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The prevalence and risk factors of pre-hypertension and hypertension among clinical students at the university of Ibadan, Nigeria

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Abstract

Background Hypertension is the most common cardiovascular disease in Africa, with a 19.3% prevalence in Nigeria. Its incidence, along with prehypertension, is rising among young adults, including undergraduate clinical students, due to risk factors like stress, poor sleep, unhealthy eating, inactivity, and substance use. However, data on pre-hypertension among young adults in Africa, including Nigeria, is limited. This study aims to determine the prevalence of hypertension and prehypertension among clinical undergraduate students and examine the relationship between risk factors and these conditions.

Methods A descriptive cross-sectional study of clinical students in the College of Medicine, University of Ibadan, Nigeria. These are students in the Clinical Science department who had crossed from the pre-clinical arm into the clinical arm of their training. They are Physiotherapy and Biomedical Laboratory Sciences students in 400–500 level, as well as Dentistry and Medicine and Surgery students in 300–600 level. 346 participants were selected from the study population through a random probability sampling technique, and data were collected using a self-administered structured questionnaire. Participants' blood pressure, weight, height, Body Mass Index (BMI), and waist-to-hip ratio were measured. Data were analyzed using SPSS, with descriptive statistics and chi-square test used to determine relationships between sociodemographic factors and hypertension/pre-hypertension. Stress was self-reported. The level of statistical significance was set at 0.05.

Results Of the 346 participants, 57% were male, while 43% female. The mean age was 23.9 ± 0.2 years. The prevalence of hypertension was 8%, and that of prehypertension was significantly higher at 33%. The prevalence of hypertension was significantly higher in males than in females. Approximately 6 out of every 50 male students were hypertensive. Hypertension was found to be associated with gender, level of study and marital status. 77% reported a moderate-to-high perceived stress levels, which could be contributing to developing hypertension.

Conclusion This study found a high prevalence of prehypertension and hypertension among clinical students, with smoking, poor sleep, and perceived stress as common risk factors. Most affected students were unaware of their condition and received no treatment. The findings underscore the need for institutions to implement cost-effective

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hypertension awareness and screening programs for undergraduate clinical students, emphasizing early identification, lifestyle modification, and appropriate treatment to reduce future cardiovascular risks.

Trial registration Clinical trial number not applicable.

Keywords Hypertension, Prehypertension, Clinical students, Stress, Young adults

Background

According to the World Health Organization (WHO), hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure. Diagnosis of hypertension is made if, when measured on two different days, the systolic blood pressure reading on both days is ≥ 140 mmHg and/or the diastolic blood pressure reading on both days is ≥ 90 mmHg (WHO). Prehypertension is defined as a systolic blood pressure (SBP) of 120–139 mmHg or diastolic blood pressure (DBP) of 80–89 mmHg, or both, according to the Joint National Committee (JNC-8) [1].

Hypertension is a major public health concern globally, affecting more than 1 billion people worldwide and is still increasing [2]. It is also one of the major causes of premature death, killing more than 8 million people every year [3]. Uncontrolled hypertension is known as a major contributor to cardiovascular diseases such as coronary artery disease, peripheral artery disease, and stroke, with a high prevalence in Nigeria (19.3%), Egypt (20%), and South Africa (30%). It is a "Silent Killer," with more than 50% of individuals with hypertension oblivious of their condition [4].

Subjects with prehypertension have a higher probability of developing hypertension later in life and an increased risk of catastrophic cardiovascular events regardless of other risk factors [5, 6]. Workload stress, high-calorie, salty food consumption, decreased physical activity, overweight, and obesity are all risk factors for prehypertension [7]. In a systematic review carried out on studies conducted in Nigeria, the prevalence of prehypertension in Nigeria was 34%, and it was higher in males (39.1%) than in females (28.5%) [8].

Previously, hypertension was thought to be an illness that only affected adults over the age of 40 [9]. However, it is becoming common among young adults and teenagers [10]. Hypertension in young people is often attributed to a combination of genetic predisposition, lifestyle factors, and underlying medical conditions [11]. Risk factors include obesity, excessive salt intake, high stress levels, sedentary behaviour, smoking, alcohol consumption, and metabolic disorders such as diabetes [12]. Additionally, conditions such as renal disease, endocrine disorders, and congenital heart abnormalities can contribute to hypertension in younger populations [13, 14].

Pathologically, hypertension results from increased vascular resistance due to endothelial dysfunction, arterial stiffness, and hyperactivity of the sympathetic nervous system [15]. In young individuals, these changes can occur early due to unhealthy lifestyle choices, leading to long-term cardiovascular complications.

In a recent study carried out among medical students, who are mostly young adults, at Qassim University, Saudi Arabia, the prevalence of hypertension was determined to be 14.6% in the study sample, with 6.9% having isolated diastolic hypertension, 4.6% having isolated systolic hypertension, and the remaining 3.1% having both systolic and diastolic hypertension. Prehypertension was prevalent in 29.2% of the same population of medical students at Qassim University. Only 21.1% of those identified as hypertensive were diagnosed and receiving antihypertensive treatment [16]. In a study carried out in Odisha, Jamaica, an increased prevalence of prehypertension amongst medical students was reported (67%) as against a 30% prevalence in the general population [17]. In the United States, an estimated 4% of adolescents aged 12 to 19 are hypertensive, compared to 95% of a similar group aged 13 to 19 in Africa [18]. Studies suggest that hypertensive young adults are unaware of their conditions and were newly diagnosed during the studies [19]. Hence, these alarming numbers call for the need for more research on the prevalence of hypertension among young adults.

The study aimed to assess the prevalence and identify the risk factors of hypertension and prehypertension among clinical students at the University of Ibadan, given that this particular population is susceptible to established risk factors for hypertension such as stress, poor sleep patterns, anxiety, depression, poor eating habits and consumption of tobacco and alcohol [7, 20–23].

Methods

Study design and participants

It was a descriptive cross-sectional study. It was carried out among undergraduate clinical students in University College Hospital, Ibadan. All participants were residents of the Alexander Brown Hall, which houses all undergraduate clinical students within the hospital premises. Clinical students included students enrolled in medicine and surgery (300–600 level), dentistry (300–600 level), physiotherapy (400–500 level) and basic medical laboratory science (400–500 level). All undergraduate clinical students who gave consent following their selection by the randomization algorithm

Table 1 Students' quota random selection based on class percentage contribution

Department	Level	(a)	(b)	(c)	(d)	(e)*
MBBS	600	159	929	17.1%	340	58(+ 1)
MBBS	500	154	929	16.6%	340	56(+ 1)
MBBS	400	149	929	16.0%	340	54
MBBS	300	146	929	15.7%	340	53
BDS	600	39	929	4.2%	340	14(+ 1)
BDS	500	38	929	4.1%	340	14(+ 1)
BDS	400	37	929	4%	340	14(+ 1)
BDS	300	36	929	3.9%	340	13
BMLS	500	53	929	5.7%	340	19
BMLS	400	50	929	5.4%	340	18
PHYSIO	500	33	929	3.6%	340	12(+ 2)
PHYSIO	400	35	929	3.8%	340	13(+ 1)
TOTAL						**338(+ 8) = 346**

a = Total No. of possible students in level, b = Sum total No. of clinical students, c = Percentage contribution(c = a/b*100%), d Calculated Sample Size (nearest whole number), e = Quota selected from each class based on percentage contribution (nearest whole number)

MBBS Medicine and Surgery, *BDS* Dentistry, *BMLS* Medical Laboratory Sciences, *PHYSIO* Physiotherapy

* The total number of selected students based on percentage contribution was 338, which is less than the calculated minimum sample size of 340. Hence, a single student was randomly selected from each class to make a total of 346 randomly selected participants who were rightly distributed

were included in the study. Participants were excluded based on refusal to give consent.

Sample size

The sample size for this study was calculated using the formulae of Kish and Lisle: N = Z2pq/d2. The value of p in this study was 33% [24].

Where.

n: minimum sample size.

Z: standard normal deviation at 95% confidence interval, which is set at 1.96.

p: proportion of the target population estimated to have a particular characteristic. The value of p in this study, as taken from a previous prevalence study, is 33% [24].

q: proportion that does not have the characteristics being investigated (q = 1-p).

d: degree of accuracy set at 0.05 (precision set at 5%).

$q = 1 - 0.33 = 0.67$.

Therefore, $n = (1.96)2 \times 0.33 \times 0.67/(0.05 \times 0.05)$.

$n = 3.8416 \times 0.33 \times 0.67/0.0025$.

$n = 0.8494/0.0025$.

$n = 339.76$, approximately 340.

A total of 340 participants were to be recruited.

Sampling technique

The calculated sample size was selected from the study population (929) using a stratified simple random probability sampling method. The quota contribution for each class was assessed and accounted for. The departments of Dentistry and Medicine and Surgery have a total of 4 classes in the clinical school (with an average of 30 students per class and 150 students per class, respectively.) The Physiotherapy and Medical Laboratory Sciences departments have two classes in the clinical school with an average of 30 students per class and 50 students per class respectively. This percentage contribution (or quota) was used to determine the number of students selected from each class to constitute our sample size, as described in Table 1 below. This was done to ensure that participants were not skewed to a particular department or class, but rather, each class's proportion was preserved and well represented in our sample.

The randomization was done for each class in the Microsoft Excel software by using a randomization function, which randomly selected the required quota of students from the available pool of students in each class.

Data collection

After ethical approval was granted by the University of Ibadan/University College Hospital (UI/UCH) Research Ethics Committee on 7th November 2022 with IRB number 22/0362, informed consent was obtained from selected participants. Data was collected from the participants using a self-administered structured questionnaire, and participants remained anonymous (Appendix questionnaire). The questionnaire assessed sociodemographic characteristics, history of previous medical conditions, family history of hypertension, diet, sleep, stress, alcohol, and tobacco consumption. Participants were screened by taking their blood pressure readings.

After resting or sitting calmly for five minutes, three (3) blood pressure readings were taken from each participant about five minutes apart using the OMRON electronic sphygmomanometer. The first blood pressure reading served as a control, while the average of the second and last readings was computed and rounded off to the nearest whole number to derive the systolic and diastolic blood pressure readings for each participant. Other parameters such as Weight, Height, Body Mass Index (BMI) and waist-to-hip ratio were also measured. The weight was derived by using a bathroom analogue weighing scale. The participants stood on the scale, and the weight was read. The height was derived using a stadiometer. The participants stood on the stadiometer's plastic base with their backs against the vertical measuring ruler. The stadiometer's head plate/slider was then made to rest on their heads, and the height was read off at this level. The waist-to-hip ratio was derived by dividing the waist circumference by the hip circumference. These circumferences were measured using the "cm" part of a standard measuring tape, which ranged from 0 to 150 cm. The waist circumference was measured using the umbilicus as a landmark, while the hip circumference was measured using the widest part of the hips. This was done using chaperones while also maintaining the participants' privacy.

Data analysis

Data analysis was done using the Statistical Packages for Social Sciences (SPSS) version 23. Descriptive statistics was conducted using frequency and proportions for categorical variables and mean and standard deviation for continuous variables. The Chi-square test was used to determine the relationship between sociodemographic factors and the proportion of individuals with hypertension, and also for pre-hypertension.

Hypertension was defined based on the 8th Joint National Committee (JNC) as systolic blood pressure $\geq$140 mmHg and diastolic blood pressure $\geq$90 mmHg, while prehypertension was taken as systolic blood pressure of 120–139 mmHg and diastolic blood pressure of 80-89 mmHg [1].

Stress was assessed using the Perceived Stress Scale to measure the personal stress of clinical students. This is a classic stress assessment instrument which remains a popular choice for helping us understand how different situations affect our feelings and our perceived stress.

The questions on this scale ask about feelings and thoughts during the last month. It is made up of a set of 10 questions, and the sum is calculated. Individual scores on the PSS can range from 0 to 40, with higher scores indicating higher perceived stress.

- Scores ranging from 0–13 would be considered low stress.
- Scores ranging from 14–26 would be considered moderate stress.
- Scores ranging from 27–40 would be considered high perceived stress.

The level of statistical significance was set at a p-value of less than 0.05.

Results

Sociodemographic characteristics

Majority of our participants (64%) were students of the Department of Medicine and Surgery, and of the 346 participants, 57% (198) were male, while 43% (148) were female. The mean age of the respondents was 23.9 ± 0.2 years, with the minimum age of respondents being 20 years and the maximum 36 years. The majority, 69% (238), fell between 20 and 24 years old. Table 2 shows the socio-demographic characteristics of the study participants.

Blood pressure measurements and prevalence

On average, the systolic blood pressure of the students was 116 ± 1.4 (95% CI) mmHg, while the mean diastolic blood pressure was 74 ± 0.9 (95% CI) mmHg. The prevalence of hypertension in our sample population of clinical students was found to be 8%.

As shown in Fig. 1, 28 students (8%) had blood pressure readings that indicated hypertension (SBP $\geq$140 mmHg, DBP $\geq$90 mmHg); Conversely, we recorded a significantly higher prevalence of pre-hypertension among the participants, 33%, 113 students were identified to be pre-hypertensive; while 205 students (59%) had normal blood pressure readings.

The prevalence of hypertension was significantly higher in males than in females. Male participants accounted for 82.5% of those with significant hypertension. Approximately, 6 out of every 50 male students are hypertensive compared to 2 out of every 50 female students.

Interestingly, the prevalence of hypertension was higher in students aged 20—24 years (61%) compared to students aged 25 and above. Similarly, the Medicine and Surgery department had the highest proportion of hypertensive students (71%), which can be attributed to the large number of students in that department. However, the Dentistry department had the highest proportion of hypertensive students, based on the proportion of hypertensive students to the total amount of students in a department, with 1 in every 10 Dentistry students being hypertensive.

Table 2 Sociodemographic characteristics of the respondents ($N = 346$)

a: Age, Gender, Years of Study, Religion					
Characteristics	**Dentistry**	**BMLS**	**MBBS**	**Physiotherapy**	**Total (%)**
Age (years)					
20–24	32	29	152	25	238(68.8)
25 and above	26	8	71	3	108(31.2)
Gender					
Male	32	19	137	10	198(57.2)
Female	26	18	86	18	148(42.8)
Year of study					
300 level	13	0	53	14	80(23.1)
400 level	15	18	54	14	101(29.2)
500 level	15	19	57	0	91(26.3)
600 level	15	0	59	0	74(21.4)
Religion					
Christianity	48	30	194	24	296(85.5)
Islam	8	7	27	4	46(13.3)
Others	2	0	2	0	4(1.2)
b: Marital status, Ethnicity, Parents' Monthly Income Range					
Characteristics	**Dentistry**	**BMLS**	**MBBS**	**Physiotherapy**	**Total (%)**
Marital Status					
Single	56	37	215	28	336 (97.1)
Married	2	0	7	0	9(2.6)
Separated	0	0	1	0	1(0.3)
Ethnicity					
Yoruba	50	31	161	24	266(76.9)
Ibo	7	3	45	2	57(16.5)
Others	1	3	17	2	23(6.6)
Parents' Monthly					
Income Range					
< N50,000	19	4	38	2	63(18.3)
N50,000—99,000	9	9	30	7	55(15.9)
N100,000 –150,000	10	11	39	4	64(18.6)
> N200,000	19	15	114	15	163(47.2)

MBBS Medicine and Surgery, *BMLS* Medical Laboratory Sciences

Statistical analysis revealed that gender, marital status and level of study are socio-demographic variables that are significantly associated with developing hypertension among the participants ($p \leq 0.05$), as shown in Table 2 below. Our study revealed that Students in the 300 level across all departments had a higher prevalence of hypertension than the 400, 500 and 600 levels (13% vs 1% vs 9% vs 12% respectively, $p = 0.01$). Out of the 28 students with hypertension, 64% had a normal BMI (Table 3). Similarly, 17% reported alcohol use, and 4% reported to have used tobacco in the past (Table 4).

Risk factors association, physcial activity, Waist Hip Ratio (Whr) and perceived stress

Risk factor association

Regarding medical history and risk factor association, out of the 346 participants, four students had been diagnosed with hypertension within the past five years, and none of them were on antihypertensive medication. The percentage of students reporting a history of hypertension in either parent was 30% (Fig. 2). Table 4 shows the significant relationship between different risk factors observed in our participants and the development of hypertension. About 2% of the students currently smoke cigarettes, 6% claimed to have used tobacco products in the past, and as many as 20% of participants reported current use of alcohol. The majority (59%) reported an average sleep duration of 6–7 h daily. One participant reported a history of chronic diseases (either Diabetes Mellitus and/or Chronic Kidney Disease) that may be associated with long-standing hypertension. Normal BMI (18.5–24.9 kg/m^2) was recorded in 65%, while 5% of the students were obese (30.0 kg/

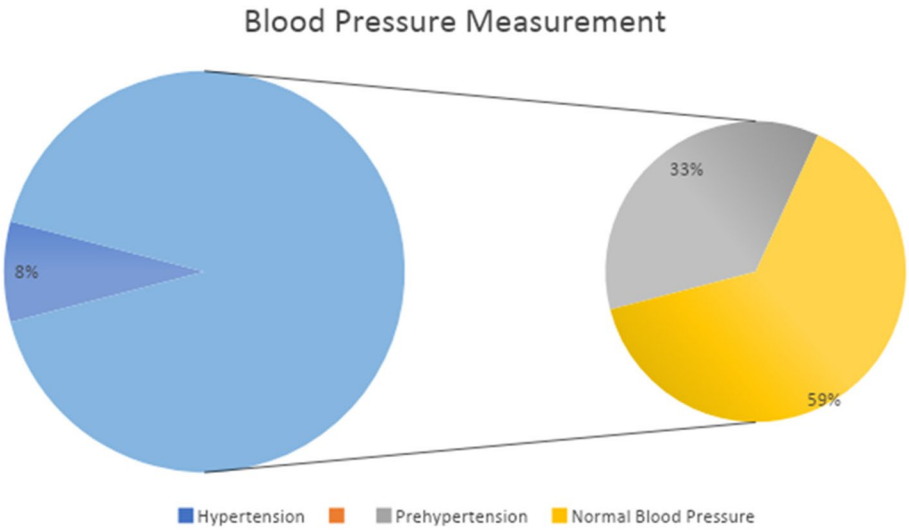

Fig. 1 Pie chart showing Blood pressure measurement of respondents

m^2), 19% were overweight, and 10% were underweight (Table 4).

Physical activity

Among the 346 participants, 236 (68%) reported engaging in moderate-intensity activities such as brisk walking or carrying light loads for at least 10 min continuously. Over 60% of these individuals performed such activities at least three days per week, while 40% spent at least 15 min per day doing these moderate-intensity activities.

Regarding whether their work involves vigorous-intensity activities (e.g., fast running or heavy lifting for at least 10 min continuously), 101 participants (29%) responded "Yes." Among them, 68% engaged in such activities at least three days per week, and 84% spent at least 15 min per day on these activities.

Waist Hip Ratio (WHR)

According to the WHO, a high WHR above 0.90 in men and 0.85 in women is associated with an increased risk of cardiovascular disease, diabetes, and hypertension [25]. In our analysis, the mean WHR was 0.82 (SD = 0.06) for males and 0.78 (SD = 0.06) for females.

Perceived stress

The mean of the stress scores was 18 ± 0.69 (95% CI). 79 students (23%) had low stress, 231 students (67%) had moderate stress, and 36 students (10%) had high perceived stress (Fig. 3).

As shown in Table 5, we found that the level of stress was significantly associated with gender (similarly for hypertension) and ethnicity.

Discussion

A doctor's primary responsibility to care for others cannot be actualized unless he cares for himself. As contained in the Physician Pledge, "I will attend to my health, well-being and abilities, in order to provide care of the highest standard" [26]. There is negligence towards the prevention of non-communicable diseases in undergraduate students [27, 28]. Young undergraduate students are not immune to hypertension; rather, the risk factors for hypertension begin to develop at this age [29]. Hypertension is a silent killer that only becomes symptomatic when complications develop [30]. To ensure prevention and early detection, we evaluated the prevalence, demographic contributions, and associated risk factors for hypertension and prehypertension in young clinical students in Nigeria.

The prevalence of prehypertension and hypertension in this study was 33% and 8%, respectively. The prevalence of prehypertension is similar to a study conducted among medical undergraduates within Andhra Pradesh, India, which showed a prevalence of 37% [31]. The overall prevalence of prehypertension and hypertension in this study is 41%, which is lower than the overall prevalence of a study on medical students in Saudi Arabia, which was 57%. A possible reason for this higher value in the Arabians might be the higher prevalence of overweight students recorded in the sample population [32]. Out of the 28 participants found hypertensive in our study, only four were aware of their hypertensive state. Also, none of these previously diagnosed participants was on medication. This depicts substandard health-seeking behaviour amongst clinical students who ought to be paragons of health awareness.

Table 3 Socio-demographic Factors associated with Hypertension (*N* = 346)

a: Age, Gender, Department, Level of Study, Religion, Ethnicity			
	Hypertensive n (%)	**Non-Hypertensive n (%)**	***p*-value**
Age (years)			
20–24	17 (7.14)	221(92.85)	0.45
25 and above	11(10.19)	97(89.81)	
Gender			
Male	23(11.62)	175(88.38)	0.01*
Female	5(3.38)	143(96.62)	
Department			
Dentistry	6 (10.34)	52 (89.66)	0.42
Biomedical Laboratory Sciences	1(2.70)	36 (97.30)	
Medicine and Surgery	20 (8.97)	203 (91.03)	
Physiotherapy	1(3.57)	27(96.43)	
Level of Study			
300 level	10 (12.50)	70 (87.50)	0.01*
400 level	1(0.99)	100 (99.01)	
500 level	8(8.79)	83(91.21)	
600 level	9 (12.16)	65(87.84)	
Religion			
Christianity	25(8.45)	271(91.55)	0.76
Islam	3 (6.52)	43(93.48)	
Others	0(0.00)	4(100.00)	
Ethnicity			
Yoruba	19(7.14)	247 (92.86)	0.43
Ibo	7(12.28)	50 (87.72)	
Others	2(8.70)	21(91.30)	
b: Marital status, Parents' Monthly Income Range, BMI Category			
	Hypertensive n (%)	**Non-Hypertensive n (%)**	***p*-value**
Marital Status			
Single	25(7.44)	311(92.56)	< 0.01*
Married	2(22.22)	7(77.78)	
Separated	1(100.00)	0(0.00)	
Parents' Monthly Income Range			
< N50,000	7(11.11)	56(88.89)	0.75
N50,000—99,000	4 (7.84)	47(92.16)	
N100,000—150,000	4(6.25)	60(93.75)	
> N200,000	12(7.36)	151(93.64)	
BMI Category			
Underweight (< 18.5 kg/m^2)	1(2.78)	35(97.22)	0.41
Normal weight (18.5–24.9 kg/m^2)	18(8.00)	207(92.00)	
Overweight (25.0–29.9 kg/m^2)	8(11.94)	59(88.06)	
Obese (≥ 30.0 kg/m^2)	1(5.88)	17(94.12)	

* Statistically significant variables, BMI: Body Mass Index

The ethnic proportion of our respondents is reflective of our study location. Our study was conducted at a federal university in South-Western Nigeria, where Yoruba is predominant. The majority of our respondents were Yoruba (76.9%); Igbo and other tribes were 16.5% and 6.6% respectively. Hypertension was found to be more prevalent among the Yoruba clinical undergraduates (67.9%). This finding agrees with some studies that reported hypertension to be more prevalent in the southwest [33, 34]. However, our finding disagrees with a lot of other studies that reported a higher prevalence in the southeast and north-central areas [35–39].

Table 4 Risk Factors Frequency For Hypertensive, Pre-Hypertensive And Non-Hypertensive

a: Smoking status, Smoking history, Alcohol use, Sleep duration					
Risk Factors	Frequency (%)	Hypertensive	Pre hypertension	Non hypertension	*p*-value
Do you currently smoke any Tobacco?					
Yes	6(1.70)	0 (0.00)	5(83.33)	1(16.67)	0.03*
No	340(98.30)	28(8.24)	108(31.76)	204(60.00)	
Have you smoked any tobacco product in the past?					
Yes	20(5.80)	1(5.00)	9(45.00)	10(50.00)	0.41
No	320(93.20)	27(8.43)	99(30.94)	194(60.63)	
Do you currently take any Alcoholic drink?					
Yes	68(19.70)	4(5.88)	28 (41.18)	36(52.94)	0.23
No	278(80.30)	24 (8.63)	85(30.58)	169(60.79)	
How many hours of sleep on average do you get in a day?					
Less than 3 h	1(0.30)	0 (0.00)	1(100.00)	0(0.00)	0.04*
3–5 h	102(29.50)	11(10.78)	38(37.25)	53(51.96)	
6–7 h	204(59)	14(6.86)	63(30.88)	127(62.25)	
More than 7 h	39(11.30)	3(7.69)	11(28.20)	5(12.82)	
b: Family history, BMI category					
Risk Factors	Frequency (%)	Hypertensive	Pre hypertension	Non hypertension	*p*-value
Is your father hypertensive					
Yes	101(29.20)	11(10.89)	31(30.69)	59(58.42)	0.22
No	213(61.60)	13(6.10)	68(31.92)	132(61.97)	
I don't No	32(9.20)	4(12.50)	14(43.75)	14(43.75)	
Is your mother hypertensive					
Yes	106(30.60)	16(15.09)	31(29.25)	59(55.66)	0.45
No	215(62.10)	19(8.84)	73(33.95)	s123(57.20)	
I don't No	25(7.20)	3(12.00)	9(36.00)	s13(52.00)	
Are any of your siblings hypertensive?					
Yes	8(2.30)	2(25.00)	2(25.00)	4(50.00)	0.04*
No	315(91.00)	21(6.67)	103(32.70)	191(60.63)	
I don't know	23(6.60)	5(21.74)	8(34.78)	10(43.48)	
Are any of your grandparents hypertensive?					
Yes	105(30.30)	5(4.76)	40(38.10)	60(57.14)	0.23
No	100(28.90)	7(7.00)	34(34.00)	59(59.00)	
I don't know	141(40.80)	16(11.35)	39(27.66)	86(60.99)	
BMI Category Underweight (< 18.5 kg/m^2)	36(10.40)	1(2.78)	5(13.89)	30(83.33)	0.09
Normal weight (18.5–24.9 kg/m^2)	225(65.00)	18(8.00)	78(34.67)	129(57.33)	
Overweight (25.0–29.9 kg/m^2)	67(19.40)	8(11.94)	23(34.33)	36(53.73)	
Obese (≥ 30.0 kg/m^2)	18(5.20)	1(5.56)	7(38.89)	10(55.55)	

BMI Body Mass Index

* Statistically significant variables

In addition, a national survey conducted across the six geopolitical zones found that the highest prevalence of hypertension is amongst Kanuri ethnicity [39].

The larger proportion of our respondents being Yoruba could have skewed the prevalence of hypertension towards the ethnic group (a sample size that represented all major ethnic groups would have required a multi-stage, stratified, randomized design; this was beyond the scope of our study and the available sample size). This discordance between our study and the other studies can also be due to a variation in the age of the sampled population [the mean age of our respondents being 23.9 + 0.2 years]. It would also be expected that closeness to home should confer our Yoruba participants the benefit of family support. However, compared with students of other ethnic groups, the Yoruba

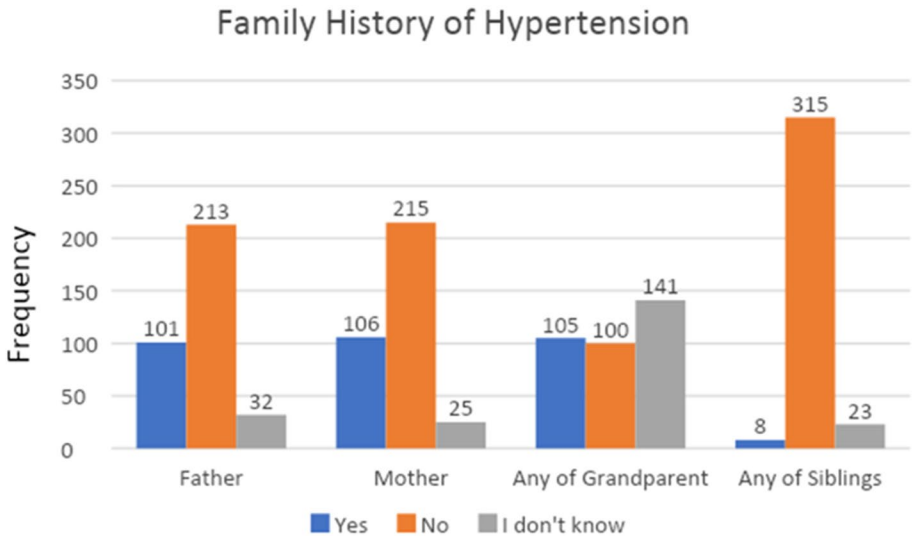

Fig. 2 A Bar chart showing respondents' family history of hypertension

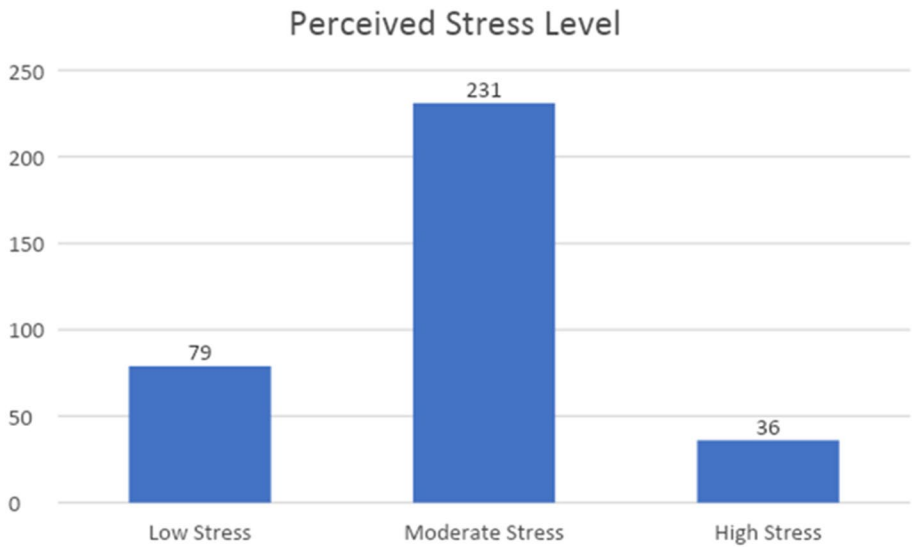

Fig. 3 Bar chart showing respondents' level of stress

undergraduates experienced more moderate and severe stress (76.2% and 72.2%, respectively). Stress has an established relationship with hypertension [20, 40, 41].

There was an association between currently smoking tobacco and being hypertensive or prehypertensive, which was statistically significant ($p = 0.03$), but there was no statistically significant association with having smoked tobacco products in the past ($p = 0.41$). A small proportion of our participants smoke tobacco currently or in the past (1.7% and 5.8% respectively). Another study conducted in this environment reported a similar low prevalence (3.5%) [42], whereas 2.6% was reported among university students in Ethiopia [43]. This low prevalence might be due to strict regulations regarding smoking within school premises and halls of residence. Compared with smoking, more participants currently consume alcohol (19.7%). However, currently taking alcohol was not significantly associated with hypertension or prehypertension. This might be due to the low prevalence of alcohol drinkers in the studied population; our participants may also be occasional or early drinkers such that the level of alcohol ingested is not significant to predispose them to hypertension or prehypertension. Lieber, in 1998, identified chronic high-dose ethanol consumption

Table 5 Perceived stress scale

	Low Stress	ModerateStress	High Stress	*p*-value
Age (years)				
20–25	49	166	23	0.21
26 and above	30	65	13	
Gender				
Male	56	124	18	0.02
Female	23	107	18	
Department				
Dentistry	8	42	8	0.49
Biomedical Laboratory Sciences	8	26	3	
Medicine and Surgery	56	143	24	
Physiotherapy	7	20	1	
Level of Study				
300 level	12	59	9	0.16
400 level	19	72	10	
500 level	26	58	7	
600 level	22	42	10	
Religion				
Christianity	69	198	29	0.80
Islam	9	31	6	
Others	1	2	1	
Ethnicity				
Yoruba	64	176	26	0.03
Ibo	6	45	6	
Others	9	10	4	
Marital Status				
Single	77	223	36	0.80
Married	2	7	0	
Separated	0	1	0	
Parents' Monthly Income Range				
< N50,000	13	44	6	0.94
N50,000—99,000	11	33	7	
N100,000—150,000	16	40	8	
> N200,000	39	109	15	
BMI Category				
Underweight (< 18.5 kg/m^2)	11	22	3	0.43
Normal weight (18.5–24.9 kg/m^2)	53	152	20	
Overweight (25.0–29.9 kg/m^2)	12	46	9	
Obese (≥ 30.0 kg/m^2)	3	11	4	

BMI Body Mass Index

as a predisposing factor for cardiovascular injuries [44]. Recent epidemiological and clinical studies have demonstrated that chronic ethanol consumption (greater than three drinks per day, 30 g ethanol) is associated with an increased incidence of hypertension and an increased risk of cardiovascular disease [45–47]. There have also been studies that found a significant association between drinking alcohol and being hypertensive [43, 48].

Sleep often becomes a secondary priority so medical students can offset their cumbersome academic workload. Therefore, it is important to evaluate the relationship between sleep duration and hypertension in this population. In our study, the majority of participants (88.7%) slept an average of 7 h or less per day. Those who slept more than 7 h had the highest risk of hypertension (15.8%), while those who slept 6–7 h had the lowest risk

(6.9%). The risk of prehypertension was highest among participants who slept less than 3 h (100%) and lowest among those who slept 6–7 h (30.9%). Overall, participants who slept 6–7 h per night had the lowest risk of developing both hypertension and prehypertension. There was an association between the average hours of daily sleep and being hypertensive or prehypertensive ($p = 0.04$). Other studies have also reported an association between sleep duration and increased risk of hypertension. These studies found a negative effect for sleeping for ≤5 h and a benefit for sleeping for 7 h, but not for more than 7 hours [43, 49].

The high risk of hypertension and prehypertension among those who sleep for more than 7 h can be explained by research that observed that the relationship between sleep duration and adverse health outcomes is U-shaped. Both extremities of sleep duration (too short or too long) are associated with an increased risk of cardiovascular-related health problems [50]. Qualitative changes in sleep patterns and distribution can also explain the association between long sleep duration and hypertension or prehypertension. Long sleep duration reported by the participants may be indicative of poor sleep efficiency, which could be due to poor sleep hygiene, increased sleep fragmentation, or the presence of health problems [50, 51]. Although participants may report longer sleep duration, this characteristic change in sleep quality may hinder them from achieving optimal sleep and further predispose them to adverse health effects. Sleep duration in our study was reported by the participants. It is well known that self-reported sleep duration overestimates the actual sleep duration [50, 52]. Thus, the reported sleep duration was subjective and may have been overestimated.

Many epidemiological studies have proposed that genetic factors account for nearly 30% of the variation in blood pressure in various populations [53, 54]. Family history significantly predicts hypertension and prehypertension in young people. Our participants had hypertensive relatives; 29.2% had hypertensive fathers, 30.6% had hypertensive mothers, 30.3% had hypertensive grandparents, and 2.3% had hypertensive siblings. Our average prevalence of a family history of hypertension was similar to 31.1% reported among students in a public university in Malaysia [28]. Apart from siblings, we did not find a significant association with any relative. There was a significant association between having a hypertensive sibling and being hypertensive or prehypertensive ($p = 0.04$). Studies have found that a parental history of hypertension is a significant predictor of hypertension in young people [21, 30]. On the other hand, there have been studies that did not find a significant association between a family history of hypertension and hypertension in young people [9, 54, 55]. A small proportion of our respondents were hypertensive and had a small prevalence of hypertensive siblings but higher hypertensive parents and grandparents. This finding indicates that age plays a significant role in hypertension, in which progressive changes occur in systemic arteries and further predispose patients to hypertension [9, 27]. These findings indicate that earlier detection and intervention should be performed as soon as possible. Screening among undergraduates, especially those with a family history of hypertension, is vital for detecting those at risk.

Obesity predisposes patients to several non-communicable diseases, including hypertension [55]. Excessive weight has a well-established relationship with the development of essential hypertension. The Framingham Heart Study reported that the contribution of obesity to hypertension is between 65 and 75% [28, 56]. The majority (65.0%) of our respondents had normal weight; 10.4% were underweight, 19.4% were overweight; and 5.2% were obese. This prevalence was similarly reported among children in secondary school in Khartoum; 28.5% were overweight and 5.6% were obese [9]. The increasing prevalence of overweight and obesity among adolescents, especially medical students, is attributable to skipping meals, eating junk food, and perpetually choosing to study over physical activities [29]. We found no significant association between BMI and prehypertension or hypertension. Another study also reported this lack of significant association [55]. However, some studies have observed a significant association between BMI and both prehypertension [54] and hypertension [9, 43, 57]. A continued increase in the prevalence of obesity will lead to an epidemic of obesity [55, 58]; this epidemic is certain to increase morbidity and mortality associated with non-communicable diseases (NCDs) such as hypertension. Thus, to curb this menace, it is pertinent to implement structured interventions that will lead to dietary changes and increased physical activity.

Medical students are constantly exposed to stress. The nature of medical education is that it is highly competitive, the curriculum is voluminous, and there is limited time for recreational activities [40]. Through links that can be explained by chemical, mental, and behavioural pathways, depression, anxiety, and stress have an established relationship with elevated blood pressure [20, 40, 41]. Among our 346 respondents, 79(23%) had low stress levels, 231 (67%) had moderate stress, and 36(10%) had high perceived stress. For gender [$p = 0.02$] and ethnicity [$p = 0.03$], we found that the level of stress had a statistically significant relationship with elevated blood pressure. Participants who were male and Yoruba were more likely to be stressed, and this determined whether they were prehypertensive or hypertensive. In a study

conducted among undergraduate nursing students in Saudi Arabia, respondents with abnormal stress were three times more likely to develop elevated diastolic prehypertension [40]. Consistent with our findings, studies have established a relationship between stress and elevated blood pressure [30, 40]. However, unlike our study, these studies did not evaluate stress in terms of sociodemographic factors. The relationship between stress and elevated blood pressure in medical students could be attributed to the poor lifestyle changes and eating habits associated with stress, which further worsen their risk of hypertension [41, 59, 60].

Hypertension is getting younger, and there is an increasing prevalence among young adults [40]. If uncontrolled, it can herald an explosion of cardiovascular, cerebrovascular, and chronic kidney diseases. Health authorities should be startled and quickly adopt preventive strategies to deter this impending threat. Essential hypertension is highly amenable to lifestyle modification, especially if correctional steps are instituted early [43]. College health practitioners should incorporate periodic blood pressure monitoring and screening for students into school activities. Hypertension is largely asymptomatic until complications develop; therefore, policymakers and programme managers need to develop targeted and cost-effective intervention programmes that will increase awareness of the need to screen for hypertension among university students [43]. An unhealthy eating habit that leads to uncontrolled weight gain should be discouraged; excessive alcohol intake and tobacco smoking should be discouraged; and participation in physical activities should be encouraged. The objective of the prehypertension category is to facilitate early identification, awareness, and intervention in young adults. This preventive strategy can slow or even stop the development of cardiovascular disease later in life. Inappropriate sleep patterns were observed among the participants. There is a growing body of evidence that appropriate sleep patterns play a considerable role in the prevention of elevated blood pressure [50, 61, 62]. Health education on improving the quality of sleep should be incorporated into public health messaging. Considering the huge and unsustainable cost of medical care in developing countries, prevention is the best cure because a stitch in time saves nine.

A major strength of this study is that in this environment, it is the first of its kind to assess prehypertension and the relationship between elevated blood pressure and stress and sleep in medical students. Another strength is that the blood pressure measurements followed the WHO guidelines for STEPS surveillance. A limitation of this study is that circadian variations were not considered because blood pressure measurements were mostly taken during the day. In addition, because of the nature of this study (cross-sectional), cause and effect cannot be established. Experimental studies should be conducted to establish a cause between prehypertension and the factors we considered, such as sleep and stress.

Conclusion

In conclusion, the prevalence of prehypertension and hypertension among young people in this region is currently in the rise and more so for medical students in their clinical years. This may be explained by lifestyle changes including smoking, poor sleep and perceived stress due to the academic workload. Worthy of note is the proportion of students unaware of their elevated blood pressures. In order to combat the rising prevalence and optimize the health of these students, efforts must be targeted at regular screening and better access to healthcare services in addition to curriculum revisions to create a more conducive learning environment.

Abbreviations

WHO	World Health Organization
STEPS	STEPwise approach to NCD risk factor Surveillance
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
BMI	Body mass index

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

A.A conceived the idea and study design, A.A and C.U reviewed the data analysis and interpretation. All authors collected data, contributed to writing the manuscript, read and approved the final manuscript and have accepted responsibility for the entire content of this manuscript and as well consented to its submission to this journal.

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Data availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the University of Ibadan and University College Hospital Research Ethics Committee. Informed consent was obtained from participants prior to participating in the study. No human experiments were carried out and human tissues or samples were not collected for this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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