Nigerian Medical Journal
NIGERIA MEDICAL ASSOCIATION
Print ISSN 0300-1652, E-ISSN 2229-774X

Original Research

Prevalence of Prehypertension, Hypertension, and its Determinants Among Young Adults in Enugu State, Nigeria.

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Abstract

Background: Emerging epidemiological data suggest that Hypertension (HTN) has become a significant public health challenge in sub-Saharan Africa. HTN in young adults is a problem lacking relevant attention because it is still erroneously considered a disease of the old. This study aimed to determine the prevalence of hypertension and its associated risk factors in undergraduate medical students at the University of Nigeria, Enugu Campus, Enugu State, Nigeria.

Methodology: This was a cross-sectional study conducted between March and April 2021. This study recruited 279 consenting medical students (136 males and 143 females) aged 18–35 years. They were administered with a structured questionnaire. Data on sociodemographic information and risk factors for hypertension were collected. Blood pressure, waist circumference, weight, height, and body mass index were measured using standard methods. All data collected were carried out following the Institutional ethical guidelines and that of the Helsinki as revised in 2000. Data were analyzed using IBM Statistical Package for Social Sciences version 25, and statistical tools employed include descriptive statistics and Chi tests. Results were recorded as mean standard deviation, and statistical significance was taken at $p<0.05$.

Results: This present study has shown a prevalence rate of 19.93% for hypertension. Isolated diastolic hypertension constituted a greater burden with a prevalence of 13.65% than systolic Hypertension (0.74%) and systolic-diastolic Hypertension 5.4%. The prevalence of prehypertension was 48.7%, with a higher incidence observed in females (25.8%), individuals aged 21-25 years (26.4), and those with normal BMI (35.1%). A significant association was observed between the stage of hypertension and gender ($p = 0.005$), and age category ($p = 0.037$). Of the examined cohort, 7.75% were underweight, 16.5% overweight, and 2.2% obese. Notably, systolic, and diastolic blood pressure, weight, as well as waist circumference showed significant ($p = 0.01$, $p = 0.007$, $p =0.01$ and $p<0.0001$ respectively) increases concomitant with advancing age.

Conclusion: There is an increased prevalence of prehypertension and hypertension among young adults. This calls for a comprehensive national screening, public enlightenment, and targeted prevention programs that foster healthy lifestyle behaviours, physical activity, and healthy eating among students.

Keywords: Prehypertension, Hypertension, Medical Students, Risk Factors, Blood Pressure.

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How to cite: Nwoke OC, Nubila NI, Ekowo OE, Nwoke NC, Okafor EN, Anakwue RC. Prevalence of Prehypertension, Hypertension, and its Determinants Among Young Adults in Enugu State, Nigeria. Niger Med J 2024;65(3):241-254 https://doi.org/10.60787/nmj-v65i3-404.

Quick Response Code:

Introduction

Hypertension (HTN) is one of the major non-communicable diseases which has, in recent years, been attributed to accompany human lifestyle changes following increasing urbanization and industrialization .[1]HTN is defined by the World Health Organisation (WHO) in conjunction with the International Society of Hypertension, as a systolic blood pressure ≥140 mmHg or a diastolic blood pressure of ≥90mmHg or both in adults over 18 years of age.[2,3] Most cases of HTN are asymptomatic; that is why it has been dubbed the 'silent killer.'

Hypertension is one of the most prevalent chronic diseases and cardiovascular risks factors worldwide, accounting for about 10 million deaths worldwide each year. The prevalence of HTN globally is approximately 30 - 40% and is the leading global risk factor for death or disability. Data suggest that in 2015, 25% of men and 20% of women had abnormally high blood pressure, but less than 20% of these individuals had the disease adequately managed. According to World Heart Organisation, the condition affects around 1.13 billion people worldwide,[4] with Sub-Sahara Africa having the highest prevalence of 27%. Hypertension-related disease burden is a major challenge globally, with an estimated 1.56 billion adults expected to be affected with hypertension by 2025.[5]

Emerging epidemiological data suggest that hypertension has become a major public health challenge [6,7] and Nigeria, the most populous country in the continent, hugely contributes to this burden. In a country with 209.6 million people in 2019 and a life expectancy of 54 years in 2018,[7] about 25% of hospital admissions among adults are due to complications of Hypertension.[8] The overall prevalence of HTN ranges from 8%-46.6% (27.3% on average), with an almost equal male to female ratio. The estimated prevalence of Hypertension in Nigeria from studies published between 1980 and 2013 (using a cut-off definition of ≥140/90 mmHg) is 28.9% (30.6% in urban and 26.4% among rural dwellers.[7,9] An overall prevalence of 38.1% from a nationwide survey which also showed a closing of the urban and rural gap, with the highest prevalence of hypertension (52.8%) recorded in Southeast Nigeria, and this brings to light the considerable burden of Hypertension in Nigeria.[6] In 2010, about 20.8 million cases of HTN was estimated in Nigeria, and it was projected that this could increase to 39.1 million by 2030 if the present trend continues.[10]

Over recent decades, clinicians have observed an increasing number of children, adolescents, and young adults diagnosed with elevated blood pressure. Hypertension in the young is less well studied compared to adults.[2] While more common in the older population, an increasing incidence in the younger population is observed. Globally HTN among young adults (aged 18 - 40 years) ranges from 1.8% to 20%, and studies have shown that prevalence in this category constitutes more than half the global overall figure.[10] Worldwide estimates of the prevalence of hypertension in 2000 among adults aged 20 to 29 years were 12.7% in men and 7.4% in women, rising to 18.4% and 12.6%, respectively, in 30- to 39-year olds.[11] The estimated prevalence of hypertension among those aged 18 to 39 years rose in the United States in 2011–2012 to 7.3% against 2-4% between 1988-1991.[2]

From studies carried out amongst adolescents in secondary schools in South East, Nigeria, the prevalence of hypertension and prehypertension ranged from 5.4 -8.4% and 6.6-17.3% was observed with a higher prevalence observed in females than males.[12,13,14] According to the work of Umegbolu and Ogamba,[10] the overall prevalence of HTN in young adults aged 18-40 years in Enugu state Southeast Nigeria was 21.3%, with 24.3% in males and 20.3% in females, while Odili *et al*.,[6] recorded a prevalence of 12.4% in adults <30 years of age.

Studies have shown that the risk factors for hypertension in the young are obesity, low birth weight, family history of hypertension and diabetes, poor nutrition, and sedentary behavior. [12,15] The risk of developing hypertensive cardiovascular complications is greater in younger than older individuals.[12] In addition, the presence of hypertension at a young age increases the risk of cardiovascular events at middle

age. It contributes to an earlier onset of coronary heart disease, heart failure, stroke, and transient ischaemic attacks.[11] Therefore blood pressure in adulthood may also be determined by factors occurring many years earlier. However, young adults meeting hypertension diagnostic criteria have a lower prevalence of a hypertension diagnosis than middle-aged and older adults.[16] In this study, we aim to to determine the prevalence of pre-hypertension and hypertension and its determinants among young adults of the University of Nigeria, Enugu Campus. So, identifying young individuals who present with greater risks for developing hypertension may help target public health prevention efforts to reduce morbidity and mortality. This could help reverse the present trend so that the number of cases of HTN in the country would not hit 39.1 million by 2030 as has been projected.[10]

Materials and Methods

This was an Institutional-based cross-sectional study carried out in the College of Medicine, University of Nigeria, Enugu Campus, Enugu State, Nigeria, from March 2021 to April 2021.

Study Area - The study was carried out in the University Enugu Campus located in Enugu city, a major commercial and industrial hub in southeastern Nigeria with an estimated population of just over a million people. The University of Nigeria, commonly referred to as UNN, is a federal university located in Nsukka, Enugu State, Nigeria. The University of Nigeria has three campuses in Enugu State– Nsukka, Enugu, and Ituku-Ozalla – and the Aba campus in Abia State. The University of Nigeria Enugu Campus (UNEC) consists of 200 hectares of land in the very heart of Enugu city. The Faculties of Business Administration, Environmental Studies, Law, Health Sciences and Medical Sciences are located at the Enugu Campus.

Ethical Considerations: Approval of the study was obtained from the Health Research Ethics Committee of the University of Nigeria Teaching Hospital, ItukuOzalla with approval number UNTH/HREC/2022/02/301. Written informed consent was obtained from individuals who agree to participate in the study.

Sample Size Calculation.

The sample size was determined using the methodology outlined by Dahiru et al. [17] for scenarios where the population size is below 10,000. Employing a 95% confidence interval with a margin of error set at 5%, calculations yielded a minimum sample size requirement of 270 individuals. This estimation was based on a prior meta-analysis indicating a prevalence of hypertension among young adults aged 18 to 40 years in Enugu State, Nigeria, to be 21.3%.[10]

This was calculated using the formula.

$N = Z_\alpha^2 \times P(1-P)/D2$

Where:

$Z_\alpha = 1.96$ (the corresponding value of the standard deviation at 95% confidence limit.

P = 21.3% (the prevalence of hypertension from the previous study)

D = 0.05 (the margin of error tolerance of prevalence rate of the practice of hypertension).

$N = 1.96^2 \times 21.3/100(1-0.213/100)/0.05 \times 0.05 = 257.6$

With an attrition rate of 5% (12.9), this was calculated minimum sample size is 270.

Study Population: A cohort of two hundred and seventy-nine (279) medical students—comprising 143 females and 136 males—from the Faculty of Medical Sciences, College of Medicine, University of Nigeria, Enugu Campus, participated in this study. The participants were aged between 16 and 35 years. Exclusions from the study criteria included individuals who were not medical students, those younger than 16 or older than 35 years, pregnant women, individuals with debilitating chronic conditions, or those who did not provide consent.

Data Collection and Analytical Measurements.

A researcher-developed questionnaire and clinical measurements were employed for data collection. A questionnaire designed to obtain information regarding socio-demographic attributes of the respondents, family history of hypertension, co-morbidities, and current lifestyle modifications was given to the study participants. Blood pressure, weight, height, waist circumference was measured, and body mass index calculated.

Blood Pressure Measurement: Systemic blood pressure was measured using a standard mercury sphygmomanometer as described by Onwubere *et al*. [18] Blood pressure readings were taken using the left arm with the subject in a sitting position. Using a mercury sphygmomanometer (Accusson) and a stethoscope (Littman) with the bare arms supported at heart level on a desk, readings were taken at five-minute intervals after ten minutes rest. An appropriate-sized cuff (cuff bladder encircling at least 80% of the arm) was used to achieve accuracy. The systolic blood pressure (SBP) and the diastolic blood pressure (DBP) were taken as the first and fifth koroktoff sounds, respectively, and BP values were calculated and recorded as the average of the two independent readings,

Height, Weight, BMI, and Waist Circumference Measurement.
The height and weight of each subject was measured using a Stadiometer to which a weighing scale (*ZT-120 health scale*) was attached as described by Umegbolu and Ogamba.[10] Measurements were taken with the subjects standing erect, on light clothing, and wearing no footwear. The participant stood with the back against the stadiometer to measure the height, and the sliding part was lowered until it touched their head. Height was measured to the nearest centimeter and converted to meter to calculate body mass index (BMI). With the participant still standing on the stadiometer, facing the investigator, the weight was recorded to the nearest 0.1 kilograms (kg) as soon as the swinging indicator of the scale balance had come to rest. Waist circumference was measured at the highest point of the iliac crest of the subject using a measuring tape.

The body mass index (BMI) was calculated using the formula:

$BMI = Weight\ (kg)/ Height\ (m)^2$.

Measurement of risk factors
Body mass index was calculated as weight (kg) divided by the square of height (m) and classified as underweight if weight <18.5 kg/m2, normal if 18.5–24.9 kg/m2, overweight if 25–29.9 kg/m2, and obese if > 30 kg/m^2 according to WHO recommendations.[7,19] Abdominal obesity was defined as a waist circumference ≥ 102cm in males and ≥88cm in females. We classified blood pressure according to the JNC-7 guidelines as follows: normal (systolic BP <120mmHg and diastolic BP< 80mmHg), pre-hypertension (SBP; 120–139 mmHg and DBP 80–89 mmHg), stage 1 hypertension (SBP: 140–159 mmHg and/or DBP: 90–99 mmHg), stage 2 hypertension (SBP:≥160mmHg or DBP≥100mmHg).[20] Subjects were classified as having hypertension using either SBP, DBP, or both. If both BPs fell under different classes, the higher one was used to classify the subject. Individuals with FBG<70mg/dl was considered low, 70 -125 mg/dl normal, and > 125mg/dl high.

Statistical Analysis
The collected data were sorted, coded, inputted in, and analyzed using the IBM Statistical Package for Social Sciences (IBM SPSS) Statistics for Windows, version 24.0 Armonk, New York: IBM Corp released. Results were presented as mean ± standard deviation (Mean±SD) or as frequencies where applicable. Statistical tools used include descriptive statistics and logistic regression to determine the relationship between various variables. All analyses were done at the 5% significance level with $p<0.05$ considered statistically significant.

Results

Table 1 shows the association between hypertension and age, gender, and BMI among the subjects. The result shows that there was a statistically associated with age (p = 0.006) and sex (p = 0.001) in the study group. HTN was higher in males, 13.7%, compared to the female subjects, 6.3%. However, within 21-25 years had a higher prevalence of hypertension (11.4%) than other age categories, 26-30 years (4.1%), 16-20 years (3.0%), and 31-35 years (1.5%). Among the hypertensive subjects, 14.4% had normal BMI, while 3.3% were overweight, 1.5% underweight, and 0.7% obese. 7% of the study population had abdominal obesity, 0.7% were hypertensive, and 6.3% were normotensive. Of those with normal waist circumference, 19.2% were hypertensive, while (73.8%) were not. BMI, and abdominal obesity status had no significant association with the presence of hypertension.

Table 1: Hypertensive status of the respondents as characterized by age, gender, BMI, and waist circumference categories.

	Presence of Hypertension Frequency (%)			
	Yes	**No**	X^2	P
Age categories (yrs)				
16-20	8(3.0)	59(21.8)		
21-25	31(11.4)	135 (49.8)	12.36	0.006
26-30	11(4.1)	15(5.5)		
31-35	4(1.5)	8(3.0)		
Sex				
Male	37(13.7)	93(34.3)	11.41	0.001
Female	17(6.3)	124(45.8)		
BMI Category (BMI kg/m^2)				
Underweight *(<18.5 kg/m^2)*	4(1.5)	17(6.3)		
Normal weight *(18.5-24.9 kg/m^2)*	39(14.4)	160(59.0)	0.70	0.873
Overweight *(≥ 25–29.9)*	9(3.3)	36(13.3)		
Obese *(≥ 30)*	2(0.7)	4(1.5)		
Abdominal Obesity (>94cm for males or >80cm for females)				
No	52 (19.2)	200 (73.8)		
Ye s	2 (0.7)	17 (6.3)	1.131	0.531

Figure 1 reveals the type of hypertension in relation to sex amongst the hypertensive subjects. From the figure, 3.7% of the male subjects had systolic hypertension, while diastolic hypertension was more prevalent in both sexes but higher in males (49.74%) than females (27.78%). Systolic-diastolic hypertension was observed in 24.07% of the males and 3.7% of the females. No significant association was observed between hypertension type and gender (p>0.05).

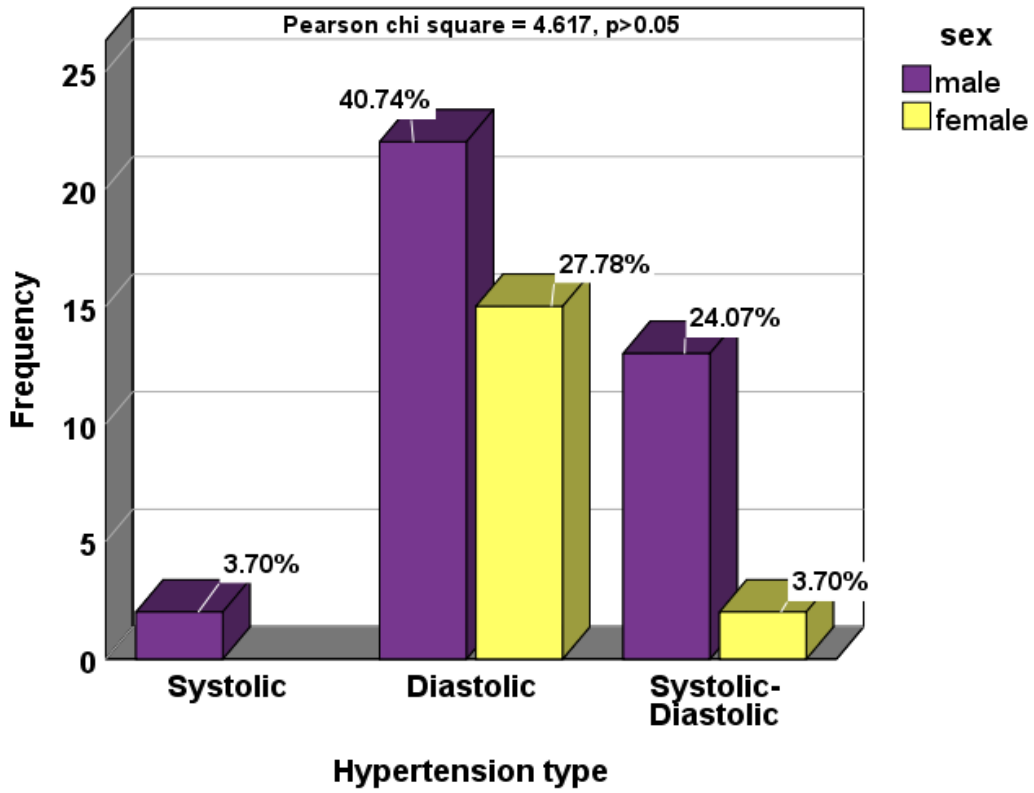

Figure 1: Hypertension type in the male and female hypertensive subjects.

Table 2 represents the mean values of the anthropometric indices of the male and female subjects. Statistically significantly lower mean values were observed in the females in age (21.78±2.33), weight (62.12±10.20), height (1.67±0.07), waist circumference (71.90±7.88), systolic blood pressure (112.74±8.84) ($p<0.0001$ respectively) and diastolic blood pressure (76.11±7.36) ($p = 0.007$) than their male counterparts (23.90±3.75, 71.95±11.18, 1.77 ±0.13, 77.57±7.60, 119.71±11.23 and 78.31±8.95 respectively). Though lower in females, BMI did not reveal any significant differences between the sexes ($p = 0.374$).

Table 2: Anthropometric indices and blood pressure in male and female subjects.

	Female (n =141)	Male (n =130)	t	P value
Age (yrs)	21.78±2.33	23.90±3.75	5.632	<0.0001
Weight (Kg)	62.12±10.20	71.95±11.18	7.567	<0.0001
Height (m)	1.67±0.07	1.77 ±0.13	8.209	<0.0001
Waist circumference (cm)	71.90±7.88	77.57±7.60	6.025	<0.0001
Systolic (mmHg)	112.74±8.84	119.71±11.23	5.693	<0.0001
Diastolic (mmHg)	76.11±7.36	78.31±8.95	2.218	0.027
BMI (kg/m^2)	22.30±3.56	23.63±11.37	1.323	0.374

In table 3, the blood pressure, weight, height, waist circumference, and BMI in the different age groups. Systolic and diastolic blood pressure show a statistically significant increase with age ($p = 0.01$ and $p = 0.007$). Also, a statistically significant increase with age was observed in weight ($p = 0.001$) and waist circumference ($p<0.0001$) in the study population. The mean height and BMI values did not show any

statistically significant change with increasing age (p = 0.066 and p = 0.374). Among the significant variables, post hoc analysis reveals a significant difference between age groups 16-20 and 26-30 years (p<0.05) in diastolic blood pressure, 16-20 versus 31-35 years (p<0.01) and 21-25 versus 31-35 years (p<0.05) in mean weight values and 16-20 versus 31-35 years (p<0.0001), 21-25 versus 31-35 years (p<0.0001) and 26-30 versus 31-35 years (p<0.05) in waist circumference.

Table 3: Anthropometric parameters according to age groups.

Parameter	16-20 (n =67)	21-25 (n = 166)	26-30 (n = 26)	31-35 (n = 12)	F	P value
Systolic bp (mmHg)	114.91±10.21	115.37±10.53	120.31±10.92	123.33±9.85	3.87	0.01
Diastolic bp (mmHg)	75.81±8.08	76.77±7.77	81.15±10.22*	81.67±7.18	4.08	0.007
Weight (kg)	63.99±10.65	66.79±11.97$^{\alpha}$	69.56±11.23	77.50±9.34**	5.32	0.001
Height (m)	10.65±1.73	11.97±1.71	11.03±1.73	9.34±1.79	2.43	0.066
Waist circumference (cm)	72.68±6.59	74.29±8.51$^{\alpha\alpha\alpha}$	77.06±7.78$^{\alpha}$	84.67±5.68***	8.73	<0.0001
BMI (kg/m^2)	21.41±3.00	23.44±10.27	23.11±3.12	24.09±2.84	1.044	0.374

*Post Hoc Analysis: *represents comparison with 16 -20yrs, * is p<0.05, **p<0.01 and *** p<0.0001*

$^{\alpha}$ Compared with 31-35 yrs αp<0.05 and $^{\alpha\alpha}$ p<0.01.

Table 4 shows the relationship between smoking history, alcohol intake, physical activity, and the presence of hypertension. 50 (19%) respondents with hypertension are non-smokers, while 2 (0.8%) had a smoking history. However, among the hypertensive, 19 (7.2) do not take alcohol, 12 (4.5%) take alcohol regularly, and 20 (7.6%) of the respondents consume it occasionally. No significant association (p = 0.109) was observed between smoking history or alcohol intake and the presence of hypertension in this study. Grouped based on the frequency of at least 30 minutes of physical activities, 54 (20.2%) of the subjects were hypertensive while the rest, 212 (79.8), were not hypertensive. Of the 54 hypertensives, 12 of them do not engage in any vigorous physical activity, 25 (9.4), 7 (2.6%), and 9 (3.4%) carry out such activities once/week, 1-2days, and 3-4 days per week respectively. Vigorous physical exercise showed a significant positive association with the presence of hypertension (p<0.0001).

Table 4: Association between lifestyle and presence of hypertension

	Presence of Hypertension Frequency (%) Yes	No	X^2	P
Smoking history				
Non smoker	50(19.0%)	209(79.5%)	4.441	0.109
Active smoker	1(0.4%)	2(0.8%)		
Ex-smoker	1(0.4%)	0(0%)		
Alcohol intake				
No	19(7.2)	112(42.4)	3.920	0.114
Regularly	12(4.5%)	40(15.2%)		
Occasionally	20(7.6%)	61(23.3%)		
Physical activity (*≥30minutes exercise*)				
Never	12(4.5%)	120(44.9%)		
Daily	1(0.4%)	16(6.0%)		
<once/week	25(9.4%)	36(13.5)	35.537	<0.0001
1-2 days/week	7(2.6%)	29(10.9%)		
3-4 days/week	9(3.4%)	12(4.5%)		

Table 5 illustrates the blood pressure pattern according to age, sex, BMI, characterized by age, those in the 16-20 age group, 12.5% (34) had prehypertension, 1.5% (4) had stage 1 hypertension and 0.7% (2 subjects) stage 2 hypertension. Prevalence for prehypertension, hypertension stage 1 and stage 2 was 28.4% (77), 7.0% (19) and 1.5 (4) for age 21-25 years, 5.5(15), 2.6 (7) and 0(0) for 26-30 years and 2.2% (6), 1.5% (4) and 0% (0) for age 31-36. Age showed a statistically significant association (p= 0.037) with the stage of hypertension. Also, prehypertension was more prevalent in the female subjects (36.6%), while HTN stages 1 and 2 were more prevalent in the males at 8.1% and 2.2%, respectively. Gender associated significantly (p = 0.005) with hypertension staging. According to BMI categories, among the underweight subjects, 8 (3.0%) had prehypertension and 3 (1.1%) hypertension stage 1. In the overweight and obese individuals, prevalence of prehypertension was 9.2% (25) and 1.5% (4) respectively, hypertension stage 1 was 1.8% (5) and 0.7% (2), and for stage 2 hypertension it was 0.7% (2) and 0% (0). Among the subjects presenting with central obesity, 5.9% (16) were prehypertensive, and 0.4% (1) were stage 1 hypertensives. BMI had no association with hypertension stage; however, abdominal obesity revealed a significant association with hypertension stage (p = 0.016). The table also demonstrates a that hypertension was prevalent in 14.8% of the study population, of which 12.6% had stage 1 hypertension and 2.2% stage 2 hypertension. In this study, the prevalence of prehypertension was 48.6%, while only 36.6% of the subjects were normotensive.

Table 5: Blood pressure pattern and characteristics of the subjects

	Hypertension Stage Frequency (%) Normal BP	Pre HTN	HTN stage 1	HTN stage 2	X^2	P
Age (yrs)						
16-20	27 (10)	34 (12.5)	4 (1.5)	2 (0.7)		
21-25	66 (24.4)	77 (28.4)	19 (7.0)	4 (1.5)	17.824	0.037
26-30	4 (1.5)	15 (5.5)	7 (2.6)	0 (0)		
31-35	2 (0.7)	6 (2.2)	4 (1.5)	0 (0)		
Sex						
Males	40 (14.8)	62 (22.9)	22 (8.1)	6 (2.2)	12.647	0.005
Female	59 (21.8)	90 (25.8)	12 (4.4)	0 (0)		

BMI						
Underweight	10 (3.7)	8 (3.0)	3 (1.1)	0 (0)		
Normal weight	76 (28.0)	95 (35.1)	24 (8.9)	4 (1.5)	8.997	0.438
Overweight	13 (4.8)	25 (9.2)	5 (1.8)	2 (0.70		
Obese	0 (0)	4 (1.5)	2 (0.7)	0 (0)		
Abdominal Obesity						
No	97 (35.8)	111 (42.8)	33 (12.2)	6 (2.2)	10.386	0.016
Yes	2 (0.7)	16 (5.9)	1 (0.4)	0 (0)		

BMI *Body mass index*

Discussion

Blood pressure is a leading risk factor for cardiovascular disease (CVD), influenced by chemical and non-chemical stressors.[21] In this study, only a few of the study population were on antihypertensive, antidiabetic, or anti-lipid medication (<4%) and therefore only these proportions had a history of cardiovascular-related risk and diabetes. Based on the presence of hypertension, age and gender showed a significant association with the presence of hypertension. The highest prevalence of hypertension was observed within the 21-25 years age groups. Statistically significant associations were observed between presence of hypertension and age ($p<0.01$). In a systematic review of 53 studies of hypertension in Nigeria between 1995 and 2020, Adeloye et al.,[22] recorded a significant increase in the prevalence of HTN with advancing age and time. Their research revealed a remarkable surge in hypertension, with an increase of over 540% during the study period. Specifically, the prevalence of hypertension rose from 1%, 1.8%, and 4.5% in 1995 to 23.5%, 26.2%, and 29% in 2020 among individuals aged 20-24 years, 25-29 years, and 30-34 years, respectively. Notably, those between the ages of 30 and 34 years exhibited the highest prevalence among the three age groups [22].

Identifying precisely how sex influences blood pressure is not straightforward. It is widely acknowledged that there exist substantial discrepancies in the physiological, psychological, and hormonal mechanisms between males and females.[23]. Our study showed significant statistical associations between hypertension and gender ($p = 0.001$) with the male subjects exhibiting a predisposition to hypertension that was more than twice as high as their female counterparts. This is in line with other studies from Ethiopia,[24] and Kuwait,[25]. However, Adeloye et al. [22] found no significant association between the presence of hypertension and gender, but interestingly, females exhibited a higher prevalence compared to their male counterparts, this discrepancy could potentially be attributed to the larger sample size utilized in the aforementioned study, as well as the fact that their subjects belonged to varying age brackets not accounted for in our own research. Mouhtadi and colleagues [26] found similar findings among young adults in Lebanon, suggesting that the higher incidence of sedentary lifestyles, obesity and unhealthy diets [22] observed in females may account for the greater prevalence of hypertension in females.

This study recorded a lower prevalence of hypertention in individuals with BMI ≥25kg/m^2 (<19%) compared to the study of Ondimu *et al.*,[27] who recorded a prevalence of 37.9% in youths aged 18-35 years with BMI ≥25kg/m^2. The lower BMI observed in our study may be linked to the characteristics of the study population. Specifically, our participants are students living in hostels, where many of them consume meals sparingly due to time constraints stemming from the demands of their academic programs. Additionally, the nature of their studies necessitates frequent movement between lecture halls, often located at considerable distances from each other. Venecia et al. [28] have proposed that conventional risk factors, such as obesity, diabetes mellitus, and renal disease, are becoming more prevalent among young individuals, thereby heightening their vulnerability to hypertension.

Investigations suggest that psychosocial stressors may also play a significant role in the rising prevalence of hypertension within this demographic. These students encounter varying levels of stress as they strive to manage their academic responsibilities alongside professional assessments.

Primary hypertension is defined as a raised BP ≥140/90mmHg, not caused by any underlying disease. Studies worldwide have shown that the prevalence of hypertension among young adults (aged 18-40 years) ranges from 1.8% to about 20%.[10] This present study has shown a prevalence rate which is comparable to reports by similar studies in other parts of the world,[16,27,29,30,31] in Nigeria[7,32] and especially in South East, Nigeria.[10,12,14]. Escalating urbanization, adoption of unhealthy lifestyles, and the lack of effective nationwide screening and preventive measures have been suggested to be notable contributors to this substantial and consistent increase in hypertension.[22] .However, the prevalence varied compared to findings by Tadesse and Alemu,[24] and Al-Majed[25] who reported a lower prevalence of hypertension in College students in Gondar (7.7%)[24] and Kuwait (7%),[25] and higher rates documented in studies conducted in Tunisia (35.1%),[33] Gambia (38.0%),[34] and Ethiopia (28.3%),[35] which demonstrated a higher prevalence than observed in the present study. These discrepancies may stem from differences in data collection methods, characteristics of the study participants, ethnic and regional variations. Research has found significant evidence due to regional disparities in the prevalence of hypertension.[22]

Our study revealed statistically significant differences in age, weight, height, waist circumference, systolic blood pressure, and diastolic blood pressure between male and female subjects, with male subjects exhibiting higher values. The mean systolic and diastolic blood pressure was significantly higher in males compared to females, consistent with the earlier finding of higher hypertension prevalence among male subjects. These differences may be attributed to hormonal, environmental, and sociocultural factors. Additionally, systolic blood pressure, diastolic blood pressure, weight, and waist circumference showed significant increases with advancing age among the students. According to Adeloye et al., aging has been implicated as a factor in hypertension, as evidenced by our study's findings, although BMI and height did not show significant variation with age. Among the hypertensive participants, isolated diastolic hypertension constituted a greater burden than systolic hypertension and systolic-diastolic hypertension. This prevalence was higher than that observed in the study by Al-Wabel et al [31 among undergraduate medical students in Saudi Arabia, who reported a prevalence of 6.9% for diastolic and 4.6% for systolic hypertension, but lower for systolic-diastolic hypertension (3.1%). This disparity could be attributed to racial and environmental factors. These findings underscore the increasing impact of hypertension on the younger generation.

Among adults, the most notable modern-day risk factors are alcohol, cigarettes, and smoking and the two major risk factors among young adults are alcohol use and tobacco use. These risk factors have been revealed to be more responsible for the development of hypertension in many studies.[23] Being obese (BMI≥25kg/m^2), drinking alcohol, smoking, and having sedentary lifestyles are known associated risk factors of hypertension [22]. This study could not demonstrate any association between hypertension with BMI (as less than one-quarter of the hypertensive subjects were overweight/obese, [4%]), alcohol intake and smoking. This finding aligns with the research conducted by Tadese and Alemu [24], which also reported no significant association between hypertension and smoking or alcohol intake. This lack of association could potentially be attributed to the low prevalence of these factors within the studied population, as suggested by Tadese and Alemu.[24] However physical activity associated independently with presence of hypertension. Physical inactivity is believed to be responsible for 5-13% of hypertension today,[10] and a single episode of physical activity of 30 – 60 minutes can result in acute lowering of BP, the so-called post-exercise hypotension.[36] The underlying mechanism responsible for this reduction in

BP by exercise training remains elusive and controversial. However, reductions in cardiac output, sympathetic activity, plasma norepinephrine levels, and total peripheral resistance have been reported to be responsible for the hypotension.[10] Young adults, particularly students, often adopt unhealthy dietary habits and develop a strong preference for fast food. Among these demographics, their dietary patterns are typified by high intake of saturated fats and insufficient levels of protein and carbohydrates. This dietary trend is often attributed to the demanding nature of their academic programs, which leaves little time for meal preparation and encourages reliance on convenient but nutritionally deficient options. These dietary choices may emerge as significant contributors to high blood pressure.

In this research work, we could not find an association between hypertension and some of the factors that have often been associated with hypertension, such as alcohol intake, smoking history, and diabetes. This probably shows that there may be other unknown hypertensinogenic risk factors of fundamental importance which may be responsible for the obvious increase in blood pressure observed in this work. Prehypertension, which is more prevalent in young adults than full-blown hypertension, is an important antecedent for developing hypertension and cardiovascular disease later in life. With early detection, it can be lowered, although not always reliably, by lifestyle modifications [31]. Although age, gender, and BMI had no association with the pattern of hypertension, the observed prevalence of prehypertension was high among the study population, and this was higher in females than males and in the age group 21-25 years. This figure was higher than the findings observed in other studies in adolescents and young adults.[14]

Conclusion:

Our study confirms the notion that there are high rates of prehypertension and hypertension among young adults, the majority of which are undiagnosed cases. Although age, gender, and BMI had no association with the pattern of hypertension, the observed prevalence of prehypertension was considerable, and this was more prevalent in females than males and in the age group 21-25 years. Hypertension was more prevalent in males than females, with Isolated diastolic HTN being the most common in the study population. This calls for a comprehensive national screening, public enlightenment, and targeted prevention programs focused on fostering healthy lifestyle behaviors, physical activity, and healthy eating among the young.

Limitations

The study faced limitations in accessing and obtaining consent from the required subjects to meet the calculated sample size. Data collection had to be conducted during students' lecture breaks, as a substantial number of them lived off-campus. Many students were reluctant to be late for class or miss lectures, even briefly. Additionally, the dispersion of first-year, basic medical, preclinical, and clinical students across different campuses in various parts of the state further complicated access. Overcoming these challenges to reach diverse groups and ensure a representative sample of the entire population proved to be a significant challenge.

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