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VARIATION IN THUMBPRINT PATTERNS AND RIDGE DENSITY COUNTS BETWEEN TWO MAJOR ETHNIC GROUPS IN NIGERIA

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ABSTRACT

The uniqueness of fingerprints makes it a valued biometric trait and since the prints are regularly seen physical evidence in many crime scenes, forensic investigators employ them for sexual and ethnic differentiations when solving criminal cases. This study was an attempt to discriminate sex and ethnicity using thumbprint patterns and ridge density counts between Igbo and Efik tribes of Nigeria. The sample size for this study includes 173 adults (Efik = 37 males, 44 females) and (Igbos = 61 males, 31 females), randomly selected between the ages of 18-40 years. The subjects were asked to wash and dry their hands to remove dirt and grease. The fingers (thumbs) of both hands were smeared with indelible ink and pressed in a white plane paper. Using meter rule, 25mm^2 each was measured from radial border, ulnar border, and inferior quadrants respectively for fingerprint ridge density count. This data was analyzed using SPSS Software version 21 Chicago Incorporated. The results of this study showed that both the males and females of Igbo origin have predominantly loop fingerprint pattern, at the male to female ratio of 43% and 55% respectively. In the contrary, the male and female of Efik ethnic group recorded more whorl print pattern at the ratio of 54% and 50% respectively. More so, this results recorded sexual dimorphism ($P<0.05$) in the various ridge density count across the two ethnic groups, even the ethnic comparison of both males to males and females to females, recorded statistical significant difference ($P<0.05$) between the Igbos and Efiks. Hence, the Igbos, irrespective of sex showed more loop fingerprint pattern, contrary to the whorl fingerprint pattern more frequent amongst the Efiks.Thus, the present results will be of immense relevance in forensic practice by unveiling the peculiarities of finger ridge density associated with gender and ethnic origin.

Key Words: Thumbprints, Ridge count, Variation, Ethnicity

INTRODUCTION

Dermatoglyphic studies are very essential in medical practice as well as in forensic investigations, especially in medical diagnosis of genetically inherited diseases and in crime detection (Ekanem et al. 2009; Sudikahya et al. 2017). Fingers are generally known to display friction ridge in skin that consist of a series of furrows and ridges called fingerprint (Babler, 1991; Loesch, and Czyzewska, 2011). Fingerprint is an impression left by the friction ridges of a human finger. This is one of the dermatoglyphic traits that can be used for identification of a person. These prints are unique in each individual even in identical twins (Saladin and Miller, 2008).

Friction ridge can be differentiated from the skin of the rest of the body by the presence of raised ridges, the surface is continuously corrugated with narrow minute (friction ridges) ridges and there are neither hairs nor sebaceous (oil) gland. The presence of friction ridges enhances friction for skin used in grasping (Bonnevie, 1924). Also, it has been used to analyze the nature and origin of human variability extensively in bioanthropology, genetics, and evolutionary studies to characterize population (Cummins, 2009). Few areas of dermatoglyphics such as pattern type and ridge count, have received more attention than pattern intensity index (Karmakar et al. 2008).

However, fingerprints are easily deposited on suitable surfaces (such as glass or metal or polished stone) by the natural secretions of sweat from the eccrine glands that are present in epidermal ridges (Ashbaugh,

2008). Deliberate impressions of fingerprints may be formed by ink or other substances transferred from the peaks of friction ridges on the skin to a relatively smooth surface such as a fingerprint card (Ahmed and Osman, 2016).Human fingerprints are detailed, nearly unique, difficult to alter, and durable over the life of an individual, making them suitable as long-term markers of human identity (Huynh et al. 2015). Fingerprints of an individual have been used as one of the vital parts of identification in both civil and criminal cases because of their unique properties of absolute identity, they have the patterns constituted by the ridges on the surface of fingers and it is peculiar to each person and remains stable for a lifetime **(Nandy, 2009)**. These patterns, types, and various specific characteristics have been utilized worldwide for personal identification (Soanboon et al. 2015).

(Fingerprints are permanent morphological characteristics, and criminal detection based on fingerprints is based on the principle that no two people can have identical fingerprints (Oktem et al. 2015).

The recovery of fingerprints from a crime scene is an important method of forensic science (Åström, 2007). It is also one of the suitable and reliable methods for personal identification and verification and fingerprint do not change from birth to death (Ceyhan et al. 2017). They have a great importance in scientific, criminological, biological and anthropological studies, and are used to properly identify any person or suspect who touches any surface in the crime scene. They are also considered as biometric variables that show manifold utilities in human biology, human morphology, anthropology, and genetics (Ahmed and Osman, 2016).Fingerprint ridge density (FRD) is known to vary according to sex and population, and such variation can be used for forensic purposes (Rivalder et al. 2016).

In biometrics and forensic sciences, minutiae are the major features of a fingerprint and it is made up of the following features: ridge ending, bifurcation and shorter ridge (dot). The ridge ending is a point at which a ridge terminates. Bifurcations are points at which a single ridge split into two ridges. Short ridges (dot) are ridges which are significantly shorter than the average ridge length on the fingerprint. Minutiae and patterns are very important in the analysis of fingerprint since no two fingerprints have been shown to be identical (Sudesh, 2007). The importance of fingerprint had let to its wide application in the field of forensic sciences, medicine, biological anthropology, ethnology and population genetics for their capabilities to identify racial, ethnic and gender differences as well as congenital malformations (Sudikshya et al. 2018).

If a fingerprint is encountered as evidence, matching of minutiae is the secondary task, the primary task being the classification of the pattern present on the print, which can thereafter be used for narrowing down the suspect from the pool by discriminating the different patterns of prints taken from the crime scene, thereby reducing the burden on the investigating officer (Nandy, 2009).

The distribution of fingerprints pattern has been found to vary amongst various populations and ethnic groups in Nigeria and across the globe (Henry, 2009). Hence, this knowledge becomes crucial in forensic investigations. The relationship between the finger ridge density of the Igbo and Efik ethnic groups of Nigeria, have not been ascertained. This study is an attempt to decipher both sex and ethnic discrepancies between the two tribes.

MATERIALS AND METHOD

Study Location

This study cohort includes 173 subjects drawn from the five Efik speaking Local Government Areas of Southern Cross River State (Akpabuyo, Bakassi, Calabar Municipality, Calabar South and Odukpani) and the five Igbo States (Enugu, Anambra States, Abia, Imo and Ebonyi States)in south eastern Niger ethnic groups of Nigeria (Efik=37 males, 44=females) and (Igbos=61 males, 31 females). The subjects were randomly selected between the ages of 18-40years, whose parents are of the aforementioned ethnic groups, void of

congenital or acquired fingerprint ridge deformities. The overall aim and possible benefits of the study was properly explained to the subjects and subjects consent was taken. They were asked to wash and dry their hands to remove dirt and grease before their fingerprint was taken in the well prepared study proforma.

The materials used for this study includes; Kores quick drying duplicating ink, removable ink. Pencil: To map out various Quadrants, Study proforma containing each subject's demography, Meter rule: to measure $25mm^2$ quadrants, a hand magnifying lens, hand sanitizers: use clean dirt, Plain Sheets of papers, thumb tags: to hold the paper firm on the board, white board: Base for the white paper, Methylated Spirit: Solvent to remove the ink after data collection, cotton wool, towel and Water.

Fingerprint Collection

The subjects were asked to wash and dry their hands with hand wash sanitizers to remove dirt and grease.

Thumbprint Protocol: According the protocol earlier established by Ahmed and Osman in 2016, the subjects were asked to sit on a chair and each finger starting from the thumb, index finger, middle finger, ring finger, and the little finger was cleaned with a hand sanitizer and uniformly smeared with indelible ink and endorsed on the box provided on the proforma for each digit. The procedure was repeated for the 10 fingers of the left and right hands but for the purpose of this study, it was limited to only the left and right thumbprints. After taking thumbprints, with the aid of a sharp pencil, a straight line is drawn in the upper portion of the radial and ulna borders of each print to measure radial and ulna quadrants while the inferior quadrant was taken by making a 25mm diagonal across the inferior border to measure the inferior quadrant of the fingerprint (figure 1).

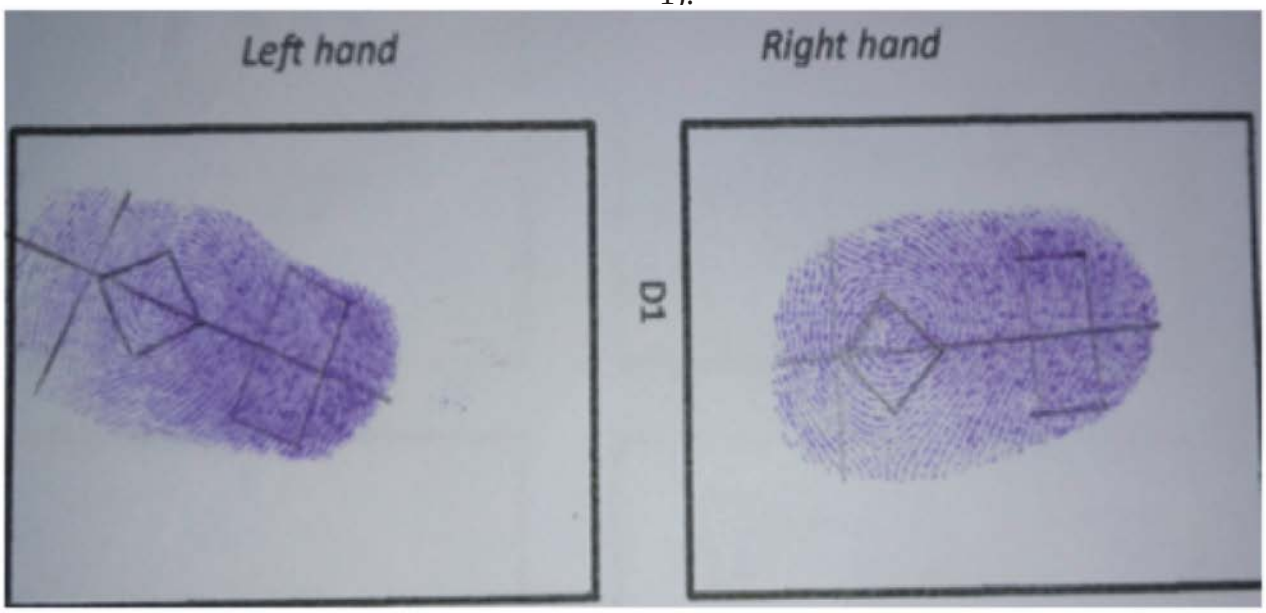

Figure 1: Showing left and right thumbprint data collection procedure protocol according to Ahmed and Osman (2016).

Statistical Analysis

The data gotten from fingerprint were entered into Microsoft word Excel spread sheet, which were copied into the Statistical Package for Social Sciences (SPSS) software version 21 Chicago incorporated for analysis. Three basic analysis were done in this research which include; Chi-square was employed for the analysis of frequency distribution of fingerprint pattern and presented in tables and pie charts. The mean, minimum, maximum and range of the dataset as well standard deviation of mean and standard error were analyzed using descriptive statistics. Independent sample student's t- tests to ascertain sexual dimorphism (differences between the males and females) in fingerprint patterns. Levene's test for equality of variance and means was used to compare the

subjects of the two ethnic groups (Ethnic variation) that's between the Igbo males and Efik males as well as between Igbo females and their Efik counterparts.

RESULTS

The results of the present study are presented in tables, pie charts and Bar chart to show the outcome of descriptive statistics, frequency distribution among the print patterns and finger ridge density, sex variation and ethnic differences in print pattern using Levene's analysis of equality of variance.

Table 1: Gender wise distribution of print patterns in Igbo Ethnic group of Nigeria

Fingerprints pattern	Males		Females	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Loop	**26**	**43.0**	**17**	**55.0**
Whorl	**21**	**34.0**	**8**	**26.0**
Arch	**10**	**16.0**	**6**	**19.0**
Composite	**4**	**7.0**	**0**	**0.0**
Total	**61**	**100**	**31**	**100**

Table 1 presents the results of gender wise frequency distribution of print pattern among the Igbos. It can be observed that both male and female of this ethnic decent had predominantly Loop print pattern with a male to female ratio of 43:55% respectively. While the arch and composite prints had lowest percentages of occurrence. Thus, it was observed that both male and female Igbos possess mainly the Loop fingerprint pattern.

Table 2: Gender wise distribution of print patterns in Efik Ethnic group of Nigeria

Fingerprints pattern	Males		Females	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Loop	**10**	**27.0**	**15**	**34.0**
Whorl	**30**	**54.0**	**22**	**50.0**
Arch	**5**	**14.0**	**6.0**	**14.0**
Composite	**2**	**5.0**	**1.0**	**2.0**
Total	**37**	**100**	**44**	**100**

The results of table 2 showed that both Efik males and female have predominantly whorl print pattern with the highest percentage of 54 and 50 in males and females respectively. While the arch and composite print patterns had the least frequency print pattern. From the analysis of the frequency distribution, it is obvious that the Efik ethnic decent have abundant of Whorl print pattern (54% and 50%) in male and female respectively.

Table 4 presents the results of descriptive statistics by quadrant of male Igbo ethnic group, which shows the total number of male Igbos who participated in the exercise, the minimum and maximum values of the ridge count, the average value of ridge count, Standard error of mean and standard error of estimate.

Table 5: Descriptive statistics of ridge density (Ridges/25mm^2) Quadrant wise among Males Efik

	N	Range	Minimum	Maximum	Mean		S. D
	Statistic	Statistic	Statistic	Statistic	Statistic	SEM	Statistic
RRQRD	37	5	7	12	9.11	0.18	1.051
RUQRD	37	4	7	11	9.20	0.19	1.132
RIQRD	37	4	7	11	9.31	0.19	1.132
R_TOTAL	37	10	21	31	27.63	0.40	2.365
LRQRD	37	7	7	14	9.59	0.28	1.654
LUQRD	37	6	6	12	9.38	0.24	1.371
LIQRD	37	5	7	12	9.66	0.18	1.035
L_TOTAL	37	12	23	35	28.41	0.49	2.804

LIQRD, Left Inferior Quadrant Ridge Density; LRQRD, Left Radial Quadrant Ridge Density; LUQRD Left Ulnar Quadrant Ridge Density; RIQRD, Right Inferior Quadrant Ridge Density; RRQRD, Right Radial Quadrant Ridge Density; RUQRD, Right Ulnar Quadrant Ridge Density; S.D., Standard Deviation, Standard Error of Mean.

Table 5 shows the results of descriptive statistics by quadrant of male Efik ethnic group, which shows the total number of male Efiks who participated in the exercise, the minimum and maximum values of the ridge count, the average value of ridge count, Standard error of mean and standard error of estimate.

Table 6: Descriptive statistics of ridge density (Ridges/25mm^2) Quadrant wise among Females Efik

	N	Range	Minimum	Maximum	Mean		S. D
	Statistic	Statistic	Statistic	Statistic	Statistic	SEM	Statistic
RRQRD	44	7	7	14	9.62	0.221	1.482
RUQRD	44	6	8	14	9.60	0.207	1.388
RIQRD	44	7	5	12	8.93	0.230	1.543
R_TOTAL	44	18	22	40	28.16	0.523	3.509
LRQRD	44	7	8	15	10.78	0.224	1.506
LUQRD	44	8	7	15	10.07	0.221	1.483
LIQRD	44	5	7	12	9.17	0.193	1.248
L_TOTAL	44	17	24	41	30.05	0.536	3.471

LIQRD, Left Inferior Quadrant Ridge Density; LRQRD, Left Radial Quadrant Ridge Density; LUQRD, Left Ulnar Quadrant Ridge Density; RIQRD, Right Inferior Quadrant Ridge Density; RRQRD, Right Radial Quadrant Ridge Density; RUQRD, Right Ulnar Quadrant Ridge Density; S.D., Standard Deviation, SEM = Standard Error of Mean

Table 6 presents the results of descriptive statistics by quadrant of the female Efik ethnic group, which shows the total number of the female Efiks who participated in the exercise, the minimum and maximum values of the ridge count, the average value of ridge count, Standard error of mean and standard error of estimate.

Table 7: Showing results of Levene's Test for sexual dimorphism in finger ridge density of Igbo ethnic group

QUADRANT	T	Df	Sig. (2-tailed) (P-value)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
RRQRD	1.586	90	0.016	0.571	1.286	1.144
RUQRD	0.925	90	0.028	1.289	1.909	1.332
RIQRD	8.013	90	0.000	2.461	1.851	3.071
R-TOTAL	2.275	90	0.025	1.601	1.203	2.999
LRQRD	1.203	90	0.023	0.434	1.283	1.152
LUQRD	1.168	90	0.018	1.387	1.278	1.352
IQRD	8.086	90	0.000	2.508	1.891	3.124
L-TOTAL	4.454	90	0.000	3.329	1.844	4.814

Values with P<0.05 are significantly different between males and females Igbos.

The result of Levene's test for equality of variance and means of gender presented in table 7 showed that all the finger prints quadrants considered recorded statistically significant difference (P<0.05) between the males and females of Igbo ethnic group. This observation further buttress the earlier speculation that no two individuals have the same finger prints qualities. Thus, fingerprint counts have shown from this study that it is sexually dimorphic**.**

Table 8: Showing the result of Levene's Test for sexual dimorphism in finger ridge density of Efik tribe

RIDGE QUADRANTS	T	Df	Sig. (2-tailed) (P-value)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
RRQRD	1.719	79	0.00	2.508	0.296	1.096	0.080
RUQRD	1.383	79	0.010	1.800	0.289	1.976	0.176
RIQRD	1.226	79	0.022	1.781	0.311	0.238	1.000
R-TOTAL	1.763	79	0.048	1.527	0.690	1.902	0.848
LRQRD	3.332	79	0.001	2.090	0.357	1.900	0.479
LUQRD	2.097	79	0.039	1.684	0.326	1.334	0.034
LIQRD	1.797	79	0.077	1.090	0.272	1.053	1.333
L-TOTAL	2.185	79	0.032	1.641	0.751	2.139	3.144

Values with P<0.05 are significantly different between males and females Efiks.

Table 8 depicts the result of Levene's test for equality of variance and means of gender between the male and female Efiks. It has been observed that all the finger prints quadrants considered recorded statistically significant difference (P<0.05) between the males and females of Igbo ethnic group.

Table 9: Results of group Statistics of the males of Igbo and Efik ethnic groups

TRIBE		N	Mean	Std. Deviation	Std. Error Mean
RRQRD	IGBO	61	10.26	1.591	.204
	EFIK	37	9.11	1.051	.178
RUQRD	IGBO	61	10.31	1.500	.192
	EFIK	37	9.20	1.132	.191
RIQRD	IGBO	61	9.36	1.403	.180
	EFIK	37	9.31	1.132	.191
R_TOTAL	IGBO	61	29.93	3.188	.408
	EFIK	37	27.63	2.365	.400
R_AV_TOTAL	IGBO	61	9.984	1.0660	.1365
	EFIK	37	9.209	.7928	.1340
LRQRD	IGBO	61	10.93	1.662	.213
	EFIK	37	9.59	1.654	.284
LUQRD	IGBO	61	10.79	1.355	.174
	EFIK	37	9.38	1.371	.235
LIQRD	IGBO	61	9.54	1.219	.156
	EFIK	37	9.66	1.035	.183
L_TOTAL	IGBO	61	31.26	3.135	.401
	EFIK	37	28.41	2.804	.496
L_AV_TOTAL	IGBO	61	10.418	1.0476	.1341
	EFIK	37	9.466	.9362	.1655

The result of group statistics to outline the mean differences of the finger ridge count of the quadrants between the males of Igbo and Efik ethnic groups is presented in table 9. This outcome is statistically significant different (P<0.05) between the males of both ethnic groups.

Table 10: Summary of the results of Levene's Test for equality of variance and means between Igbo and Efik Males

Levene's Test for Equality of Variances			t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed) P<0.05	Mean Difference	Std. Error Difference	Lower	Upper
RRQRD	7.589	0.007	3.815	94	0.000	1.148	0.301	0.550	1.746
RUQRD	3.554	0.062	3.802	94	0.000	1.111	0.292	0.531	1.692
RIQRD	2.449	0.121	0.167	94	0.868	0.046	0.278	0.506	0.598
R-Total	2.694	0.104	3.728	94	0.000	2.306	0.619	1.078	3.534
LRQRD	0.162	0.689	3.791	94	0.000	1.346	0.355	0.641	2.051
LUQRD	0.000	0.983	4.822	94	0.000	1.405	0.291	0.826	1.983
LIQRD	1.307	0.256	-0.455	94	0.650	0.115	0.253	0.618	0.388
R-Total	0.570	0.452	4.323	94	0.000	2.856	0.661	1.544	4.168

The result of the sum total of quadrants for both left and right ridge density count showed statistical significant difference (P<0.05) between the males of Igbo and Efik decent. It is observed from this outcome that both left and right total ridge count of the males of Igbo and Efik ethnic groups showed ethnic difference (P<0.05). also it is observed that only the inferior quadrant ridge density count of both left and right prints does not show ethnic variation but others quadrant showed statistical significant difference (P<0.05). Therefore, it can be deduced from this result that ridge count density is highly ethnic specific.

Table 11-showing the result of Group Statistics of the females of Igbo and Efik ethnic groups respectively

TRIBE		N	Mean	Std. Deviation	Std. Error Mean
RRQRD	IGBO	31	10.83	1.663	.304
	EFIK	44	9.62	1.482	.221
RUQRD	IGBO	31	10.60	1.163	.212
	EFIK	44	9.60	1.388	.207
RIQRD	IGBO	31	6.90	1.322	.241
	EFIK	44	8.93	1.543	.230
R_TOTAL	IGBO	31	28.33	3.089	.564
	EFIK	44	28.16	3.509	.523
R_AV_TOTAL	IGBO	31	9.443	1.0338	.1887
	EFIK	44	9.380	1.1675	.1740
LRQRD	IGBO	31	10.50	1.526	.279
	EFIK	44	10.78	1.506	.224
LUQRD	IGBO	31	10.40	1.545	.282
	EFIK	44	10.07	1.483	.221
LIQRD	IGBO	31	7.03	1.691	.309
	EFIK	44	9.17	1.248	.193
L_TOTAL	IGBO	31	27.93	3.759	.686
	EFIK	44	30.05	3.471	.536
L_AV_TOTAL	IGBO	31	9.313	1.2572	.2295
	EFIK	44	10.024	1.1588	.1788

Table 11 depicts the outcome of group statistics which shows mean differences of the fingerprint ridge density count of the quadrants between the females of the two ethnic groups.

The analysis of independent sample t-test for ethnic variability employed here showed statistical significant difference ($P<0.05$).

Table 12: Summary of the results of Levene's Independent Test for equality of variance and means between Igbo and Efik Females

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
RRQRD	1.827	.181	3.302	73	.001	1.211	.367	.480	1.942
RUQRD	.722	.398	3.255	73	.002	1.000	.307	.388	1.612
RIQRD	.235	.630	-5.911	73	.000	-2.033	.344	-2.719	-1.348
R_TOTAL	.053	.818	.225	73	.822	.178	.789	-1.395	1.751
R_AV_TOTAL	.064	.801	.241	73	.810	.0633	.2631	-.4610	.5877
LRQRD	.037	.847	-.779	73	.439	-.278	.357	-.989	.433
LUQRD	.607	.439	.938	73	.351	.333	.355	-.375	1.042
LIQRD	3.965	.050	-6.163	70	.000	-2.133	.346	-2.824	-1.443
L_TOTAL	1.109	.296	-2.462	70	.016	-2.114	.859	-3.827	-.401
L_AV_TOTAL	1.051	.309	-2.476	70	.016	-.7105	.2870	-1.2828	-.1381

DISCUSSION

Fingerprints are the most dynamic form of evidence in existence. They are unique, permanent and objective (Ekanem et al. 2009). There are impressions left by the friction ridges of a human finger. They are one of the dermatoglyphic traits that can be used for the identification of an individual, these prints are unique in each individual even in identical twins with identical DNA have different fingerprints (Saladin and Miller, 2008). They are also said to be permanent morphological characteristics, and criminal detection based on fingerprints is based on the principle that no two people can have identical fingerprints (Okatem et al. 2015).

In the past, attempts have been made by different researchers (Wang et al. 2007; Ekanem et al. 2009; Soanoboon et al. 2015; Tamil, 2018) to study the distribution of fingerprint patterns in various populations and ethnic divide. Human fingerprints are detailed, unique, difficult to alter, and durable over the lifespan of an individual, making them suitable as long-term bio-markers of human identity (Huynh et al. 2015). Latent fingerprints are primary physical and biological evidence that investigating officers commonly collect in a crime scene and use for personal identification. The leading step is to decipher the type of fingerprint pattern and ridge density count before any further analysis is done on the prints (Gutierrez-Redomero et al. 2014).

The present research was an attempt to investigate the sex and ethnic variability of fingerprint ridge density amongst the Efik and Igbo population of Nigeria. Table 1 presents the results of gender wise frequency distribution of fingerprints pattern among the Igbos. It was

observed from these results that both male and female of the Igbo ethnic descent predominantly had Loop prints pattern with a male to female ratio of 43:55% respectively, although the female values showed higher frequency. Meanwhile the arch and composite prints had the lowest percentages of fingerprints pattern.

The results documented in table 2, outline that both the Efik males and females have predominantly whorl print pattern with the highest percentage of 54% and 50% in males and females respectively. While the arch and composite (multiple) print patterns recorded the least print pattern based on frequency distribution. From the analysis of the frequency distribution, it is obvious that the people of Efik origin have abundant of Whorl print pattern (54% and 50%) in male and female respectively. Studies on gender predictions from fingerprints have gained more popularity in the scientific and judicial fields and some researchers has said the number of ridges on the right hand are more than the number of ridges on the left hand by 20% in most people (Kimura et al. 2008; Soanoboon et al. 2015; Tamil, 2018).

The results of frequency distribution of the Efik population regardless of sex differences is presented in figure 4. It was observed that, the Efiks had more of Whorl pattern (52)% followed by loop pattern (31%) also the arch and composite prints recorded the least number of prints. This shows that the Efiks had more of whorl prints than other categories.
The result of frequency distribution of the Igbo population irrespective of gender difference is presented in figure 3, which shows that, the Igbos had more of Loop prints pattern (47%) followed by whorl pattern (32%) while the arch and composite prints recorded the least number of prints. This is a pointer that the Igbos predominantly have Loop pattern of prints which conforms to the findings of Ekanem et al. (2009) among the Annangs that recorded ulna loop50.1% and 39.6% for the males and females respectively followed by whorls 42.9% in males then arches 31.1% in the females and radial but contrary to the result of the Efiks from the present study in table 2 that recorded more Whorls print pattern with male to female ratio of 54%a and 50% respectively.

Furthermore, this current data is an evidence that indicates equality of variance and mean of gender of fingerprints quadrants across recorded statistically significant difference ($P<0.05$) between the males and females of Igbo. This observation further buttress an earlier result by Okatem et al. (2015) that said no two individuals have the same fingerprints features which is applicable to print patterns and ridge density count. Thus, fingerprint density count shown from the present study reveals sexual dimorphism ($P<0.05$) between the males and females of Igbo and Efik ethnic descent respectively.

The findings of Acree (1999), reports that the mean ridge thickness in males is more than that of the females, this is contrasting with report from Adamu et al (2016), which proves that women tends to have a greater ridge thickness than men but this findings observed that the ridge thickness in males of Efik and Igbo ethnic groups are more than that of their female counterparts which agrees with the report given by Acree (1999). Results from the present study also indicated that all fingerprints quadrants considered in male and female Efiks recorded statistically significant difference ($P<0.05$) between the Igbo males and their female counterparts, which is in tandem with the works of Acree (1999), Esperanza et al. (2008), Nayak et al. (2010) and Krishan et al. (2013) who reported that ridge count is sexual dimorphic ($P<0.01$) and fingerprint with a ridge density count of 11 ridges/25 mm2 or less is most likely to be that of a male. Likewise a ridge density of 12 ridges/25 mm2 or more is likely to be of female origin, regardless of the race, which conforms with the outcome of the present data that recorded statistical significant difference ($P<0.05$) in the ridge density of females when compared with their male counterparts. Similarly, the research of Sudesh, (2007) speculate that a finger print ridge of < 13 ridges/25 mm^2 is more likely of male origin and finger print ridge of > 14 ridges/25 mm^2 is more likely of female origin, which are not very similar with the present data.

The current result showed statistical significant difference ($P<0.05$) in ridge density count of the males of Igbo and Efik ethnic

groups when compared with their female counterparts with a male to female ratio of 43:55% and 54:50% for the Igbo and Efik tribes respectively which conforms with the report given by Gutiérrez-Redomero et al. (2013) on the males and females of Argentina and Spain. Similarly, the outcome of ethnic variability of the males of Igbo and Efik are presented in tables 9 and 10 which shows significant differences ($P<0.05$).

The findings of Gutiérrez-Redomero et al. (2013) on sexual differences in ridge density count between Argentinian and Spanish populations, showed a statistical significant difference ($P<0.05$) in the total ridge density count between the Argentine males and their Spanish counterparts. Meanwhile the female samples between the two countries did not recorded statistical significant difference ($P<05$) in the ridge density count for radial, ulnar and proximal areas. Their reports contradict the present data on the Igbos and Efik as presented in tables 11and 12 respectively, between the females of Igbo and Efik tribes which recorded statistical significant difference ($P<0.05$).

CONCLUSION

This research has proven that both the males and females of the Igbo ethnic descent possess mainly the loop fingerprint pattern, although the females recorded more loops than the males. On the contrary, the Efik people recorded predominantly whorl fingerprint pattern. The ridge count of the Efiks males and females recorded statistical significant ($P<0.05$) with consistent higher values recorded among the Efiks than their Igbo counterparts. These similarities observed in fingerprint patterns amongst the males and females of the same ethnic group could be attributed to their close ancestral affinity. More so, the variation between the two ethnic groups may be traceable to their differences in genetic and environmental factors. Thus, this knowledge will help a forensic expert whenever they are saddled with responsibilities that borders on human identification and biological profiling.

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