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*Research Article*

# A comparative study of electrocardiogram among male hypertensive students attending University Health Services and normotensive students of Ahmadu Bello University, Zaria, Nigeria.

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**Keywords:**
*Hypertension, blood pressure; Electrocardiogram, Left Bundle Branch Block.*

**ABSTRACT**

**Background:** Worldwide cardiovascular diseases account for approximately 17 million deaths annually, these complications. Hypertension is responsible for at least 9.4 million deaths every year globally. Electrocardiogram (ECG) is a simple, convenient, economical, and suitable test for screening a relatively large population. The study was aimed at determining electrocardiographic patterns among male hypertensive students attending university health services and normotensive students of Ahmadu Bello University, Zaria, Nigeria. **Methods:** A total of 109 participants (18 – 53) years were recruited, among which were53 hypertensive and 56 non-hypertensive participants. Information on subject's blood pressure, anthropometric measurements and electrocardiogram were recorded. **Results:** The result showed a significant higher mean age 35.60 ± 7.26 years, mean weight73.28 ± 12.06 kg, mean body mass index (BMI) 25.23 ± 5.56 kg/m$^2$, mean systolic blood pressure (SBP) 141.17 ± 14.32 mmHg, mean diastolic blood pressure (DBP) 89.74 ± 7.36 mmHg and mean arterial blood pressure (MABP) 107.27 ± 9.68 mmHg among hypertensive subjects as compared to control subjects. The calculated ECG of higher mean heart rate (HR) (73.96 ± 13.77), mean QTc interval (392.11 ± 22.56),mean T wave (281.43 ± 119.45), and lower mean QRS axis (39.79 ± 29.22) among hypertensive subjects as compared to control subjects and some of the ECG abnormalities that were detected include; sinus tachycardia (16%), sinus bradycardia (2%), atrial fibrillation (8%), left bundle branch block (2%), left axis deviation (8%), left ventricular hypertrophy (40%), ST elevation (2%), ST depression (12%) and T wave inversion (24%). **Conclusion:** This study shows that male hypertensive subjects of ABU Zaria had higher HR, QTc interval, T wave and lower QRS axis. Most frequently found ECG abnormalities were left ventricular hypertrophy, T wave inversion, ST depression, sinus tachycardia, left axis deviation and atrial fibrillation. The students should therefore routinely check the status of cardiovascular performance through electrocardiogram recording.



## INTRODUCTION

Hypertension also known as high blood pressure is a long-term medical condition in which the blood pressure is elevated (Abhimanyu *et al*., 2017). Hypertension is classified into two, namely, essential/ primary/ idiopathic hypertension and non-essential/ secondary hypertension. Essential hypertension is the form of hypertension that has no identifiable cause. It is the most common type of hypertension, affecting 95% of hypertensive patients (Ukpabi and Ewelike, 2017). Secondary hypertension is a type of hypertension which is caused by an identifiable underlying secondary cause. It is much less common than essential hypertension affecting only 5% of hypertensive patients (Hasanain *et al*., 2017). The American Heart Association (AHA) categorized individual with hypertension as those with sustained elevated systolic blood pressure (SBP) ≥ 140mm Hg or diastolic blood pressure (DBP) ≥ 90mm Hg or both (Hasanain *et al*., 2017). It is a growing public health problem and a major risk factor for cardiovascular

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diseases. It is an important public health problem globally with an increasing prevalence (31.1%) (Mills, 2016), severity and attendant complications on the heart and other internal organs. Electrocardiography (ECG) is a simple, convenient, economical and suitable test for screening a relatively large population, it is a noninvasive method of measuring some parameters of cardiovascular system, which reports have shown that ECG changes appear early in the course of cardiovascular diseases, and usually include alterations such as sinus tachycardia, QTc prolongation, QT dispersion, changes in heart rate variability, ST–T changes, and left ventricular hypertrophy (LVH) (Ayoola, *et al*., 2019).Also, different ECG changes like left ventricular hypertrophy, ST segment depression, Abnormal T waves, pathological Q waves, prolong QRS complex have been frequently observed in hypertensive subjects (Sudipto *et al*., 2016). The study is aimed at determining electrocardiographic patterns among male hypertensive students in Ahmadu Bello University, Zaria.

## METHODS

*Methods*

The study was conducted among (undergraduate and postgraduate) students in Ahmadu Bello University (ABU), Zaria, Nigeria. Zaria is a major city in Kaduna State in northern Nigeria, as well as being a Local Government Area. Formally known as Zazzau, it was one of the original seven Hausa city-states. It is located at latitude 11.07 – 11.40 N, and longitude 7.71 – 7.42 E (GPS co-ordinate: 11. 111, 7.723). It has a population of 975, 228 (2015 projected), about 0.535% of Nigeria's population, and covers an area of 563Km$^2$ (UNDESA, 2014).Ahmadu Bello University, Zaria was founded on October 4$^{th}$ 1962, with 13 faculties, 82 academic departments and Post Graduates School, about 1,400 academic and research staffs, 5,000 supporting staffs, 57, 401 students and 500, 000 alumni (Management Information System-Unit, ABU, Zaria, 2018).The study was conducted using a comparative cross-sectional study among students of Ahmadu Bello University (ABU), Zaria. A total of 109 participants, among which include53 hypertensive participants were recruited from students attending Hypertensive Clinics in the University Health Servicesand56 non-hypertensive participants were without history of any significant physical, medical and surgical illness. The following participants such as Female participants, participants with medical complications like, diabetes mellitus, Chronic Obstructive Pulmonary Disease (COPD)/Asthma, thyroid disorder were excluded from the study. The study was conducted for a period of ten weeks, Physical examination included measurement of height by using a stadiometer, weight was measured with a weighing scale, and blood pressure recording with a mercury sphygmomanometer. Following detailed assessment of the participants, a 12lead electrocardiogram was recorded by using ECG machine. Participants had their ECG recording in the Department of Human Physiology, the recording was carried out in the standard way based on the American Heart Association Specifications (John *et al*., 2012). Electrocardiogram (ECG) was evaluated for the following parameters e.g. Heart rate, P wave, PR interval, QRS complex, QRS axis, QT interval, QTc interval, ST segment and T wave.

*Statistical Analysis*

The results were expressed as mean ± SD. Two tailed P values $< 0.05$ were considered statistically significant. Differences between cases and the control subjects were analyzed using the unpaired t test. Statistical Package for the Social Sciences (SPSS) 23.0 for Windows statistical package was used for statistical analysis.

## RESULTS

*Anthropometric Indices between Hypertensive and Non-hypertensive Participants*

There was significantly higher mean age 35.60 ± 7.26 years, mean weight 73.28 ± 12.06 kg, mean body mass index (BMI) 25.23 ± 5.56 kg/m$^2$, mean systolic blood pressure (SBP) 141.17 ± 14.32 mmHg, mean diastolic blood pressure (DBP) 89.74 ± 7.36 mmHg and mean arterial blood pressure (MABP) 107.27 ± 9.68 mmHg among hypertensive participants when compared to non-hypertensive participants. Mean height 173.51 ± 8.06 cm was the only parameter that was not statistically significant among hypertensive participants when compared to non-hypertensive participants (Table 1).

*Electrocardiographic (ECG) Parameters between Hypertensive and Non- hypertensive Participants*

There was significant higher mean heart rate (HR) 73.96 ± 13.77bpm, mean QTc interval 392.11 ± 22.56ms, mean T wave 281.43 ± 119.45ms and lower mean QRS axis 39.79 ± 29.22degree among hypertensive participants when compared to non-hypertensive participants. (Table 2)

*Electrocardiographic (ECG) Abnormalities among Hypertensive and non-hypertensive Participants*

The electrocardiographic abnormalities which the commonest was left ventricular hypertrophy (40%),

others included: sinus tachycardia (16%), sinus bradycardia (2%), atrial fibrillation (8%), left bundle branch block (2%), left axis deviation (8%), ST elevation (2%), ST depression (12%) and T wave inversion (24%) among hypertensive participants when compared to control participants. (Table 3)

**Table 1:** Anthropometric Indices between Hypertensive and Non-hypertensive participants.

| Parameters | Hypertensive (n=53) (mean ± SD) | Non-hypertensive (n=56) (mean ± SD) |
|---|---|---|
| Age (years) | 35.60 ± 7.26* | 31.42 ± 6.83 |
| Weight (kg) | 73.28 ± 12.06* | 61.51 ± 7.55 |
| Height (cm) | 173.51 ± 8.06 | 174.66 ± 7.24 |
| BMI (kg/m$^2$) | 25.23 ± 5.56* | 20.25 ± 2.29 |
| SBP (mmHg) | 141.17 ± 14.32* | 111.45 ± 9.58 |
| DBP (mmHg) | 89.74 ± 7.36* | 74.50 ± 9.94 |
| MABP (mmHg) | 107.27 ± 9.68* | 86.45 ± 8.45 |

*= statistically significance; p value < 0.05; BMI= body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; MABP=mean arterial blood pressure, SD= standard deviation

**Table 2:** Electrocardiographic (ECG) Parameters between Hypertensive and Non-hypertensive participants.

| Quantitative ECG parameters | Hypertensive (Mean ± SD) | Non-hypertensive (Mean ± SD) |
|---|---|---|
| Heart rate (bpm) | 73.96 ± 13.77* | 63.70 ± 10.68 |
| P wave (ms) | 108.58 ± 12.80 | 105.16 ± 12.11 |
| PR interval (ms) | 178.94 ± 54.07 | 163.89 ± 18.52 |
| QRS complex (ms) | 89.91 ± 13.50 | 88.45 ± 11.64 |
| QRS-axis ($^0$) | 39.79 ± 29.22* | 55.96 ± 20.99 |
| QT interval (ms) | 362.87 ± 28.73 | 371.38 ± 17.54 |
| QTc interval (ms) | 392.11 ± 22.56* | 373.86 ± 27.36 |
| ST segment (ms) | 103.96 ± 85.64 | 83.80 ± 17.19 |
| T wave (ms) | 281.43 ± 119.45* | 205.41 ± 15.52 |

*= statistically significant; p value < 0.05; SD= standard deviation

**Table 3:** Electrocardiographic (ECG) Abnormalities among Hypertensive andNon-hypertensive participants

| ECG Abnormalities ++ | Hypertensive n=53 | | Non-hypertensive n=56 | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Sinus tachycardia | 8 | 16 | 2 | 4 |
| Sinus bradycardia | 1 | 2 | 4 | 8 |
| AF | 4 | 8 | 1 | 2 |
| LBBB | 1 | 2 | 1 | 2 |
| LAD | 4 | 8 | 1 | 2 |
| LVH | 20 | 40 | 2 | 4 |
| ST elevation | 1 | 2 | 0 | 0 |
| ST depression | 6 | 12 | 1 | 2 |
| T wave inversion | 12 | 24 | 0 | 0 |

++ (More than one ECG diagnosed per subject is possible) AF = Atrial fibrillation, LBBB = Left bundle branch block, LVH = Left ventricular hypertrophy, RAE = Right atrial enlargement, LAD= left axis deviation.

## DISCUSSION

Systemic hypertension is an important public health problem with significant morbidity and mortality through-out the world (Julian and Sam, 2015). This current study presents information obtained from the Electrocardiographic (ECG) patterns among male hypertensive students attending university health services and normotensive students of Ahmadu Bello University, Zaria, Nigeria. In this current study, there was statistically significant increase in age, weight, Body Mass Index (BMI), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and Mean Atrial Blood Pressure (MABP) among hypertensive subjects when compared to non-hypertensive subjects. Therefore, individuals who are overweight are at higher risk of developing hypertension when compared to people with normal BMI. Oladapo *et al*, (2010) demonstrated a significant relationship between hypertension in university students with a BMI >25. Pang *et al*, (2010) and Sarry El-Din *et al*, (2012) confirmed that overweight and being obese were the major risk factors in hypertension. Heart rate was significantly higher with 16% of sinus tachycardia in hypertensive subjects than in non-hypertensive controls in this study. John, *et al*, (2012) reported that sympathetic nervous system causes sinoatrial (SA) node and atrioventricular (AV) node increases in vagal tone in hypertensive subjects thereby giving rise to sinus tachycardia. There was significant decrease in QRS axis among hypertensive subject when compared to non-hypertensive subject in this study. Left Axis deviation (LAD) was found in 8% of hypertensive subjects in our study, which is higher than the population (3% to 6%) of a study by Ayoola, *et al*., 2019. There was significant increase in QTc interval

among hypertensive subject when compared to non-hypertensive subjects. This is in agreement with the findings of Saaden and Jones (2011) where patients with arterial hypertension had an increased QTc dispersion when compared with non-hypertensive subjects, and this increase was found to be higher in those hypertensive patients with LVH. Left ventricular hypertrophy (LVH) is the most common ECG change seen in (40%) hypertensive subjects in this study. The prevalence of LVH is higher in hypertensive subjects than non-hypertensive control and corresponds to finding by Agomouh and Odia, 2017. There was significantly higher T wave among hypertension participants when compared to non-hypertensive control. High proportion of ST depression (12%) and T wave inversion (24%) were also associated with hypertension in this study. This agrees with the study by Stojanovic *et al*, (2013) who showed that ECG strain pattern of ST depression and T-wave inversion is strongly associated with left ventricular hypertrophy in hypertensive patients.

## CONCLUSION

The study revealed an association between hypertension and electrocardiographic (ECG) patterns. The most affected ECG changes in male hypertensive students were higher HR, higher QTc interval, higher T wave and lower QRS axis. Most frequently found ECG abnormalities were left ventricular hypertrophy, T wave inversion, ST depression, sinus tachycardia, left axis deviation and atrial fibrillation.

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