

## Prevalence of Hypertension among Teenage Students in Kano, Nigeria

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**Abstract**

**Background:** Hypertension has been reported among young people worldwide. It is known to track from youth to adulthood, which makes it a useful predictor of essential hypertension in adulthood. This study determined the prevalence of hypertension and associated cardiovascular risk factors among secondary school teenagers in Kano, Nigeria.

**Methods:** A questionnaire was administered on a cross section of 1000 teenage students to inquire about cardiovascular risk factors. Participants' blood pressure, height and weight were measured. Relevant investigations were done for those with raised blood pressure.

**Results:** The participants' ages ranged from 13 to 19 years with a mean of 15.91.62 years. Seventy of the students had systolic blood pressure 140mmHg and/or diastolic blood pressure 90mmHg giving a prevalence rate of hypertension of 7.2% [95% CI=5.6-8.9%]. Specifically, 32 (6.7%) of the 476 males were hypertensive compared to 38 (7.7%) of the 492 female participants. This difference was not statistically significant ( $\chi^2 = 1.6$  df=1  $p > 0.05$ ). The prevalence rate of hypertension rose from 4.3% (among the younger participants) to 11.8% among the oldest students.

Of the 70, a majority (88.5%) had grade 1 hypertension, 10.0% had Grade 2 hypertension and 1.5% had Grade 3 hypertension. The hypertensives were about twice more likely to have a family history of hypertension compared to their normotensive counterparts. This difference was statistically significant [OR=2.1, 95% CI=1.12-3.83] ( $\chi^2 = 6.4$  df=1  $p = 0.01$ ).

**Conclusion:** Hypertension exists among teenage students in Kano, Nigeria. Early detection can reduce risk of cardiovascular changes and end organ damage.

**Key words:** Hypertension, Teenagers, Students,

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**Introduction**

Hypertension, defined as a systolic blood pressure of 140 mmHg and/or a diastolic blood pressure of 90mmHg,

is a global health problem with higher prevalence among certain ethnic/racial groups.<sup>1</sup> It was earlier considered to be rare among young people<sup>2</sup>. However, with increasing reports of hypertension in children all over the world including Africa, this view has changed.<sup>3</sup> The reported prevalence rates of hypertension among southern Nigerian teenagers range from 1.9% in Lagos<sup>4</sup> to 4.8% in Oyo.<sup>5</sup> Etta and Watson reported a zero prevalence rate in Zaria, northern Nigeria.<sup>6</sup> Higher prevalence rates of 6.7%, 7.1% and 7.7% were reported from India<sup>7</sup>, Spain<sup>8</sup> and Brazil<sup>9</sup> respectively.

The consequences of hypertension in children could be severe, for instance, Abdulrahman et. al, in a study of hypertension in Nigerian children observed a mortality rate of 28% in the first year after diagnosis.<sup>10</sup> Furthermore, hypertension in childhood requires adequate attention for several reasons: firstly, the evaluation and treatment of hypertension in children and adolescents differ from that of the adult population, secondly raised blood pressure tracks relatively well from youth to adulthood, thus, making blood pressure in youth a useful predictor of essential hypertension in adulthood<sup>11,12</sup> and finally, attention to cardiovascular risk factors during the first two decades of life may prevent or retard the development of vascular complications and their effects on target organs associated with hypertension.<sup>13</sup> Additionally, it has been observed that the pattern of cardiovascular risk factors in a population such as raised blood pressure is not static over time, and predate subsequent changes in pattern of cardiovascular diseases.<sup>14</sup>

In view of the foregoing, coupled with the paucity of such information in northern Nigeria, the determination of the prevalence of hypertension and related risk factors among teenagers would be of paramount importance. Such study would undoubtedly shed more light on the burden of hypertension among this age group and encourage physicians and other health care providers to be more vigilant when dealing with this age group. Early detection and intervention would also reduce the risk of irreversible vascular changes that lead to end organ damage and complications in adult life. The main

objectives of this study therefore, were to determine the prevalence of hypertension and associated risk factors among 13 to 19 year olds (teenagers) attending secondary schools in Kano, Nigeria.

## METHODS

### Study Area

The study was carried out among teenagers attending public and private secondary schools in Kano metropolis. Kano has a population of about 1.4 million<sup>15</sup>, predominantly made up of Hausa and Fulani Muslims engaged in trading and farming. There is a sizeable representation of other Nigerian tribes including Igbo, Yoruba, Kanuri and Nupe. There are 181 secondary schools in Kano metropolis, of which 97 are public schools and the remaining 54 are privately owned.

### STUDY DESIGN

The study was descriptive and cross-sectional in design.

#### Participant selection and data collection

A minimum sample size of 877 was obtained using an appropriate statistical formula<sup>16</sup> and based on the following assumptions; 95% Confidence level, a prevalence rate of 4.8% from a previous study in Oyo<sup>5</sup> and a 5% margin of error. The sample size was increased to a total of 1000 students to cater for non-response. The multistage sampling technique was adopted. In the first stage, the schools were stratified into public and private schools. Five schools each were selected from the two strata using the simple random sampling technique. In the second stage, a number of students were selected from the sampled schools based on probability proportionate to size. Using the classroom registers as sampling frame, a systematic sample of participants was selected from each class till the allocated sample was obtained.

Students were only recruited into the study if their parents signed the consent form that was given to their wards before the commencement of the study. Similarly, institutional ethical clearance and permission were obtained from Aminu Kano Teaching Hospital and the Kano State Ministry of Education respectively. Excluded from the study were Non-Nigerians. A structured pre-tested and validated questionnaire was administered on all eligible students. It inquired about socio-demographic characteristics, current and past medical conditions. Other information elicited includes family history of hypertension and other cardiovascular risk factors.

#### BLOOD PRESSURE MEASUREMENT

The procedure was explained to participants in advance and demonstrated on one of the research assistants to

allay anxiety. Participants were allowed to sit and relax for at least five minutes. Thereafter, tight clothing was removed and with the arm placed on the table at the level of the heart, the blood pressure was recorded using a standard mercury sphygmomanometer and a Littman's stethoscope. Depending on the arm size of the students, different cuff sizes ranging from 9.5x25cm, 12x22.5cm to 12x35cm were used. The essence was to cover the required area of middle two-thirds of the upper arm, since deviation from this could lead to over or under diagnosis of hypertension especially in children and adolescents.<sup>17</sup> The reading on the sphygmomanometer that coincided with the appearance of the first sound (Korotkov Phase I) was considered as the systolic blood pressure, while the disappearance of the sound (Korotkov Phase V) was recorded as diastolic blood pressure, in accordance with the 1999 WHO/ISH guidelines of the management of hypertension<sup>1</sup>. Blood pressure measurements were repeated three times (at 5minutes' interval) on each student. Subjects whose blood pressures were  $\geq 140$ mmHg for systolic and/or  $\geq 90$ mmHg for diastolic in all the 3 recordings were regarded as being hypertensive. The mean values of the 3 readings of the systolic and diastolic blood pressures of those considered to be hypertensive was calculated. These values were used separately to classify the severity of the hypertension. The 1999 WHO/ISH guidelines were also followed for the grading of the hypertensive subjects<sup>1</sup>. The students that were found to be hypertensive received a free full clinical evaluation in Aminu Kano Teaching Hospital. The assessment included fundoscopy, chest radiograph, urinalysis and electrocardiography. Blood samples were also obtained for analysis of serum glucose, cholesterol, urea, creatinine and electrolytes.

#### HEIGHT AND WEIGHT MEASUREMENTS

Each student dressed in school uniform was requested to remove his/her head-wear and shoes and stand on a WEYLUX weighing scale. Measurements were recorded to the nearest one tenth of a kilogram. Height was measured using an ACCUSTAT Ross stadiometer. The students were asked to stand erect with the heels, buttocks, upper back and occiput against the stadiometer. The measurements were recorded to the nearest 1 cm.

#### DATA ANALYSIS

The data was analyzed using the EPI-info 6.0 statistical software package (CDC Atlanta, Georgia, USA).<sup>18</sup> Prevalence, 95% Confidence intervals, mean and

standard deviation were used to summarize blood pressure, height and weight. BMI were also computed for the participants. Microsoft Word was used for tabulations. The Chi-square test was used for testing the significance of associations between categorical variables. The level of significance was set at  $P < 0.05$ .

## RESULTS

Of the 1000 students recruited, 968 completed the study, giving a response rate of 96.8%. The main reason for non-completion of the study was school absenteeism. There were 476 (49.2%) male and 492 (50.8%) female students giving a sex ratio of approximately 1:1. The participants age ranged from 13 to 19 with a mean of 15.91.62 years. The Body Mass Index (BMI) of participants ranged from 16.3 to 30.5 Kg/m<sup>2</sup> with a mean of 18.222.7 Kg/m<sup>2</sup>. Females had a significantly higher mean BMI (18.51.3 Kg/m<sup>2</sup>) compared to males (17.10.86Kg/m<sup>2</sup>) [ $t=2.5$   $p=0.03$ ]. The demographic characteristics of the participants are shown in Table I.

**Table I: Age and sex distribution of participants**

Age (years)	Males No. (%)	Females No. (%)	Total
13	38 (48.1)	41 (51.9)	79 (100.0)
14	44 (37.9)	72 (62.1)	116 (100.0)
15	70 (33.2)	141 (66.8)	211 (100.0)
16	81 (38.0)	132 (62.0)	213 (100.0)
17	98 (59.0)	68 (41.0)	166 (100.0)
18	87 (75.7)	28 (24.3)	115 (100.0)
19	58 (85.3)	10 (14.7)	68 (100.0)
Total	476 (49.2)	492 (50.8)	968 (100.0)

## BLOOD PRESSURE PATTERN

Table IIa shows the overall mean systolic blood pressure of all the participants to be 11112.4mmHg. Considered by sex, the mean systolic blood pressure for males was 11213.2mmHg compared to 11111.7mmHg for female students. Generally, the mean systolic blood pressure showed an increasing trend with age. However, females had a higher mean systolic blood pressure compared to their male counterparts during early teenage. This tendency was reversed during the late teenage years.

The mean diastolic blood pressure for all the participants was 739.4mmHg. It was 729.5mmHg and 749.2mmHg for male and female participants respectively. There was a rising trend of the DBP with age in both sexes. The mean diastolic blood pressure was higher among females in the early teenage period with a reversal towards the end of the teenage years as shown in Table IIb.

**Table IIa: Mean systolic blood pressure pattern by age and sex**

Age (years)	Males (mmHg)	Females (mmHg)	Both sexes
13	102±7.8	108 4.1	104 14.6
14	105 ±3.1	108 9.2	107 10.8
15	108 11.1	109 14.1	109 11.4
16	109 12.1	114 12.2	112 12.9
17	111 13.2	112 12.4	112 13.2
18	116 12.1	114 11.5	116 12.1
19	118 11.1	117 7.8	118 11.5
All	112 13.2	111 11.7	111 12.4

**Table IIb: Mean diastolic blood pressure pattern by age and sex**

Age (years)	Males (mmHg)	Females (mmHg)	Both sexes
13	69 8.4	74 4.2	72.1 8.7
14	69 9.3	74 8.4	72.3 8.9
15	71 8.5	73 10.5	73.2 9.1
16	70 9.6	74 10.1	73.3 10.1
17	71 10.2	72 8.2	71.7 9.5
18	75 8.4	74 10.3	75.2 10.7
19	77 8.6	74 10.5	77.4 8.4
All	72 9.5	74 9.2	73 9.4

## Prevalence of hypertension

Table III shows that 70 of the 968 students had systolic blood pressure 140mmHg and/or diastolic blood pressure 90mmHg and were therefore considered to be hypertensive. This gives an overall prevalence rate of hypertension of 7.2% [95%CI=5.6-8.9%]. Specifically, 32 (6.7%) of the 476 male students were hypertensive compared to 38 (7.7%) of the 492 female participants. This difference was not statistically significant ( $\chi^2=1.6$   $df=1$   $p>0.05$ ). In addition, the lowest prevalence rate of 4.3% was seen in the 14 year old participants, and then there was a gradual rise with age, reaching a peak of 11.8% among the 19 year old students. However, this trend was also not statistically significant ( $\chi^2$  for trend=2.23  $p=0.14$ ).

**Table III: Prevalence of hypertension by age and sex**

Age (years)	Number in study (n)		Prevalence of hypertension No. (%)		
	Males	Females	Males	Females	Both sexes
13	38	41	1 (2.6)	3 (7.3)	4 (5.0)
14	44	72	3 (6.8)	2 (2.8)	5 (4.3)
15	70	141	3 (4.3)	13 (9.2)	16 (7.6)
16	81	132	3 (3.7)	14 (10.6)	17 (8.0)
17	98	68	8 (8.2)	4 (5.9)	12 (7.2)
18	87	28	6 (6.9)	2 (7.1)	8 (7.0)
19	58	10	8 (13.8)	-	8 (11.8)
Total	476	492	32 (6.7)	38 (7.7)	70 (7.2)

### PATTERN AND GRADE OF HYPERTENSION

Forty three (61.4%) of the 70 students had only diastolic hypertension while 16 (22.8%) had both systolic and diastolic hypertension. Isolated systolic hypertension was seen in eleven (15.7%) of the participants. This pattern of predominance of diastolic hypertension was also observed when considered by gender. Majority of hypertensive students 62 (88.5%) had grade 1 hypertension, 7 (10.0%) had Grade 2 hypertension while a 16-year-old female student had Grade 3 hypertension.

### RISK FACTORS OF HYPERTENSION

Seventeen (24.3%) of the 70 students with hypertension had a family history of hypertension compared to 120 (13.4%) of the 898 students that were normotensive. Hypertensive students were therefore about twice more likely to have a family history of hypertension compared to their normotensive counterparts. This difference was statistically significant [OR=2.1, 95% CI=1.12-3.83] ( $\chi^2=6.4$  df=1 p=0.01). Four of the 70 hypertensive students were obese (BMI $\geq$ 30Kg/m<sup>2</sup>) compared to only one of their normotensive counterparts. None of the students gave any history of cigarette smoking or alcohol consumption. All respondents reported participating in physical education activities in their schools. Furthermore, none of them gave a history suggestive of previous kidney disease. There were no clinical features suggestive of thyroid disease, adrenal disease, acromegaly or coarctation of the aorta.

### COMPLICATIONS AND TARGET ORGAN DAMAGE

There was no clinical evidence of left ventricular hypertrophy among those found to be hypertensive. Only 41 of the hypertensive students were available for electrocardiography (ECG) and none of them showed evidence of left ventricular hypertrophy. Fifteen (21.4%) of the hypertensive students had proteinuria of 30mg/dl. Serum urea and creatinine levels were within normal limits for all the hypertensive subjects. Similarly, fasting glucose levels and lipid profile were within normal limits. None of them had retinopathy.

## DISCUSSION

The prevalence rate of hypertension among in-school teenagers in Kano was 7.2%, with a slightly higher rate of 7.7% among females compared to 6.7% among males. The mean systolic blood pressure among these teenage students showed an increasing trend with age. In addition, females had a higher mean systolic and mean diastolic blood pressure during early teenage compared to their male counterparts. However, this observation was reversed during the late teenage years.

Our study population was in-school teenagers, and participants were selected from both public and private secondary schools using a probability sampling technique. The response rate was quite high (96.8%). We also standardized the measurement of blood pressure and anthropometry to minimize observer variation. While the use of adult criteria could underestimate the prevalence of hypertension; the non-inclusion of out of school teenagers could restrict external validity. Similarly, the multiplicity of diagnostic criteria used by previous researchers could hinder comparability. Nevertheless, the figures obtained could serve as a reference point for further studies and be useful in creating awareness among health practitioners of the existence of hypertension among this group.

The prevalence rate of 7.2% found in this study is comparable with those reported from Lagos (7.4% systolic, 7.0% diastolic hypertension)<sup>19</sup>, Madrid (7.2%)<sup>8</sup> and Benin (6.8%)<sup>20</sup>. It was higher than the rates of zero, 3.3% and 5.8% reported from Zaria<sup>6</sup>, Kwara<sup>21</sup> and Ibadan<sup>22</sup> respectively. In Jos<sup>23</sup>, the overall prevalence rate was 9.52% among primary school children. This value is higher than the one obtained in our study. These differences could be explained by differences in the study populations, and the different diagnostic criteria. The observed increase in mean blood pressure levels with age in this study corroborates previous findings among children<sup>5, 24</sup>. This could be explained by the observation that with increasing age, vascular stiffness increases with an accompanying decrease in elasticity especially of the major arteries. The mean blood pressure and gender specific prevalence rate for hypertension was slightly higher among females. This finding contrasts with previous studies which found a higher mean blood pressure level among males<sup>25, 26</sup>. Nevertheless, the finding in the present study is similar to some previous studies in Nigeria<sup>27, 28</sup>. The higher mean blood pressure and rate of hypertension among female students (especially during the early teenage

period), could be partially due to the significantly higher BMI observed among females in this study, a finding similar to an earlier study in Lagos<sup>27</sup>. It has been reported that the higher the BMI or Quetelet index, the greater the risk of hypertension, ischaemic heart disease and diabetes mellitus<sup>29</sup>. In addition, Akinkugbe et al<sup>19</sup> also suggested that this pattern could be due to the earlier onset of puberty among girls.

We also found that hypertensive students were twice more likely to have a family history of hypertension compared to their normotensive counterparts. This is in agreement with a report from the United States that showed that children and adolescents with a positive family history of hypertension had a greater increase in systemic vascular resistance and systolic and diastolic blood pressure levels<sup>30</sup>. In another study restricted to teenage boys, Treiber and colleagues<sup>31</sup> found a 20-30% increased risk of high blood pressure among those whose parents had hypertension. This could be due to the combined roles of genetic and environmental risk factors in the development of hypertension. Essential hypertension in particular, is thought to be fundamentally a polygenic disease whose understanding could be advanced through molecular genetic analysis<sup>32</sup>. The absence of clinical and ECG evidence of left ventricular hypertrophy among hypertensive students in the present study is in agreement with the findings of Schieken et al<sup>33</sup> who did not observe ECG differences in nearly 200 school-aged children with blood pressures in the lowest, middle and highest quintile of systolic blood pressure. Similarly, Aristimuno et. al reported no ECG changes among black children with blood pressure above the 90<sup>th</sup> percentile<sup>34</sup>. Normal biochemical parameters were found in this study, fasting blood glucose; urea; electrolytes; creatinine and lipid profile. Elevation of the urea and/or creatinine would have presented difficulties in

determining whether the hypertension is primary or secondary to renal disease.

Our observations suggest that hypertension exists among teenage students in Kano. However, the prevalence rate of 7.2% could be an underestimate due to the use of adult criteria. There is a need to standardize diagnostic criteria that considers the effect of age and gender on blood pressure among youths. This would enhance comparability between studies and serve as a guide for clinicians while evaluating teenagers. It is imperative that school health personnel responsible for pre-entry and periodic medical examinations measure blood pressure and refer students found to have raised blood pressure to hospitals for further evaluation. Particular attention should be paid to students with a family history of hypertension and other cardiovascular risk factors, since there is a generally accepted view that if these are identified early, then primary prevention of hypertension might become a realistic public health and clinical goal. There is a need to study the prevalence of hypertension and cardiovascular risk factors among out-of-school teenagers in order to obtain a complete picture of the situation in this age group in the environment of the present study.

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