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Relationship between Triradii Angles and Blood Pressure among Adolescents of Ebira Ethnic Group of Kogi State, Nigeria.

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Abstract

Dermatoglyphics have been wildly studies to identify and classify individual and population. Several health and disease conditions have been reported to present unique dermatoglyphic patterns. This study was aimed at investigating the relationship between triradii angles on the palm and the blood pressure of selected dialects of Ebira ethnic group. A total of 591 subjects (Ebira-Tao, n=199; Ebira-Etuno, n=196; Ebira-Koto, n=196), both males and females randomly selected participated in this study. The palm prints of participants were collected using the ink and roller method and analyzed for the triradii points and measurements of triradii angles using a hand magnifying lens. The participants' resting blood pressure; systolic (SBP) and diastolic blood pressure (DBP) were measured by manual auscultation using a sphygmomanometer. Data obtained were analyzed using descriptive statistics,

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one-way ANOVA, and Chi-Square. The three dialects had mean SBP and DBP within the normal range. The triradii angles revealed mean acute angles across the three dialects in the order atd < dat < adt angles. There were differences in means triradii angles across the blood pressure categories (normal, low and high) for the three dialects in males and females as higher atd and dat angles were significantly related to higher blood pressure. This was also corroborated by the test for association. In conclusion, there was a significant relationship between blood pressure and some triradii angles in two out of the three dialects. Hence, triradii angles may be an indicator for individuals with the tendency to develop high blood pressure.

Keywords: Blood pressure, Ebira, Palm print, tri-radii angles.

INTRODUCTION

The skin on the palmar and plantar surface is continuously wrinkled with narrow minute ridges known as friction ridges (Desai *et al.*, 2013). The ridges are portions of skin that are raised between furrows on either side. They are also known as papillary or epidermal ridges. The ridges flow in various directions giving rise to innumerable patterns (Ganapati, 2013).

Dermatoglyphics is the study of the epidermal ridges of the skin covering the digits, palms of the hands, and soles of the feet (Ozyurt *et al.*, 2010; Abhilash *et al.*, 2012). Fingerprints are derivative of the papillary layer of the dermis (Charles, 2001; Abhilash *et al.*, 2012). Fingerprints appear for the first time on the human fingers, palm, soles and toes from 12th to 16th week of embryonic development and their formation gets completed by the 14th week i.e. about the 4th foetal month (Sangam *et al.*, 2011; Desai *et al.*, 2013). The ridges thus, formed during the foetal period do not change their course or alignment throughout the life of an individual, until destroyed by decomposition of the skin after death (Surinder, 1984; Babler, 1991; Ganapati, 2013). Dermatoglyphic patterns form the most reliable criteria for personal identification (Sangam *et al.*, 2011). Dermatoglyphics have been used extensively to characterize and differentiate human populations and, hence, are highly suitable for studying population variation (Biswas, 2011).

Many diseases such as diabetes mellitus (Barta *et al.*, 1978; Oladipo & Ogunowo, 2004), Sickle cell disease (Oladipo *et al.*, 2007), breast cancer (Seltzer *et al.*, 1990), obesity (Regoly-Merci *et al.*, 1982), rheumatoid arthritis (Ravindranath *et al.*, 2006), schizophrenia (Zavala & Nunez, 1970; Gyenis *et al.*, 1990) have all been reported to have characteristic dermatoglyphic patterns. Triradius is the point of confluence from where, the ridges usually radiate in three different directions. Schaumann and Alter (1976) defined the 'triradius' as the meeting point of three ridges that form angles of approximately 120 degrees with one another. Generally, on the palm, four digital triradii points are located in the distal portion. They are termed as a, b, c, and d in radio-ulnar direction. The axial triradius 't' is commonly found near the proximal palmar margin. This triradial point gets displaced in many conditions such as Mongolism, Down's syndrome, Broad thumb syndrome, Great toe syndrome, Turner's syndrome and congenital heart defect (Paez *et al.*, 2001; Neiswanger *et al.*, 2002).

Blood pressure is a measure of the force that the circulating blood exerts on the wall of the main arteries (McArdle *et al.*, 2001). The normal blood pressure range for systolic is 90 to 120 mmHg while diastolic is 60 to 80 mmHg. A systolic reading lower than 90mmHg and a diastolic reading below 60mmHg signifies low blood pressure. A systolic reading above 130 mmHg and a diastolic reading above 80 mmHg are considered high blood pressure (Iqbal & Jamal, 2023).

Pursnani *et al.,* (1989) and Kulkarni & Herekar (2005) in their works demonstrated a relationship between fingerprint types and the tendency to develop high blood pressure in adult life. Lahiri (2013) demonstrated a relationship between higher ridge count, fingerprint type and higher palmer angle in essential hypertension among Indians. Oladipo *et al.* (2010) reported a high frequency of whorl pattern and total digital ridge count of 1000 in patients with essential hypertension but no relation with triradii angles among Rivers indigenes. Akhtar *et al.* (2020) reported significant differences in atd angles of hypertensive and non-hypertensive subjects among Indians.

This study aims to determine the value of tri radii angles, estimate systolic and diastolic blood pressures and assess the relationship between triradii angles and blood pressure among adolescents of selected dialects of the Ebira ethnic group of Kogi State, Nigeria.

MATERIALS AND METHODS

Study Area

Kogi is one of the states in the north-central geopolitical zone of Nigeria. It is popularly called the Confluence State because of the confluence of River Niger and River Benue (Osunmadewa & Wessollek, 2014). Ebira, as a name is used by more than nine different but historically related groups of people. These are the Ebira Opanda, Ebira Jukun, Ebira Agatu, Ebira Toto, Ebira Abaji, Ebira Koto, Ebira Mozum, Ebira Etuno and Ebira Tao (Salami, 2011). This research was done in selected secondary schools in Igarra (7.2755^0 N and 6.1076^0 E), Koton Karfe (8.1046^0 N and 6.7976^0 E), and Okene (7.5614^0 N and 6.2429^0 E) using participants from the Ebira-Koto, Ebira-Etuno, and Ebira-Tao dialects of the Ebira ethnic group. 591 consented subjects were recruited using a stratified probability sampling technique with the following breakdown: 196 Ebira-Etuno subjects (98 males and 98 females); 196 Ebira-Koto subjects (97 males and 99 females), and 199 Ebira-Tao subjects (99 males and 100 females). Before the commencement of this study, permission was sought and obtained from the authority of the participating secondary schools and ethical approval was obtained as well from the Ahmadu Bello University Committee on Use of Human Subjects for Research (ABUCUHSR/2018/001). For inclusion, two filial generations of pure ethnicity and dialect of apparently healthy adolescents of the age range 13-17 years were used. Subjects with obvious hand deformity or permanent tears on the palm were excluded.

Palm print collection

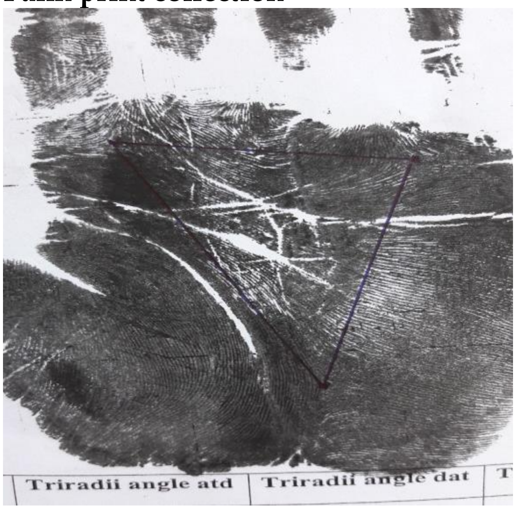

Figure 1: Palm print of a participant showing ATD triangle

Collection of samples

Procedure

The palm prints were collected using standard ink and roller method of modified Cotterman's technique (Cotterman, 1951). Palm prints were collected after washing the hands and complete drying. The right palm was smeared with ink by pressing gently on an ink-soaked pad. The inked hand was gently pressed against a white plain paper with the fingers and palm stretched. Slight pressure was applied on the back of the hand in this process of printing. The same was done to obtain a print of the left palm. The palm prints obtained were analyzed using a magnifying lens for triradii angle atd, triradii angle dat and triradii angle adt. The atd angle is one of the dermatoglyphic traits formed by joining the triradii points below the first and last digits and the most proximal triradius on the hypothenar region of the palm. Measurement of the triradii angles involves measuring the angles formed by joining these triradii points. The various angles were measured using a protractor.

The blood pressure of the subjects was measured as described by Francis & Suleiman (2015). The subjects were allowed to sit and relax before measurement. Manual auscultation using a sphygmomanometer was used to obtain the resting blood pressure [systolic blood pressure (SBP) and diastolic blood pressure (DBP)] of the subjects. The armlet/cuff was wrapped tightly around their arm. The brachial artery pulsation was felt at the cubital fossa after which the diaphragm of the stethoscope was placed there. The sphygmomanometer was rapidly run up to about 200mmHg and allowed to fall steadily until the first tapping sound was heard. This was immediately recorded as the systolic pressure. The pressure continued to fall slowly until it got to a point where the tapping sound disappeared. This was recorded as the diastolic pressure. This procedure was repeated for the second arm. The average of the two readings were taken and recorded as the subject’s systolic and diastolic blood pressure

Data analyses

Data were analyzed using the software Statistical Product for Service Solution (SPSS version 26.0) and the result was expressed as mean ± standard deviation (SD). One-way analysis of variance (ANOVA) was used to determine differences in mean among the various Ebira dialects. The chi-square test was used to test for association between some parameters. $p< 0.05$ was considered significant.

Results

The age range for the three dialects was 13 to 17 years. The mean ages were (15.74 ± 1.21), (15.72 ± 1.09) and (15.76 ± 1.19) and for Ebira-Etuno, Ebira-Koto and Ebira-Tao respectively. The mean SBP as presented in the table was (116.09 ± 10.35) mmHg while the mean DBP was (75.77 ± 7.25) mmHg. The three triradii angles ATD, DAT and ADT as presented in the Table showed acute angles for both right and left hands (Table 1).

Table 1: Descriptive statistic of all the studied variables

Parameters	Mean ± SD	Minimum	Maximum
Age (yrs)	15.74 ± 1.16	13.00	17.00
SBP (mmHg)	116.09 ± 10.35	90.00	140.00
DBP (mmHg)	75.77 ± 7.25	58.00	90.00
R-atd (°)	39.39 ± 4.82	28.00	53.00
R-dat (°)	57.81 ± 5.06	42.00	80.00
R-adt (°)	81.70 ± 4.46	62.00	92.00
L-atd (°)	39.90 ± 5.25	27.00	61.00
L-dat (°)	57.45 ± 5.20	42.00	75.00
L-adt (°)	81.56 ± 4.24	58.00	92.00

SBP= Systolic blood pressure, DBP= Diastolic blood pressure, R-atd, R-dat and R-adt= Right triradii angles, L-atd, L-dat and L-adt= Left triradii angles.

Figure 2 showed the result of Ebira-Tao subjects for systolic and diastolic blood pressure. 68% of Ebira-tao subjects had normal SBP values, 27% had high SBP values and 5% had low SBP values. For DPB, 67% of the subjects had normal DBP, 24% had high DBP and 9% had low DBP values.

For Ebira-Etuno subjects, 64% had normal SBP values, 24% had high SBP values and 12% had low SBP values (Figure 3). For DBP, 71% had normal DPB values, 20% had high DBP values and 9% had low DBP values.

For Ebira-Koto subjects, 58% of the subjects had normal SBP values, 11% had high SBP values and 31% had low SBP values (Figure 4). The DBP showed that, 68% of the subjects had normal DBP values, 7% had high DBP values, and 25% of the subjects had low DBP values.

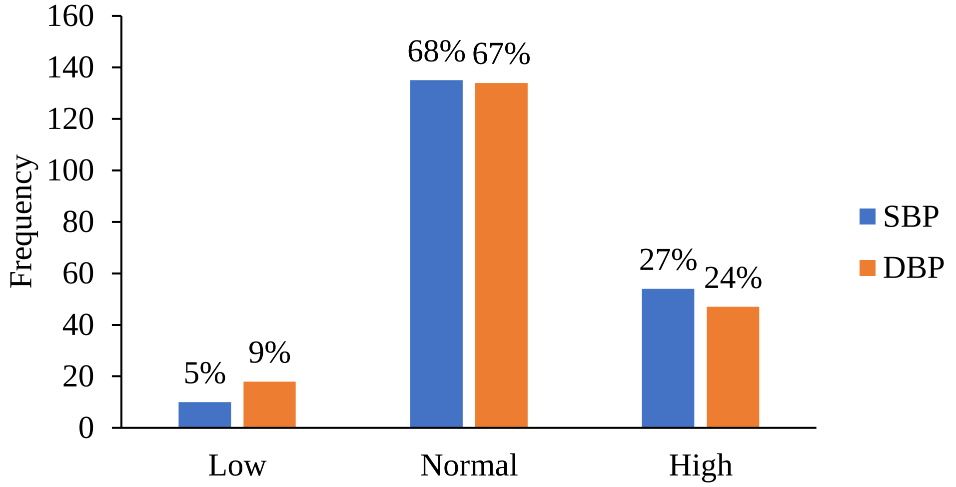

Figure 2: Frequency and percentages of blood pressure category of Ebira-Tao subjects.
SBP= Systolic blood pressure, DBP= Diastolic blood pressure

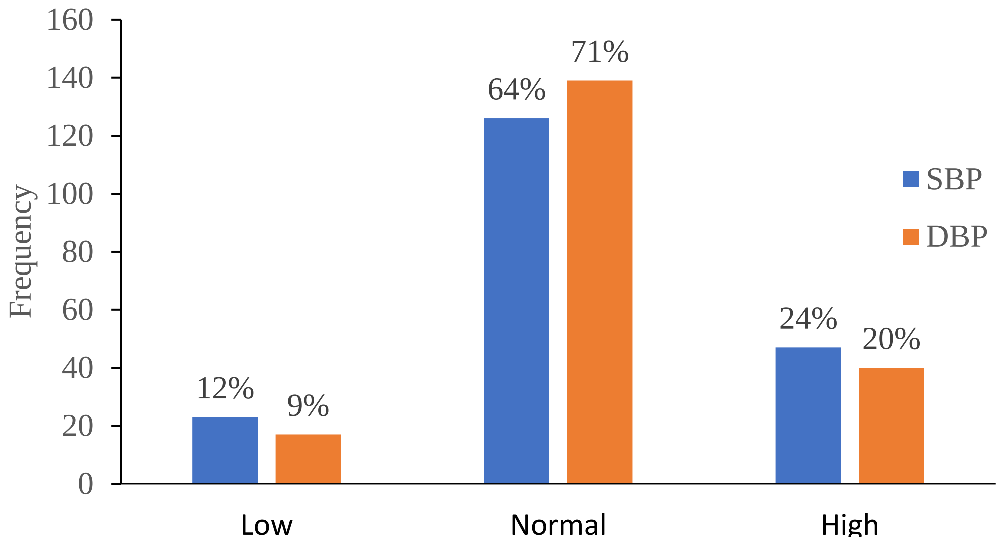

Figure 3: Frequency and percentages of blood pressure category of Ebira-Etuno subjects.
SBP= Systolic blood pressure, DBP= Diastolic blood pressure

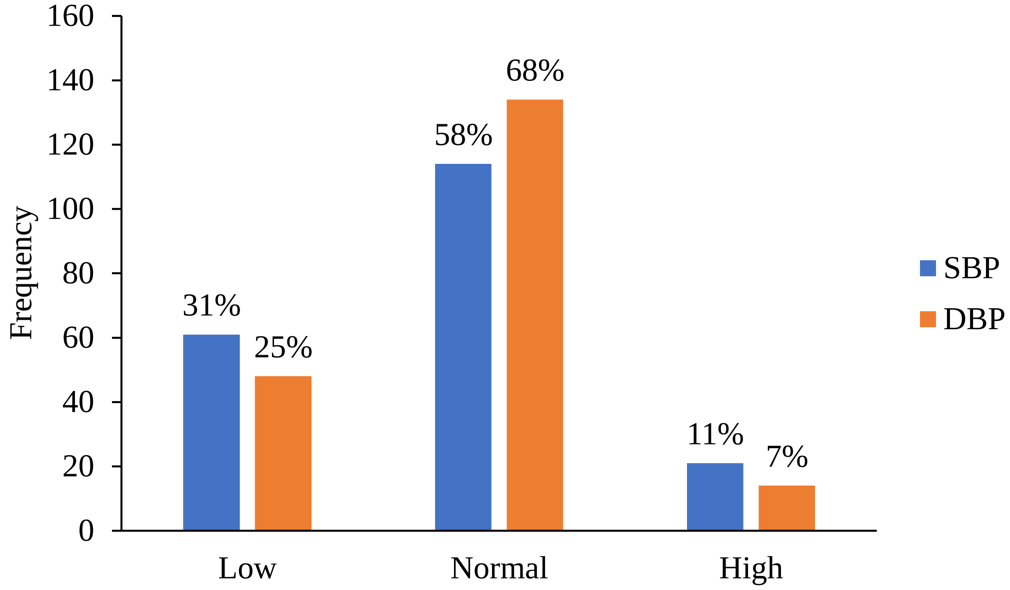

Figure 4: Frequency and percentages of blood pressure category of Ebira-Koto subjects.
SBP= Systolic blood pressure, DBP= Diastolic blood pressure

Relationship between Tri-radii Angles and Blood Pressure

For Ebira-Tao subjects, the mean value for ATD triradii angle increased as the SBP increased from low through normal to high for the right and left hand. The DAT triradii angle increased for the right hand from low to high SBP while it decreased for the left hand from low to high SBP. Triradii ADT angles for both hands, however, showed a decrease in values from low through normal to high SBP (Table 2). The DBP for Ebira-Tao subjects showed that the triradii ATD angle was highest in the low DBP category for both hands. Triradii DAT angle was averagely the same for all the DBP categories with slight differences, while triradii ADT angles for both hands decreased from low DBP through normal to high DBP (Table 3).

Table 2: Relationship between triradii angles and systolic blood pressure in Ebira-Tao subjects

	L (n= 10) Mean ± SD	N (n= 135) Mean ±SD	H (n= 54) Mean ± SD	f values	p-values
RIGHT HAND					
ATD (°)	36.30 ± 4.03	38.98 ± 4.48	40. 01 ± 5.01	3.009	0.052
DAT (°)	54.40 ± 5.42	58.47 ± 4.17	57.07 ± 5.15	2.259	0.107
ADT (°)	82.70 ± 2.50	81.18 ± 4.93	81.40 ± 4.70	0.658	0.519
LEFT HAND					
ATD (°)	37.30 ± 5.48	39.57 ± 5.97	40.19 ± 5.08	1.091	0.338
DAT (°)	60.50 ± 5.17	58.04 ± 5.15	56.98 ± 5.47	2.108	0.124
ADT (°)	82.40 ± 3.86	81.66 ± 4.81	81.72 ± 4.02	0.123	0.885

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles.

Table 3: Relationship between triradii angles and diastolic blood pressure in Ebira-Tao subjects

	L (n= 18) Mean ± SD	N (n=134) Mean ±SD	H (n= 47) Mean ± SD	f values	p-values
RIGHT HAND					
ATD (°)	40.00 ± 3.48	38.89 ± 4.50	39.49 ± 5.44	0.634	0.523
DAT (°)	58.06 ± 5.61	58.19 ± 3.97	58.02 ± 5.64	0.028	0.972
ADT (°)	81.72 ± 5.06	81.73 ± 4.12	80.34 ± 5.92	1.580	0.209
LEFT HAND					
ATD (°)	40.39 ± 4.46	39.32 ± 4.82	40.19 ± 8.10	0.577	0.562
DAT (°)	57.83 ± 4.03	57.84 ± 5.02	58.00 ± 6.35	0.017	0.983
ADT (°)	82.22 ± 3.98	80.60 ± 5.83	81.71 ± 4.55	1.890	0.154

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles.

For Ebira-Etuno subjects, both triradii ATD and DAT angles increased for both hands from low SBP through normal to high SBP categories except for right hand DAT angle which showed the highest value in the normal category with a significant difference at p= 0.009 (Table 5). Triradii ADT angles for both hands, showed a significant decrease in values from low through normal to high SBP at p= 0.003 for right and left hands (Table 5). The DBP showed increased triradii ATD and DAT angles from low through normal to high DBP categories for both hands with an exception in the low category of the left hand which had a higher DAT angle compared to the normal DBP category. Triradii ADT angles for both hands decreased from low DBP through normal to high DBP with a significant difference (*p*= 0.019) in the right hand (Table 6).

Table 5: Relationship between triradii angles and systolic blood pressure in Ebira-Etuno subjects

	L (n= 23) Mean ± SD	N (n= 126) Mean ±SD	H (n=47) Mean ± SD	f values	p-values
RIGHT HAND					
ATD (°)	39.52 ± 5.56	39.84 ± 4.46	40.21 ± 5.18	0.174	0.840
DAT (°)	55.65 ± 4.68	58.24 ± 5.42	57.38 ± 5.30	4.857	**0.009**
ADT (°)	83.78 ± 4.98	80.85 ± 4.51	82.68 ± 3.99	5.943	**0.003**
LEFT HAND					
ATD (°)	40.04 ± 4.98	40.50 ± 5.05	40.91 ± 5.28	0.240	0.787
DAT (°)	54.52 ± 4.49	57.17 ± 5.35	57.02 ± 5.09	2.578	0.079
ADT (°)	84.17 ± 4.25	81.05 ± 3.99	81.32 ± 4.03	5.908	**0.003**

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles. $p<0.05$ is considered statistically significant.

Table 6: Relationship between triradii angles and diastolic blood pressure in Ebira-Etuno subjects

	L (n= 17) MEAN ± SD	N (n= 139) MEAN ±SD	H (n= 40) MEAN ± SD	f values	p-values
RIGHT HAND					
ATD (°)	38.71 ± 3.42	39.94 ± 4.72	40.25 ± 5.84	0.616	0.541
DAT (°)	57.06 ± 5.34	57.40 ± 5.37	57.45 ± 5.16	0.035	0.966
ADT (°)	83.35 ± 5.09	81.88 ± 3.91	80.03 ± 5.93	4.029	**0.019**
LEFT HAND					
ATD (°)	39.18 ± 4.76	40.77 ± 5.12	40.35 ± 5.11	0.781	0.460
DAT (°)	57.53 ± 3.66	56.42 ± 5.28	57.95 ± 5.59	1.503	0.225
ADT (°)	83.00 ± 4.29	81.43 ± 3.90	81.00 ± 4.76	1.439	0.240

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles. $p<0.05$ is considered statistically significant.

For Ebira-Koto subjects, triradii ATD angle was highest in the normal SBP category with the high SBP category having the lowest for both hands. Triradii DAT angle decreased in value from low through normal to high SBP categories for right and left hands. Triradii ADT angles for both hands decreased from low SBP through normal to high SBP with a significant difference (p= 0.032) in the right hand (Table 8). The DBP result showed the highest triradii ATD angle value in the normal DBP category with the high DBP category having the lowest for both hands with a significant difference at *p*= <0.001 and 0.006 for left and right hands. Triradii DAT angle was highest in the low DBP category for the right hand and highest in the high DBP category for the left hand with a significant difference in the values for the left hand at *p*= 0.006. Triradii ADT angle was highest in the high DBP category for both hands with the normal DBP category having the lowest values (Table 9).

Table 8: Relationship between triradii angles and systolic blood pressure in Ebira-Koto subjects

	L (n=61) Mean ± SD	N (n= 114) Mean ±SD	H (n=21) Mean ± SD	f values	p-values
RIGHT HAND					
ATD (°)	38.29 ± 4.53	39.82 ± 4.87	38.14 ± 5.92	2.499	0.085
DAT (°)	58.64 ± 5.43	57.87 ± 5.33	56.05 ± 4.38	1.894	0.153
ADT (°)	82.15 ± 4.04	81.67 ± 3.96	84.19 ± 4.34	3.498	**0.032**
LEFT HAND					
ATD (°)	39.15 ± 4.85	40.04 ± 4.97	37.90 ± 4.19	1.980	0.141
DAT (°)	58.15 ± 5.68	57.53 ± 4.85	56.76 ± 4.31	0.648	0.524
ADT (°)	81.26 ± 4.33	82.26 ± 3.70	83.43 ± 4.62	2.737	0.067

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles. p<0.05 is considered statistically significant.

Table 9: Relationship between triradii angles and diastolic blood pressure in Ebira-Koto subjects

	L (n= 48 Mean ± SD	N (n=134) Mean ±SD	H (n= 14) Mean ± SD	f values	p-values
RIGHT HAND					
ATD (°)	37.45 ± 4.10	39.93 ± 4.89	37.64 ± 6.31	5.298	**0.006**
DAT (°)	59.19 ± 5.28	57.45 ± 5.22	58.00 ± 5.58	1.923	0.149
ADT (°)	82.40 ± 3.89	81.78 ± 4.20	83.86 ± 3.35	1.832	0.163
LEFT HAND					
ATD (°)	37.73 ± 4.28	40.49 ± 4.83	36.40 ± 4.64	9.293	**<0.001**
DAT (°)	59.27 ± 6.05	56.86 ± 4.53	59.50 ± 4.72	5.249	**0.006**
ADT (°)	81.63 ± 4.58	81.34 ± 3.85	82.50 ± 4.01	0.549	0.578

L= low blood pressure, N= normal blood pressure, H= high blood pressure, ATD, DAT and ADT= triradii angles. p<0.05 is considered statistically significant.

The correlation matrix analysis showed a significant correlation between SBP and right hand ATD angle and also DBP and left hand DAT angle in Ebira-Tao subjects (Table 4). For Ebira-Etuno subjects, a significant correlation was seen between SBP and left hand DAT and ADT angles and also between DBP and right hand ADT angle (Table 7). There was no significant correlation in Ebira-Koto subjects (Table 10).

Table 4: Correlation matrix of blood pressure and triradii angles in Ebira-Tao subjects

	SBP	DBP	R-atd	R-dat	R-adt	L-atd	L-dat	L-adt
SBP	-							
DBP	0.30**	-						
R-atd	0.17*	0.01	-					
R-dat	-0.12	0.07	-0.55**	-				
R-adt	-0.01	-0.13	-0.33**	-0.42**	-			
L-atd	0.07	0.01	0.59**	-0.39**	-0.14*	-		
L-dat	-0.04	0.03	-0.43**	0.62**	-0.22**	-0.54**	-	
L-adt	-0.11	-0.16*	-0.26**	-0.19**	0.36**	-0.27**	-0.31**	-

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
SBP= Systolic blood pressure, DBP= Diastolic blood pressure, R-atd, R-dat and R-adt= Right triradii angles, L-atd, L-dat and L-adt= Left triradii angles.

Table 7: Correlation matrix for blood pressure and triradii angles in Ebira-Etuno subject

	SBP	DBP	R-atd	R-dat	R-adt	L-atd	L-dat	L-adt
SBP	-							
DBP	0.49**	-						
R-atd	0.08	0.04	-					
R-dat	-0.019	0.10	-0.56**	-				
R-adt	-0.05	-0.22**	-0.27**	-0.42**	-			
L-atd	0.01	-0.01	0.66**	-0.40**	-0.16*	-		
L-dat	0.18*	0.08	-0.42**	0.56**	-0.27**	-0.65**	-	
L-adt	-0.20**	-0.09	-0.24**	-0.20**	0.38**	-0.39**	-0.34**	-

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
SBP= Systolic blood pressure, DBP= Diastolic blood pressure, R-atd, R-dat and R-adt= Right triradii angles, L-atd, L-dat and L-adt= Left triradii angles.

Table 10: Correlation matrix of blood pressure and triradii angles in Ebira-koto subjects

	SBP	DBP	R-atd	R-dat	R-adt	L-atd	L-dat	L-adt
SBP	-							
DBP	0.57**	-						
R-atd	0.08	0.07	-					
R-dat	-0.12	-0.03	-0.58**	-				
R-adt	0.06	0.01	-0.37**	-0.38**	-			
L-atd	0.01	0.03	0.74**	-0.46**	-0.28**	-		
L-dat	-0.07	-0.04	-0.51**	0.65**	-0.20**	-0.67**	-	
L-adt	0.06	0.06	-0.26**	-0.18**	0.53**	-0.36**	-0.35**	-

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
SBP= Systolic blood pressure, DBP= Diastolic blood pressure, R-atd, R-dat and R-adt= Right triradii angles, L-atd, L-dat and L-adt= Left triradii angles.

DISCUSSION

The triradii angles of both hands were investigated in the subjects. The triradii angles investigated were triradii ATD, DAT and ADT angles. From the study, findings showed that the mean values for the three tri-radii angles in the studied Ebira groups were all less than 90^o (acute angle). The works of Khairnar *et al.* (2012), Navgire & Meshram (2013) and Chaudhari *et al.* (2015) have all reported mean tri-radii angles value of similar range.

The blood pressure study of the three Ebira groups revealed mean systolic and diastolic readings within the normal physiologic range. Categorization of the participants' readings into low, normal and high SBP and DBP revealed a higher proportion of the population within the normal SBP and DBP groups which is the expected outcome for any given healthy population. Ebira-Etuno and Ebira-Tao had more participants in the high SBP and DBP categories. Conversely, Ebira-Koto had more participants in the low than in the high SBP and DBP categories. This observed trend could indicate that Ebira-Tao and Ebira-Etuno have similar traits for their blood pressure reading.

Systolic blood pressure and diastolic blood pressure of the subjects were investigated and the result was compared to the values of the tri-radii angles to observe if any relationship exists. Findings revealed mean value of tri-radii ATD angle which increases as the systolic blood pressure increased from low to high SBP category for Ebira-Tao subjects but a higher mean value of triradii ATD angle was observed in the low DBP category for Ebira-Tao subjects. In the Ebira-Etuno subjects, triradii ATD angle increases for both SBP and DBP from the low category to the high SBP and DBP categories. These findings revealed an increased value of tri-radii ATD angle among subjects with high blood pressure though it was not statistically significant. The findings observed in the Ebira-Koto subjects are in contrast to the above findings of Ebira-tao and Etuno as the highest mean value of tri-adii ATD angle was recorded among the normal SBP and DBP categories. Dike *et al.* (2012) had earlier reported an increased value of triradii ATD angle among subjects with high blood pressure. Akhtar *et al.* (2020) also reported higher ATD angles in subjects with prehypertention and hypertension grade I. This observed difference among the studied population could be due to differences in the physical activities of the subjects and lifestyles. Physical activities and lifestyle of individuals have been implicated among factors that determine the blood pressure of individuals. In contrast to our findings, the work of Deepa (2013), Devi & Mahalinga (2016) and Ahmed & Pimpalkar (2017) reported lower ATD angles in hypertensive subject when compared to the control.

Tri-radii angle DAT in Ebira-koto subjects was highest in the low SBP and DBP categories with a significant ($p< 0.05$) difference observed in the DBP result of the left hand. Tri-radii ADT angle was observed to increase from low to high SBP and DBP categories in both hands with a significant ($p< 0.05$) difference observed in the SBP of the right hand.

Tri-radii DAT angle for Ebira-Etuno subjects increased from low to high SBP category with however close values observed in the normal and high SBP category with normal being slightly higher. This result was however significant ($p< 0.05$) in the right hand. For DBP, tri-radii DAT is observed to increase from low to high DBP category however not statistically significant ($p> 0.05$). Tri-radii ADT showed the highest mean values in the low SBP category with statistical significance difference ($p< 0.05$) observed in the left and right hand of the subjects. In Ebira-Tao subjects, tri-radii DAT angle increased from low to high SBP and DBP categories with however close values observed in the normal and high SBP categories with normal being slightly higher (though not statistically significant). Tri-radii ADT showed the highest mean values in the low SBP and DBP categories.

The mean DAT and ADT angles as they relate to the SBP and DBP categories were different for the three studied dialects and this explains why researchers seldom use these two dermatoglyphic traits compared to the use of ATD angle. However, the observed mean values for tri-radii DAT and ADT angles in this study were in line with the mean values reported by Ujaddughe *et al.* (2015) among the Esan ethnic group of Edo state, Nigeria and Adenowo & Dare (2016).

The significant correlation observed using the correlation matrix among Ebira-Tao and Ebira-Etuno subjects indicated that there is some level of relationship between triradii angles and blood pressure. This further supports the shared closeness and similarity of these two Ebira groups which was also reported by Yusuf *et al.* (2020).

CONCLUSION

From the present study, the triradii angles and blood pressure of the selected Ebira dialects were determined and they followed similar patterns for the three Ebira dialects (Ebira-Etuno, Ebira-Tao and Ebira-Koto) with more similarities noted among Ebira-Tao and Ebira-Etuno subjects. There was a significant relationship between blood pressure and some triradii angles in two out of the three dialects. Hence, triradii angles may be an indicator for individuals with the tendency to develop high blood pressure.

Conflicts of interest

The authors declared that there is no known conflict of interest

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