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ABSTRACT

The study was designed to determine sexual dimorphism among Ebira Ethnic group living in Okene, Kogi state using palm print pattern classification, ATD angle, and ridge density. A total of four hundred subjects (200 males and 200 females) participated in the study. Palm prints were collected using an HP Scanner (Scanjet 300). Chi-square and Pearson correlation were used in analyzing the data and statistical significance was set at $p \leq 0.05$. The result of this study showed that the predominant palmprint patterns in males and females were category 5 and category 4 respectively. ATD angle for females was greater than that of the males which showed that ATD angle is sexually dimorphic among Ebira ethnic group while ridge density on the other hand showed no relationship with sex. In conclusion, it is established that palm print classification and

ATD angle can be used to determine sex among Ebira ethnic group which will enhance personality identification.

Keywords: *Sexual dimorphism, Ebira Ethnic group, Palm prints, Pattern classification, ATD angle, Ridge density, Sex determination.*

INTRODUCTION:

Biometric is the automatic recognition of human through their unique physiological and behavioral attributes or characteristics. There are different types of physiological attributes which are; fingerprints, face and iris, hand geometry, and palm print (Unar *et al.*,2014). Biometrics is the science of measuring human characteristics for the purpose of authenticating or identifying of individual based on specific physiological or behavioral characteristics (Krishneswari and Arumugam, 2010). A palm is the inner surface of the hand between the wrist and fingers. A palm print is defined as prints on the palm, which are mainly composed of the palm lines and ridges. A palm print, as a relatively new biometric feature, has severe advantages compared with other currently available features: palm prints contain more information than fingerprints (Zhang *et al.*,2004). Palm print image consists of much discriminative information such as ridges and palm lines, which ensures recognition accuracy (Zhong *et al.*,2018).

Dermatoglyphics is a scientific study that deals with the epidermal ridges and certain configurations on certain body parts such as fingers, palms, and soles that comes as a branch of Anthropometry; the measurement of the individual. Thus, dermatoglyphics can also be referred to as palmer anthropometry which refers to the measurement of palmprints, other epidermal patterns on the palm, and fingerprints of an individual. Dermatoglyphics, once matured, remain unchanged throughout a person's life and are not influenced by either the environment or age-related factors (Rawat *et al*.,2020). Palm print's main features contain ridges, wrinkles, principle lines, valleys, minutiae, and creases. The area of palm prints is larger when compared to fingerprints and also palm prints contain more distinctive information. Palm prints contain a large amount of information when compared to palm hand geometry and fingerprints. Its features vary over time and can be captured with a low-resolution device (Gayathri and Ramamoorthy, 2012).

The importance of human identification as a measure to counter theft and criminality around the world cannot be over-emphasized. This study, however, shows the significance of dermatoglyphics and its importance to crime management, and control. These data are limited to

the African population particularly the Ebira ethnic group living in Kogi state, Nigeria. This study is time-consuming and also important because it provides information that states the interpretation of imprints on the palm of the Ebira ethnic group which can serve as building blocks for further research in the presentative population of Ebira ethnic group.

This study aims to determine sex among Ebira ethnic group living in Okene Kogi using the knowledge of dermatoglyphics. This study is important because it shows how the unique imprints on the hand can help identify individuals in Ebira ethnic group. It has the potential to significantly enhance identity recognition, classification, and contribute to the fight against crime and unlawful activities. Furthermore, this study aims to: identify the predominant palmprint pattern among the Ebira ethnic group, to evaluate the relationship of ATD angle between males and females. To also determine sexual dimorphism using the number of ridge counts found among the Ebira ethnic group and to evaluate the relationship of ridge density between males and females living in Okene, Kogi state.

MATERIALS AND METHODS:

The research took place in Kogi among Ebira ethnic group living in Okene. The study was conducted on people who are of Ebira ethnicity by either parent traced to second generation. A sample size of four hundred people (400) composed of 200 males and 200 females was obtained from the population of individuals above the age of 18 and not more than 65 years of age within Okene, Kogi state, Nigeria. A simple Random Sampling method was carried out. The instrument used in measuring palmprints in this study was the LaserJet HP scanner, Protractor, Tracker Physics 6.1.2 desktop application. Informed consent forms and questionnaires for this study were given to the selected individuals who in turn gave their consent for the research process.

For the palmar dermatoglyphics, the subjects were instructed to place the palmar surface of their hands (palm) in a flattened position as possible on the scanning surface of the LaserJet Hp scanner so as to get clear, vivid, and maximum imprints of the impressions on their palms, of which the LaserJet HP scanner has been checked to ensure optimum efficiency.

The ATD Angle is formed by drawing lines connecting the a-triradius (present below the index finger), the t-axial triradius (present near the wrist), and the d-triradius (present below the little finger) points on the palm. The ATD Angle was gotten using the Tracker Physics 6.1.2 desktop application. The tracker physics version 6.1.2 desktop application was calibrated to a measurement of 100m (in-built ruler) to 10cm (real-time ruler) i.e. 10cm real time is 100m on the

tracker application. The process also required the need to employ the in-built protractor to measure the angle formed after connecting the a-triradius and d-triradius with the t-axial triradius.

To measure the ridge density, a 5 mm × 5 mm square was drawn on a print sample in the well-defined areas to be analyzed. The epidermal ridges were counted with the help of a magnifying glass. The ridge count was carried out diagonally, according to the method described by (Acree, 1999). This count represents the number of ridges in 25 mm square area and reflects the ridge density value. The ridge density was obtained individually from the designated areas on the palm prints. The areas of the palmprint analyzed in the study and the orientation of the 5 mm × 5 mm square during the analysis of ridge density are shown in Fig.1 While P2, P3, and P4 areas are relatively well-defined and fixed to the respective triradii, P1 area is not related to any fixed landmark. The designated areas on the palmprint that were analyzed for the palmprint ridge density are:

P1 – The central prominent part of the thenar eminence.

P2 – The mount distal to the axial triradius on the hypothenar region.

P3 – The mount proximal to the triradius of the second digit.

P4 – The mount proximal to the triradius of the fifth digit (Kanchan *et al.*,2014).

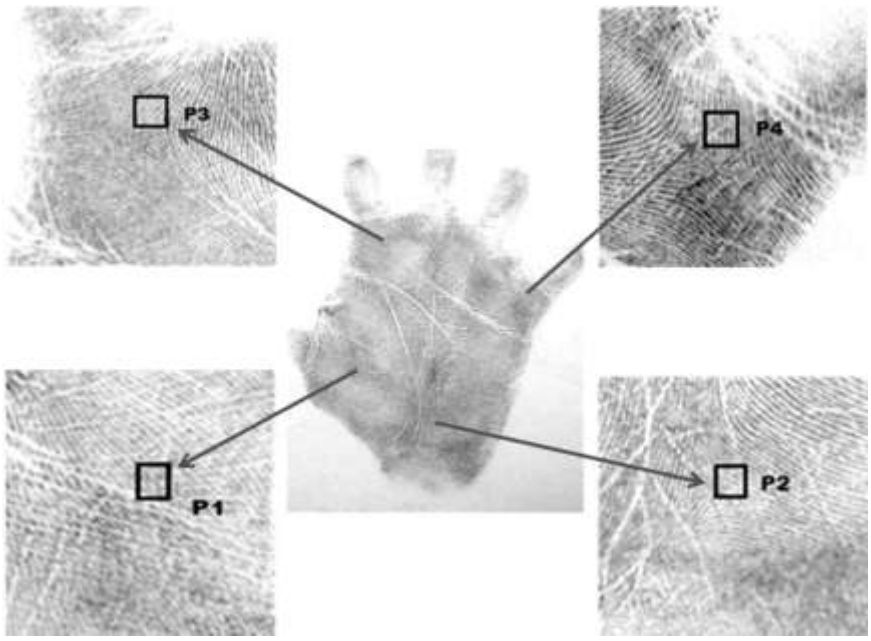

Fig 1. *Four designated areas on the palmprint that were analyzed for the palmprint ridge density (Kanchan et al.,2014).*

Statistical Analysis: The analysis of the data was presented in tables and graphs, and the variables were in categorical forms, presented as frequency (percentages). Using Chi-square for the test of relationship and T-test for test of association, a model of the relationship between palm print and fingerprint were described. Statistical significance was considered when (P=0.05 or P≤ 0.05).

Ethical Approval: This study was conducted in line with the ethical requirements of the Research Ethical Committee for human experimentation of the University of Ilorin, Nigeria and this was approved with the ethical approval number: UERC/ASN/2024/2759.

RESULTS:

Table 1: *Descriptive statistics of Distribution of the studied population by LGAs stratified by sex.*

LOCAL GOVERNMENT AREA	SEX		
	MALES	FEMALES	Total
Okehi	63(15.8%)	38(9.5%)	101(25.3%)
Adavi	58(14.5%)	87(21.8%)	145(36.3%)
Ajaokuta	6(1.5%)	5(1.3%)	11(2.8%)
Eganyi	2(0.5%)	0%	2(0.5%)
Okene	70(17.5%)	67(16.8%)	137(34.3%)
Ogori	1(0.3%)	1(0.3%)	2(0.5%)
Akoko	0%	1(0.5%)	1(0.3%)
Lokoja	0%	1(0.5%)	1(0.3%)
Total	200(50%)	200(50%)	400(100%)

The above table shows the descriptive statistics of the distribution of the studied individual participation by LGAs stratified by sex using chi-square. The table shows that 15.8% males and 9.5% females were from Okehi L.G.A, 14.5% males and 21.8% females were from Adavi, 1.5% males and 1.3% females were from Ajaokuta, 0.5% males and no females were from Eganyi

L.G.A, 17.5% males and 16.8% females were from Okene L.G.A, 0.3% males and 0.3% females were from Ogori L.G.A, no males and 0.5% females were from Akoko L.G.A and no males and 0.5% females were from Lokoja.

Table 2: *Descriptive statistics of palm print patterns and test of the relationship between male and female palm print patterns on the right hand using chi-square.*

PALMPRINT PATTERN	**SEX**		
	MALES	**FEMALES**	**TOTAL**
CATEGORY 1	0	0	0
CATEGORY 2	10(2.5%)	13(3.3%)	23(5.8%)
CATEGORY 3	0	3(0.8%)	3(0.8%)
CATEGORY 4	80(20.0%)	102(25.5%)	182(45.5%)
CATEGORY 5	109(27.3%)	79(19.8%)	188(47%)
CATEGORY 6	1(0.3%)	3(0.8%)	4(1.0%)
TOTAL	200(50%)	200(50%)	400(100%)

The above table, shows the descriptive statistics of palm print patterns and test of relationship between male and female palm print patterns on the right hand using chi square. The table show that there was no palmprint pattern with category 1, 2.5% males and 3.3% females have category 2, no males and 0.8% females have category 3, 20. 0% males and 25.5% females have category 4, 27.3% males and 19.8% females have category 5, 0.3% males and 0.8% females have category 6. The table shows the predominant palm print pattern on the right hand among the Ebira ethnic group is category 5 for males and category 4 for females.

Table 3: *Descriptive statistics of palm print patterns and test of the relationship between male and female palm print patterns on the left hand.*

PALMPRINT PATTERN	**SEX**		
	MALES	**FEMALES**	**TOTAL**
CATEGORY 1	0	0	0
CATEGORY 2	7(1.8%)	11(2.8%)	18(4.5%)
CATEGORY 3	1(0.3%)	0	1(0.3%)
CATEGORY 4	91(22.8%)	92(23.0%)	183(45.8%)
CATEGORY 5	98(24.5%)	95(23.8%)	193(48.3%)
CATEGORY 6	3(0.8%)	2(0.5%)	5(1.3%)
TOTAL	200(50%)	200(50%)	400(100%)

The above table, shows the descriptive statistics of palm print patterns and test of relationship between male and female palm print patterns on the left hand using chi square. The table show that there was no category 1 in both males and females, 1.8% males and 2.8% females have category 2, 0.3% males and no females have category 3, 22.8% males and 23.0% females have category 4, 24.5% males and 23.8% females have category 5, 0.8% males and 0.5% females have category 6. The tables shows that the predominant palm print pattern on the left hand among the Ebira ethnic group is category 5 for males and category 4 for females.

Fig 2 *Palm print pattern category 4 (Xiangqian et al.,2004).*

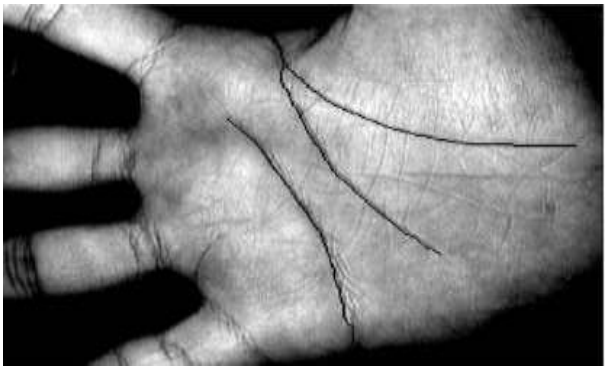

Fig 3 *Palm Print pattern category 5 (Xiangqian et al.,2004).*

Table 4: *Descriptive statistics of ATD angle and test of association with sex.*

Variables	Male			Females			T-Test		
	Mean±S.D	**Min**	**Max**	**Mean±S.D**	**Min**	**Max**	**t-test value**	**p-value**	**Inf.**
Atd Angle	38.27±4.23	31.50	56.60	41.11±4.56	31.30	54.40	-6.438	**<0.001**	**S**

Note: *S.D= Standard deviation, Inf= inference, S=Significant*

The table above shows that the mean difference was examined based on gender to see if there is any significant differences in the ATD angles. There was positive significant value p<0.001 in the ATD angle. The mean S.D of males were 38.27±4.23 and that of the females were 41.11±4.56.

Table 5: *Chi-square analysis to determine sexual dimorphism using mean ridge count among Ebira Ethnic group.*

Value	df	Significant value		Inf.
Pearson Chi- square	71.911[a]	5	**<0.001**	**S**
Likelihood Ratio	78.089	5	<0.001	
Linear-by-Linear Association	61.415	1	<0.001	
Number of Valid cases	**400**			

Note: Df= Degree of freedom, Value= Chi-square, Inf= Inference, S= Significant

In the table above, ridge count shows a positive correlation(p<0.001) with sexual dimorphism which means that ridge count can be used in the determination of the sex of an individual in Ebira ethnic group.

Table 6: *Descriptive statistics of Ridge Density and test of relationship with sex*.

Variable	SEX		
	R	**Significant value**	**Inf.**
RIDGE DENSITY	-0.052	0.302	N

Note: R= Pearson correlation, Sig.= Significant value, Inf= Inference, NS= Not Significant N= number of cases

In the table above, there is no correlation between the ridge density and the test of relationship with sex (p=0.302). In other words, ridge density cannot determine the sex of an individual in Ebira ethnic group.

DISCUSSION:

Dermatoglyphics as a study has been carried out by many researchers, the study has proven to be useful in the field of human identification as well as forensic science. This research showed that the predominant palmprint patterns for both males and females are category 5 and category 4 respectively. According to Reckha *et al*.(2015), whose study was conducted to find out the heritability and correlation of palmprints in the South Kerala population was concluded that the predominant palmprint classification in the entire study population was Category 5 for both males and females. This is also similar to the work of Xiangqian *et al*. (2004), whose work was based on palmprint classification using principle lines conducted in Hong Kong, China. The statistical results showed that the predominant palm print classification in the population was Category 5. This study correlates to this research among Ebira ethnic group as the predominant palm print pattern was also category 5 for just the males. It is established that there is no similarity of palm prints from one individual to another individual and between males and females.

The result of this research showed that the mean value of the ATD angle in females is significantly higher than that of males in Ebira ethnic group. These values are similar to the work of Ujaddughe (2015), whose study was based on the assessment of dermatoglyphic patterns and sex distribution in the Esan ethnic group of Edo state, Nigeria, the research found that the mean ATD angle value were 43.49 for males and 44.02 for females. With reference to the work of Ujaddughe (2015),

whose work also showed a level of significance in ATD angle among the males and females of Edo state. The result of this research is however, similar to the work of Badiye *et al*. (2019), whose research was on sex determination using palmar tri-radii among the central Indian population. Badiye's work suggested that there is a level of significant relationship in the ATD angle between males and females. This research, however, suggested that statistically there is a level of significant difference in the ATD angle between males and females of Ebira ethnic group living in Okene, Kogi state.

This research showed that the mean ridge density shows no correlation with sex determination. According to Kanchan *et al.* (2012), whose work was based on sex differences from ridge density in Mangalore, India population. Kanchan's study involved 131 participants (73 males and 58 females) which revealed that significant gender differences occur in the ridge density. Palmprint mean ridge density 11/25mm² or less is found to be in males and a mean of 12/25mm² is more likely in females on both right and left hands (Kanchan *et al.*,2012). This is also similar to the work of Tanuj *et al.* (2014), whose work focused on sex determination using palm print ridge density. A higher palm print ridge density is observed in females than in males in all areas except for the P3 area in the right hand (Tanuj *et al*., 2014). Ridge thickness and furrows are the two main factors that determine the density of ridges. (Cummins and Midlo, 1926). This research, however, showed that the ridge density can not determine sex in Ebira ethnic group, Okene, Kogi state.

CONCLUSION:

This present study was conducted to find out the sexual differences using palmprint classifications, ATD angle, and ridge density among adults of Ebira ethnic group living in Okene, Kogi State. The predominant palm print pattern in the entire study population was Category 5 in both the left and right palm. This study has also shown that there is a strong level of significance on the palm print pattern and ATD angle on the right and left palms of males and females and of the Ebira ethnic group living in Okene, Kogi state. The other level of insignificance, however, established the ground that ridge density cannot serve as a means of sex identification.

In conclusion, dermatoglyphics is truly at the forefront of scientific exploration, and it holds incredible potential across various domains. This research contributes to our understanding of

human characteristics and potentially impact areas like forensics, genetics, and even personal identification.

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