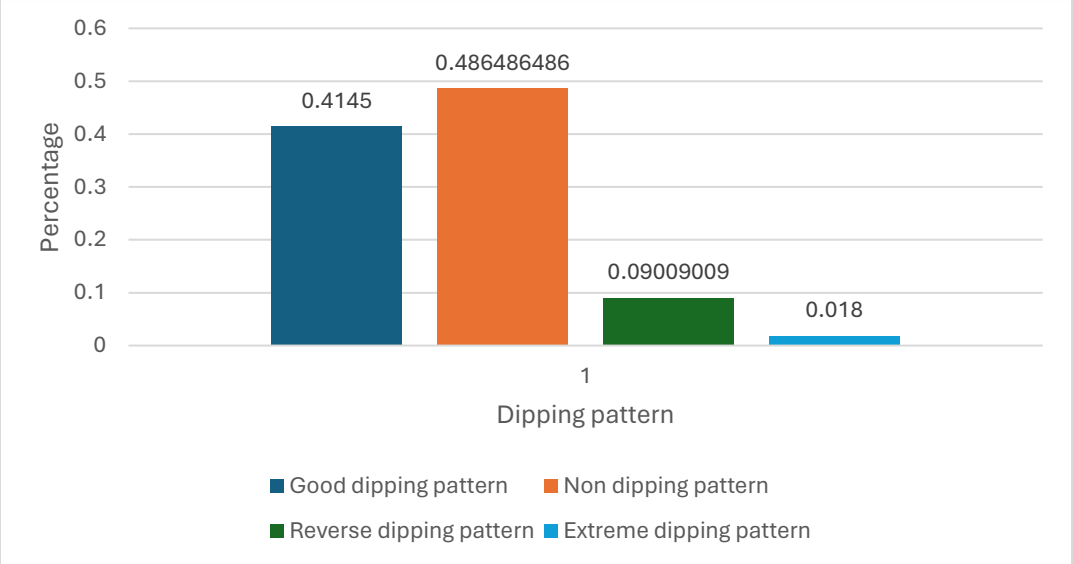

Fig. 2. Patterns of BP dipping

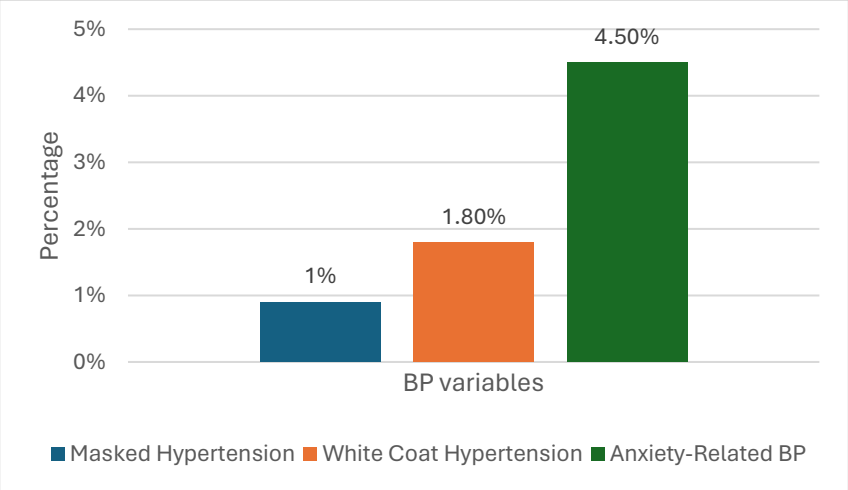

Fig. 3. BP patterns

3. DISCUSSION

This study comprehensively evaluates ABPM profiles among young adults aged 18-39 years in southern Nigeria. The mean age of the participants is 32.9 years. Approximately 10% of the respondents reported tobacco consumption and alcohol consumption was reported by 43.2% of the participants.

Table 2 showed no significant difference in both systolic and diastolic OBP in both the male and female population, but this differs from the ABPM result shown in Tables 3 and 4. During wake and sleep periods, males consistently exhibited higher SBP compared to females. While differences in DBP were significant during wakefulness, they were not significant during sleep. This difference in BP could be because of several factors. It has been established that testosterone and androgens induce higher blood pressure in males. Female hormones, such as estrogen, may also protect women from having higher blood pressure because menopause is linked to higher blood pressure in women [20,21].

Many (48.65%) of our study population had good BP levels (Fig. 1). This shows that nearly half of the young adult population (aged 18-39) maintained optimal BP levels which is supported by an Asian study (5). The high proportion of individuals with good BP levels in this study highlights the importance of early preventive measures and prompt treatment in young hypertensives as vital for the maintenance of cardiovascular health in this age group.

Although the prevalence of HTN in our study population is low (6.31%), this is similar to a local study done at Ile-ife (2015) and the University of Ibadan (2020) where the prevalence of HTN in young adults was 4.4% and 5.4% respectively indicating an upward trend in HTN among young adults. [22,23]. Factors contributing to high BP in this age group may include genetic predispositions, lifestyle factors, and underlying health conditions. This therefore underscores the need for regular monitoring and targeted intervention [24].

Occasional spikes in blood pressure of the population were 9.90%. A temporary blood pressure spike could signal the beginning of a more serious hypertension problem. Occasional spikes tend to be situational, this means the spikes occur in response to stress, physical exertion, or consumption of stimulants like caffeine [25] While occasional spikes may not necessarily indicate underlying pathology, they warrant monitoring and further evaluation to identify potential triggers and assess overall cardiovascular risk.

In the overall population, 1.8% of the participants experienced a surge in blood pressure levels during the early morning hours, typically upon awakening. The phenomenon of early morning surge in blood pressure is believed to be associated with increased cardiovascular events, particularly in individuals with pre-existing hypertension. Contributing factors may include changes in hormonal secretion patterns, increased sympathetic activity, or alterations in vascular tone during the early morning period [26] The activation of various pressor neurohumoral factors, such as the sympathetic nervous system and RAS, happens early in the morning. Elevated sympathetic activity, particularly of the α-adrenergic component elevates the vascular tone in the small resistance arteries and could potentially contribute to the morning BP surge [27].

Most of the population exhibited a non-dipping pattern (Fig. 2), characterized by minimal nocturnal BP decline, which has been associated with an increased risk of cardiovascular events. This is similar to a study conducted in 6 Sub-Saharan African countries where the majority of their study population had a non-dipping pattern [28] Conversely, a significant proportion demonstrated a good dipping pattern, reflecting a more favorable nocturnal BP profile linked to lower cardiovascular risk.

Although the prevalence of masked hypertension, white coat hypertension, and anxiety-related BP are low (Fig. 3), this result shows the importance of out-of-office BP monitoring to prevent misdiagnosis and unnecessary treatment of patients who do not require medications.

4. CONCLUSION

While most of our study population demonstrated adequate BP levels, a notable proportion exhibited suboptimal levels, emphasizing the need for sustained vigilance and therapeutic interventions to mitigate cardiovascular disorders. In comparison, with other relevant studies, there is a notable upward trend in HTN among young adults. Additionally, the high prevalence of non-dipping patterns in our

population warrants attention, as this phenomenon has been linked to heightened cardiovascular morbidity and mortality, with potential ramifications including stroke, coronary artery disease, and renal impairment. In view of the known fact that non dipping pattern constitutes a distinct cardiovascular risk, this calls for further studies and measures to prevent the consequences in the significant non dipping population found in our study. Therefore, healthcare providers should prioritize hypertension awareness campaigns among young adults and advocate for timely implementation of lifestyle changes.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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