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COMPARATIVE STUDY OF THE ECG AND INTER-ARM BLOOD PRESSURE DIFFERENCE WITHIN GENDERS IN SUBJECTS WITH HYPERTENSION IN NNEWI NORTH LOCAL GOVERNMENT AREA, ANAMBRA STATE

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ABSTRACT
This study was done using sampling methodology, the ECG and inter-arm blood pressure difference within genders in hypertensive individuals in Nnewi North Local Government Area, Anambra state, were evaluated. The convenience sampling approach was utilized to choose the study population, which consisted of hypertension patients, both male and female, ages 25 to 90, from the cardiology unit at NAUTH Nnewi. The control group consisted of normotensive individuals of the same gender and age range. The sample size was determined to be 70 subjects using this formula: n= $(z^2pq)/d$. The findings of this study showed that when a gender comparison of the blood pressure parameters was done, the mean right arterial systolic blood pressure was found to be significantly higher in the hypertensive males than the hypertensive females. The ECG readings of the female hypertension participants revealed a heart rate that was substantially greater than that of the female control group. Additionally, the hypertensive females' heart rates were considerably greater than those of the men. Since this is the first study assessing the relationship between interarm blood pressure disparities and ECG parameters, this has not been reported in other studies. The interarm diastolic blood pressure difference and p-axis showed a favorable connection in the female hypertension participants. This is also being reported for the first time.

KEYWORDS: ECG, Inter-arm, blood pressure, hypertension and Nnewi North.

INTRODUCTION
Blood pressure is a widely measured clinical parameter in patient's assessment. It is the force exerted laterally on the walls of arteries by blood due to contraction and relaxation of blood vessel muscles. Its measurement gives clinicians information about a patient's baseline cardiovascular state, (Madubuagwu *et al.*, 2018). A normal blood pressure is vital to life. Without this pressure that forces blood to flow around the circulatory system, oxygen or nutrients would not be delivered to the tissues and organs, (MacGill, 2019). A persistently high blood pressure with a systolic blood pressure (SBP) of 140 mmHg or higher and a diastolic blood pressure of 90 mmHg or higher is known as hypertension (Chobaian et al., 2003). Adeloye et al. (2021) report that it is a primary risk factor for cardiovascular diseases globally, with a comparatively greater incidence in low- and middle-income nations like Nigeria. It is estimated that 26% of the world's population, or 972 million people, suffer from hypertension. By 2025, the prevalence is predicted to rise to 29%, particularly in low- and middle-income nations (Kearney et al., 2005).

It has been seen that hypertension causes the heart to adapt structurally and functionally. These adaptations include the development of myocardial fibrosis and microvascular endothelial dysfunction, which together lead to left ventricular hypertrophy, diastolic dysfunction, and eventually heart failure. Electrocardiogram (ECG) findings include increased P-wave duration and dispersion, increased PR-interval, increased QRS duration, and increased QT interval and QT dispersion as a result of these changes (Hassing *et al.*, 2019). For an early diagnosis of hypertension and appropriate therapy, a blood pressure measurement must be performed accurately (Balushi, Jahan, Jahdhami and Bhargava, 2018). According to international guidelines, the first visit should include a measurement of blood pressure in both arms; subsequently, the arm with the higher reading should be used for blood pressure monitoring (National Institute for Health and Care. For an early diagnosis of hypertension and appropriate therapy, a blood pressure measurement must be performed accurately (Balushi, Jahan, Jahdhami and Bhargava, 2018). According to international guidelines, the first visit should include a measurement of blood pressure in both arms; subsequently, the arm with the higher reading should be used for blood pressure monitoring (National Institute for Health and Care Excellence (NICE), 2019; Whelton et al., 2018; Williams et al., 2018). It is normal to have a few millimeters of mercury's difference in blood pressure between the arms, but anything more than 10 mmHg can greatly raise the risk of unfavorable cardiovascular outcomes, particularly in cases of pre-existing vascular disease or hypertension (Do, Raiciulescu and Leggit, 2019; Ojo et al., 2020). After analyzing a few community-based studies, it was discovered that 3.6% of adults overall, 7.4% of those with diabetes, and 11.2% of those with hypertension had systolic IABPDs of ≥10 mmHg.

AIM

The aim of this study is to compare and evaluate the ECG and inter-arm blood pressure difference within genders in subjects with hypertension in Nnewi North Local Government Area, Anambra state.

Study area

Nnewi North Local Government Area, Anambra state, Nigeria's Nnamdi Azikiwe University Teaching Hospital Nnewi served as the study's site. The four autonomous villages that make up Nnewi are Uruagu, Umudim, Nnewichi, and Otolo. The second-biggest city in Anambra State, Nnewi is well-known for having a lot of business activity. The 2006 Nigerian census estimated its population to be 391,227. The city is located in Anambra state, in the southeast of Nigeria, between latitudes 6^017´N and 6^1´N and longitudes 6^55´E and 6^917´E. It has an area of more than 1,076.9 square meters (2,789km2).

MATERIALS USED

Stadiometer

Two Digital sphygmomanometers (Omron M1 Basic)
12 lead Electrocardiogram (ECG) machine (HONGBANG Medical Technology HB1006)
Electrocardiograph
Ultrasound gel
Recording files

Sampling technique

The convenience sampling approach was utilized to choose the study population, which consisted of hypertension patients, both male and female, ages 25 to 90, from the cardiology unit at NAUTH Nnewi. The control group consisted of normotensive individuals of the same gender and age range.

Sample size

The sample size was determined using this formula: n= $(z^2pq)/d^2$
Where d= level of precision required 5% (0.05)
z is the standard normal deviate at 95% confidence level= 1.96
p is the proportion of persons in the population with factors under study that is, the proportion of respondents in previous Nigerian studies with IAD ≥ 10 mmHg which is 0.043 (Ojo *et al*., 2020)
And q is 1- p = 1- 0.043 = 0.957
n= (z2pq)/d2
n= (1.96)2 x 0.043 x 0.957/ (0.05)2
= 3.8416 x 0.0412/ 0.0025
= 0.1581/0.0025
n= 63.24
However, 10% attrition rate of sample size is 10/100 x 63.24
= 6.32
Therefore, total sample size= 63.24 + 6.32 = 69.56
= 70 subjects

However, 74 subjects were recruited over a period of four months, using convenience sampling technique, 33 hypertensive subjects with complete data were used for the study while 32 normotensive subjects were used as control.

Ethical clearance/ Informed consent

Before the research started, ethical approval was requested and received from the Ethics Committee of the Faculty of Basic Medical Sciences, Nnamdi Azikiwe University, Nnewi Campus. The participants were given a detailed explanation of the research process and were asked to sign an informed consent form willingly, adhering to the ethical norms for human research.

Inclusion and Exclusion Criteria

A control group of apparently healthy adults in the same age range who had no prior history of hypertension was chosen, and a group of apparently healthy adults aged 20 to 90 who had been diagnosed with hypertension for approximately one to twenty years were included in the study. The study population did not include minors, individuals with upper limb deformities, pregnant women, or those with one arm. The study population did not include those with any other acute or chronic conditions other than hypertension, such as diabetes mellitus, thyroid disorders, cancer, congestive heart failure, or cardiomyopathies.

LABORATORY PROCEDURE

Data Collection

Data was obtained from subjects who were eligible for the study. Biodata and medical history were obtained from each subject.

Blood Pressure (BP) Measurement

After each participant had relaxed for five minutes, the blood pressure was measured. The participants were instructed to take a comfortable seat in a chair with a backrest and both feet flat on the ground. The BP cuff, which was the proper size, was placed 2.5 cm above the ante-cubital fossa. The digital sphygmomanometer, which is generally accepted for research purposes, was used to monitor blood pressure three times, simultaneously on both arms (Clark and Aboyans, 2015; Clark, 2017). After obtaining the average the three values, the difference between the left and right arms' average systolic and diastolic blood pressure was computed.

ECG Measurement

The 12-lead ECGs was recorded with each volunteer in the supine position and after resting for five minutes. The twelve-lead ECGs was recorded using an electrocardiograph. Materials such as wrist watches and mobile phones were removed from the subject's body in order to reduce electromagnetic interference. The limbs and chest were exposed and ultrasound gel was applied in the positions where the electrodes were to be placed and the electrodes were placed according to internationally approved protocol. V1 was placed over the fourth intercostal space, at the right border of the sternum. V2 was placed over the fourth intercostal space, at the left sternal border, V3 at a point midway between V2 and V4. V4 was placed over the fifth intercostal space at the left midclavicular line. V5 and V6 were placed over the left anterior axillary line and the left midaxillary line respectively at the same horizontal level with leads V4 and V5. The appropriate electrodes were attached to each of the limbs to record the limb leads. Standard 12-leads ECGs were recorded at a speed of 25 mm/s and calibration signal of 10 mm/mV. The results were printed out with the ECG parameters already indicated in the printed reports. The ECG reports were analyzed giving attention to heart rate, P-R interval, QRS complex, QT interval, corrected QT interval, P axes, QRS axes and T axes.

Statistical Analysis

A Microsoft Excel sheet was used for data collection and management, and version 25 of the Statistical Package for Social Sciences (SPSS) program was used for analysis. The mean and standard error of the mean were used to present the findings. The results were compared using the independent samples t-test, while spearman correlation was employed to ascertain the association between ECG and IABPDs. When the results were $p<0.05$, they were deemed statistically significant.

RESULTS AND DISCUSSION

Table 1: Gender comparison of demographic characteristics of normal subjects.

Variables	Males MEAN±SEM n=14	Females MEAN±SEM n=18	P-value	T-value
Age (years)	45.42±4.23	44.88±3.48	0.92[a]	0.09
Weight (Kg)	81.07±6.19	66.06±2.97	0.03[*]	2.34
Height (meter)	1.72±0.02	1.63±0.01	0.01[*]	2.98
BMI (Kg/m^2)	25.89±1.41	24.69±1.11	0.50[a]	0.68

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 1 result showed there was no difference in age between male and female subjects. The males showed a higher mean weight and height than females, however the BMI was not different between males and females.

Table 2: Gender Comparison of Blood Pressure Parameters of Normal Subjects.

Variables	Males MEAN±SEM n=14	Females MEAN±SEM n=18	P-value	T-value
Mean left arterial systolic blood pressure (mmHg)	123.17±2.31	117.44±2.57	0.12[a]	1.61
Mean left diastolic blood pressure (mmHg)	77.59±2.05	76.92±1.93	0.81[a]	0.24
Mean right arterial systolic blood pressure (mmHg)	125.33±2.14	118.20±2.78	0.06[a]	1.94
Mean right diastolic blood pressure (mmHg)	77.15±2.39	75.83±1.57	0.64[a]	0.48
Inter-arm Systolic blood pressure difference (mmHg)	-2.17±1.02	-0.75±1.05	0.34[a]	-0.97
Inter-arm Diastolic blood pressure difference (mmHg)	0.44±1.21	1.09±0.85	0.65[a]	-0.45

Data was analysed using independent samples t-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 2 result showed there was no difference in mean left arterial systolic blood pressure, the mean right arterial systolic blood pressure, the mean left diastolic blood pressure and mean right diastolic blood pressure between the male and female normal subjects. There was also no difference in the inter-arm systolic and diastolic blood pressure between the male and female normal subjects.

Table 3: Gender comparison of Electrocardiographic parameters of normal subjects.

Variables	Males MEAN±SEM n=14	Females MEAN±SEM n=18	P-value	T-value
Heart rate (b/m)	66.64±4.07	69.94±2.97	0.51[a]	-0.67
P-R interval (ms)	163.00±12.60	162.72±9.91	0.98[a]	0.02
QRS complex (ms)	129.64±16.03	135.55±9.62	0.74[a]	-0.33
Q-T interval (ms)	396.64±24.39	431.0±13.92	0.21[a]	-1.29
QTc interval (ms)	410.85±22.92	460.88±9.87	0.04[*]	-2.17
P-axis (deg)	86.43±18.84	76.11±21.10	0.72[a]	0.35
QRS-axis (deg)	46.71±5.64	37.89±5.19	0.26[a]	1.14
T-axis (deg)	27.64±16.19	30.67±11.41	0.87[a]	-0.16

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 3 result showed no significant difference in heart rate, QRS complex, Q-T interval, P-R interval, P-axis, and QRS-axis and T-axis of the males and females. However, QTc interval revealed a significantly higher mean in females than in males.

Table 4: gender comparison of demographic characteristics of hypertensive subjects.

Variables	Males MEAN±SEM n= 17	Females MEAN±SEM n=16	P-value	T-value
Age (Years)	62.47±4.17	58.12±2.75	0.39[a]	0.85
Weight (Kg)	83.76±4.72	77.25±4.40	0.32[a]	1.01
Height (meter)	1.65±0.01	1.57±0.02	0.00 [*]	3.39
BMI (kg/m2)	30.55±1.52	31.29±1.71	0.75 [a]	-0.32

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 4.2a result revealed no difference in mean age, weight and BMI in males and females. The males were taller than the females (1.65±0.01/1.57±0.02, p=0.00).

Table 5: Gender Comparison of Blood Pressure Parameters of Hypertensive Subjects.

Variables	Males MEAN±SEM n=17	Females MEAN±SEM n=16	P-value	T-value
Mean left arterial systolic blood pressure (mmHg)	147.88±6.01	135.17±4.49	0.10[a]	1.67
Mean left diastolic blood pressure (mmHg)	91.14±4.17	90.10±2.81	0.84[a]	0.20
Mean right arterial systolic blood pressure (mmHg)	151.90±6.31	135.97±4.45	0.05[*]	2.04
Mean right diastolic blood pressure (mmHg)	90.67±4.28	89.38±2.65	0.80[a]	0.25
Inter-arm Systolic blood pressure difference (mmHg)	-4.01±1.26	-0.81±0.90	0.04[*]	-2.05
Inter-arm Diastolic blood pressure difference (mmHg)	0.47±1.00	0.73±0.96	0.86[a]	-0.18

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 5 result showed no difference in male and female mean left arterial systolic and diastolic blood pressure. The mean right arterial systolic blood pressure was higher in males than in females. There was no difference in the mean right diastolic blood pressure in males and females. The inter arm systolic blood pressure was higher in males than in females (p<0.04), while there was no difference in the inter-arm diastolic blood pressure in the male and female hypertensive subjects.

Table 6: Gender Comparison of Electrocardiographic Parameters of Hypertensive Subjects.

Variables	Males	Females	P-value	T-value
	MEAN±SEM n=17	MEAN±SEM n= 16		
Heart rate (b/m)	64.88±42.50	80.75±4.27	0.00*	-3.25
P-R interval (ms)	169.06±15.85	137.25±6.93	0.08a	1.79
QRS complex (ms)	125.53±7.19	132.38±14.95	0.67a	-0.42
Q-T interval (ms)	430.06±23.64	377.38±30.31	0.17a	1.38
QTc interval (ms)	447.12±22.61	412.00±37.01	0.42a	0.82
P-axis (deg)	84.29±15.41	69.68±16.17	0.52a	0.65
QRS-axis (deg)	44.71±11.67	60.18±15.44	0.42a	-0.81
T-axis (deg)	87.76±16.84	43.43±21.51	0.11a	1.63

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 6 result revealed a significantly higher heart rate in females than in males, while there was no significant difference in P-R interval, QRS complex, Q-T interval, QTc interval, P-axis, QRS-axis and T-axis of the males and females.

Table 7: Comparison of Electrocardiogram Parameters of Control And Hypertensive Male Subjects.

Variables	Control	Hypertensive	P-value	T-value
	MEAN±SEM n=14	MEAN±SEM n=17		
Heart rate (b/m)	66.64±4.07	64.88±2.50	0.27a	0.38
P-R interval (ms)	163.00±12.60	169.06±15.85	0.45a	-0.29
QRS complex (ms)	129.64±16.03	125.52±7.19	0.73a	0.25
Q-T interval (ms)	396.64±24.39	430.05±23.64	0.63a	-0.98
QTc interval (ms)	410.00±22.92	447.12±22.60	0.72a	-1.12
P-axis	86.42±18.84	84.29±15.41	0.85a	0.08
QRS-axis	46.71±5.64	44.71±11.67	0.32a	0.15
T-axis	27.64±16.19	87.76±16.84	0.03*	-2.54

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 7 result revealed no significant difference in the heart rate, P-R interval, QRS complex, Q-T interval, QTc interval, P-axis and QRS-axis of hypertensive male subjects when compared with the control group. Meanwhile, T-axis had a significant increase when the control was compared to hypertensive subjects.

Table 8: Comparison of Electrocardiogram Parameters of Control and Hypertensive Female Subjects.

Variables	Control	Hypertensive	P-value	T-value
	MEAN±SEM n=18	MEAN±SEM n=16		
Heart rate (beat per minute)	69.42±2.96	80.75±4.27	0.04*	-2.11
P-R interval (ms)	162.72±9.91	137.25±6.92	0.04*	2.06
QRS complex (ms)	135.55±9.62	132.37±14.95	0.85a	0.18
Q-T interval (ms)	431.00±13.91	377.77±30.31	0.10a	1.67
QTc interval (ms)	460.88±9.87	412.00±37.00	0.18a	1.34
P-axis (deg)	76.11±21.10	69.68±16.16	0.81a	0.24
QRS-axis (deg)	37.88±5.19	60.18±15.43	0.16a	-1.44
T-axis (deg)	30.66±11.41	43.43±21.51	0.59a	-0.54

Data was analysed using independent T-test and values were considered significant at $p<0.05$, SEM: standard error of mean, *: significance, a: not significant.

Table 8 result showed a significant increase in the heart rate and decrease in P-R interval of the hypertensive females when compared to the control group. However, the QRS complex, Q-T complex, QTC complex, P-axis, QRS-axis and T-axis showed no significant difference.

Table 9: Correlation between the inter-arm systolic and diastolic blood pressure with ECG parameters in HTN patients among males.

N=17	Heart rate (b/m)	PR interval (ms)	QRS complex (ms)	QT interval (ms)	QTc interval (ms)	P-axis (deg)	QRS-axis (deg)	T-axis (deg)
Inter-arm systolic blood pressure difference (mmHg)	ρ= 0.183	ρ= -0.118	ρ= 0.057	ρ= 0.056	ρ= 0.354	ρ= 0.026	ρ= 0.132	ρ= 0.072
	(p=0.31)	(p=0.51)	(p=0.75)	(p=0.76)	(p=0.04*)	(p=0.89)	(p=0.46)	(p=0.69)
Inter-arm diastolic blood pressure difference (mmHg)	ρ= -0.117	ρ= -0.044	ρ= 0.144	ρ= 0.431	ρ= 0.499	ρ= 0.241	ρ= 0.208	ρ= 0.430
	(p=0.52)	(p=0.81)	(p=0.43)	(p=0.01*)	(p=0.01*)	(p=0.18)	(p=0.25)	(p=0.01*)

Data was analysed using Spearman correlation and values were considered significant at p≤0.05, ρ: correlation coefficient, p: P-value, *: significant.

Table 9 result showed a significant positive correlation between the inter-arm systolic blood pressure difference and QTc interval of males with hypertension only. There was also a significant positive correlation between the interarm diastolic blood pressure and Q-T interval, QTc interval and T-axis in the hypertensive males.

Table 10: Correlation between the inter-arm systolic and diastolic blood pressure with ECG parameters in HTN patients among females.

N=16	Heart rate (b/m)	P-R interval (ms)	QRS complex (ms)	Q-T interval (ms)	QTc interval (m/s)	P-axis (deg)	QRS-axis (deg)	T-axis (deg)
Inter-arm Systolic blood pressure difference (mmHg)	ρ= -0.416	ρ= -0.098	ρ= 0.212	ρ= 0.328	ρ= 0.228	ρ= 0.111	ρ= -0.108	ρ= 0.182
	(p=0.10)	(p=0.72)	(p=0.43)	(p=0.22)	(p=0.40)	(p=0.68)	(p=0.69)	(0.50)
Inter-arm Diastolic blood pressure difference (mmHg)	ρ= -0.254	ρ= -0.175	ρ= 0.116	ρ= 0.397	ρ= 0.356	ρ= 0.615	ρ= 0.144	ρ= 0.459
	(p=0.34)	(p=0.52)	(p=0.67)	(p=0.13)	(p=0.18)	(p=0.01*)	(p=0.59)	(p=0.07)

Data was analysed using Spearman correlation and values were considered significant at p≤0.05, ρ: correlation coefficient, p: P-value, *: significant.

Table 10 revealed a significant positive correlation between interarm diastolic blood pressure difference and P-axis in hypertensive female subjects.

In this study, the mean right arterial systolic blood pressure was found to be significantly higher in the hypertensive males than the hypertensive females. Studies have shown and it has also been observed using 24-hour ambulatory blood pressure monitoring that blood pressure is higher in males than in premenopausal females of the same age range, but after menopause blood pressure is higher in females than in males (August, 1999; Everett and Zajacova, 2015; Reckelhoff, 2001). The gender difference in blood pressure has been proposed to be due to the effect of sex hormones on the regulation of blood pressure via the Renin-Angiotensin-Aldosterone-System (RAAS) (Di Giosia *et al.*, 2018). Estrogens has also been observed to cause vasodilatation and reduce BP levels by increasing the activation of endothelial Nitric oxide synthase/Nitric Oxide signaling, while testosterone has been observed to increase blood pressure as it interacts with the RAAS. Estrogen also inhibits vascular remodeling processes, and modulates the renin-angiotensin aldosterone system and the sympathetic system leading to a protective effect on arterial stiffness during reproductive age that is reversed after menopause (Di Giosia *et al.*, 2018; Song, Ma, Wang, Chen and Zho, 2020). The finding in this study could be because some of the hypertensive females may still be premenopausal as their age suggests. A study done by Alhawari *et al*. (2018), though among younger age group (18-26 years) and included both normotensive and hypertensive subjects, also found significant gender differences in systolic blood pressure (p= 0.003) with that of the males higher than the females. The diastolic blood pressure in the above study was also higher in the males than the females (p= 0.011).

Despite being less than 5 mmHg, the male hypertensive participants had a considerably higher interarm systolic blood pressure than the female hypertensive subjects. In contrast, there was no discernible difference between the male and female blood pressure readings in the other groups. This may not be a source of concern because the results of a study by Orme et al. (1999) have shown that there is no statistically significant link between gender and differences in interarm systolic and diastolic blood pressure. In contrast, the prevalence of systolic IABPD ≥

10 mmHg was significantly higher in males than in females aged 45 to 54 in a study conducted in an unidentified African population by Gbaguidi et al. (2022), even though there was no correlation between systolic interarm blood pressure difference and gender. This prevalence increased with an increase in systolic BP. However, in the other age categories, there was no statistically significant difference found in the prevalence of sIABPD ≥ 10 mmHg between the male and female participants.

The ECG readings of the female hypertension participants revealed a heart rate that was substantially greater than that of the female control group. Additionally, the hypertensive females' heart rates were considerably greater than those of the men; in contrast, the male and female heart rates in the other groups did not differ significantly. In good health, a woman's heart rate (78–82 b/m) is somewhat higher than a man's (70–72 b/m). This is because a woman's heart is smaller than a man's and has a lower cardiac output, thus she must beat faster to equal the larger man's cardiac output. Studies also point to the possibility that women's higher heart rates are caused by the hormone estrogen and the intrinsic rhythmicity of their pacemaker (Prabhavathi, Selvi, Poornima, and Sarvanan, 2014; St Pierre, Peirlinck, and Kuhl, 2022). The study's hypertensive female participants' markedly elevated heart rates may have resulted from a confluence of physiological factors, including the correlation between elevated heart rate and elevated blood pressure, as well as an increased risk of hypertension (Dalal et al., 2019; Reule and Drawz, 2012), as well as an increased body mass index (Xu et al., 2019).

The PR interval was smaller in hypertensive female individuals (137.25±6.92 ms) compared to non-hypertensive female subjects, even though they were within the usual range (120-200 ms). This contradicts the results of a research by Bird et al. (2020), which evaluated clinical ECG features to identify hypertension and monitor blood pressure. The review examined 35 literatures on the use of ECG wave shape alone to detect hypertension. In two of the six papers that measured the PR interval, Bird et al. (2020) found that the intervals were considerably longer with rising blood pressure; however, gender was not specified. Nonetheless, it has typically been noted that women have a shorter PR interval than men (Carbone et al., 2020). Given that the PR interval has been found to fluctuate with heart rate, this could be the result of the hypertensive female individuals' noticeably greater heart rates. A shorter PR interval results from higher conduction via the AV node at faster heart rates, which is mediated by increased sympathetic tone, and vice versa. Additionally, compared to their male counterparts, the female heart's smaller size may have contributed to some of the ECG time intervals being shorter (Carbone et al., 2020).

The T-axis of the male hypertensive subjects was notably higher (87.76±16.84°/ 27.64±16.19°, p=0.03) than that of the male control group, and it was also marginally above the normal range (15-75°). According to Dilaveris, Antoniou, Gatzoulis, and Tousoulis (2017), the T-axis is a measure of ventricular repolarization and, when aberrant, is a risk factor for unfavorable cardiac events in the elderly. It is unknown what causes the aberrant T-axis in hypertension. However, the results of Chundusu et al. (2020), who analyzed normal ECGs and discovered that the T-axis marginally increases with age, suggest that the findings in this study may be due to the age of the hypertensive males (62.47±4.17 years). Furthermore, Palhares et al. (2017) reported no gender differences and an increase in the T-axis with age in a much larger, seemingly healthy sample.

The QTc intervals of the hypertensive males and females, though within normal range (360-460 ms for the males and 350-450 ms for the females), showed a significant positive correlation with the diastolic IABPD in the females and with the systolic interarm blood pressure difference in the males when the systolic and diastolic interarm blood pressure differences were correlated with their ECG parameters. The correlation between the QTc interval and the interarm blood pressure difference has not been studied. However, G. Sun, Zhou, Ye, Wu, and Y. Sun (2019) have independently linked the systolic and diastolic blood pressures to the QTc interval in both males and females. Additionally, they discovered that both males and females with hypertension had extended QTc intervals. IABPD has been linked to increased arterial stiffness and stenosis, which may be part of the aetiology of the condition (Clark, 2022). Therefore, studies that examined endothelial dysfunction or arterial stiffness may be used to evaluate variations in interarm blood pressure. Al-Zaiti, Saba, Pike, Williams, and Khraim (2018) in their study among patients with heart failure, found an association between the magnitude of arterial stiffness and QTc interval prolongation in the absence of conduction abnormalities. Mozos and Filimon (2013), who did a relatively similar study among normotensive and hypertensive subjects also found arterial stiffness, endothelial dysfunction and increased arterial age to be associated with long QTc intervals. The QT interval, which is an important marker of ventricular activity, is the time taken to depolarize and repolarize the ventricular myocardium and is frequently expressed in form of QTc interval in the general population (Rezuş, Moga, Ouatu and Floria, 2015). In this study, the diastolic interarm blood pressure difference of the hypertensive male subjects showed a strong positive connection with the QT interval. Additionally, the diastolic interarm blood pressure difference of the hypertensive male participants in this study showed a positive connection with the T-axis. Since this is the first study assessing the relationship between interarm blood pressure disparities and ECG parameters, this has not been reported in other studies. The interarm diastolic blood pressure difference and p-axis showed a favorable connection in the female hypertension participants. This is also being reported for the first time.

CONCLUSIONS

The hypertensive males had a higher systolic blood pressure and interarm systolic blood pressure than the hypertensive females. There were differences in the ECG parameters such as heart rate, P-R interval, QTc interval and T-axis when considering the two genders.

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