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Dermal Pattern Analysis Of The Ewes Of Ghana

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Abstract: ***Forensic investigations have utilized fingerprint evidence for centuries due to the uniqueness even among identical twins. The role of genes in the formation of dermal ridges has necessitated investigations into the population dermal pattern resemblance. The aim of the present study was to examine the fingerprint pattern of the Ewe population of Ghana to elucidate its forensic relevance.***

200 participants were chosen from the Ewe population for the study. The finger ridge count, total finger ridge count, pattern type and ridge density were recorded and analyzed for population characteristics. The data was then compared with the characteristics of some neighboring populations to see whether they were of forensic relevance.

The Ewes show preponderance of loops to whorls and arches. The frequency of loops among the Ewes is quite high especially in females than the Africa average. The Ewes show similarities with the populations of Tanzania, Kenya and Zimbabwe. The characteristics of the Ewe population however possesses unique features which can be utilized for population identification.

I. INTRODUCTION

The role of genes in the formation of dermal ridges has necessitated investigation into the existence of similarities and variations within and between populations (Floris, 2015; Pakhale et al, 2012). Cummins and Midlo, in spite of some deficiencies proved the role of genetics in ridge patterns using the total ridge count. The total ridge count measures the pattern size (Rivalderia *et al*, 2016). Bonnevie and other investigators also affirmed the role played by genes using other qualitative and quantitative traits (Gutiérrez *et al*, 2013). Law enforcement agencies continue to rely on dermal fingerprints for human identification during crime investigations due to the uniqueness of fingerprints (Oboako & Dzogbefia, 2017.)

The Ewe population is an ethnic group located in the Volta region of Ghana (formally British Togoland) and also Togo (formally French Togoland). The origin of the Ewes appears to be synonymous to that of the Gbe speaking people (Greene, 2002). They are believed to have migrated from Tando in the modern day Western Nigeria to Notsie in Togo before their current settlements. Identification of the fingerprint characteristics of the Ewe population is relevant to both anthropologists and forensic investigators in human identification and crime processing.

II. MATERIALS AND METHODS

Two hundred (200) sample units were collected from the Ewe population of Ghana. Sampling was done by random sampling method. All the samples were chosen from the Kwame Nkrumah University of Science and Technology campus.

Prior to recording of the prints, a table support of approximate height was set up to support the ink and paper during the taking of the print. Each individual included in the research was given alcohol to rub the hands. Even though soap and water are usually preferred over the use of alcohol, alcohol was used because of the participants' convenience.

During the printing process, the investigator grasped the hand of the participant and guided the rolling of the finger. The fingers were first rolled on the ink from the thumb position towards the little finger. This makes the printing easier and results in the generation of clearer prints for reading. No pressure or force was applied on the fingers

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during the collection of the prints; rolling was done gently to prevent smudging the print.

For each unit: the fingerprint type and type characteristics, finger ridge count (TRC), Absolute/Total finger ridge count (ARC) and Pattern Intensity Index (PII) were determined and compared within the population. The population statistics were also compared with the other study populations.

The recorded prints were studied with the aid of a magnifying lens and analyzed according to standard techniques as described by Cummins and Midlo as reported by Awuah *et al*, 2017.

III. RESULTS AND DISCUSSION

Table 1 shows the distribution of pattern types in the Ewe population as illustrated in Fig. 1. The percentages of whorls and Arches are lower in the Ewe population (12.3%) and (2.35%) while the Loop pattern is the most common (85.25%).

Pattern	Males	Females	Average percentage (%)
Whorls	22.8	1.8	12.3
Arch	4.2	0.5	2.35
Ulnar loop	73.0	97.5	85.25
Radial loop	0.0	0.2	0.1
Total	100	100	100

Table 1: Percentage distribution of pattern types in the Ewe population

Table 2 below shows the significance of variation with respect to gender within the Ewe population. The sex difference is statistically significant even at 95% confidence interval with the p-value of 0.002.

	Significance (2-sided)	
	Pattern type	Total finger ridge count
Ewe males and Ewe female	0.002	0.000
Asante females and Ewe females	0.000	0.006
Asante males and Ewe males	0.027	0.122
Asantes and Ewes	0.014	0.006

Data on Ashanti population taken from Awuah et al, 2017.

Table 2: Test for variation in frequencies of pattern types between the Asante and Ewe populations

Figure 1 shows the distribution of Total finger ridge count in the Ewe Females. The mean count of the distribution is 130.84, among the population of Ewe females, the mean (130), appears to be slightly higher than the mode (125). It can also be seen that the graph is negatively skewed (most of the values appear to occur above the mode).

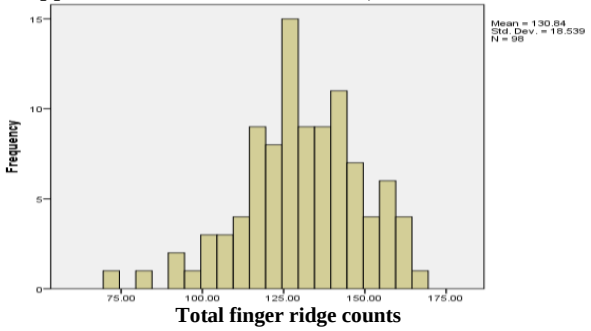

Figure 1: Frequency distribution of total finger ridge count among the Ewe females

Figure 2. shows the distribution of Total finger ridge count in the Ewe males. The mean count of the distribution is 117.30. A greater percentage of the Ewe male population have TFRC between 100 and 150. The close cluster of data about the mean reflects the population standard deviation (17.63) as compared to those of the other populations.

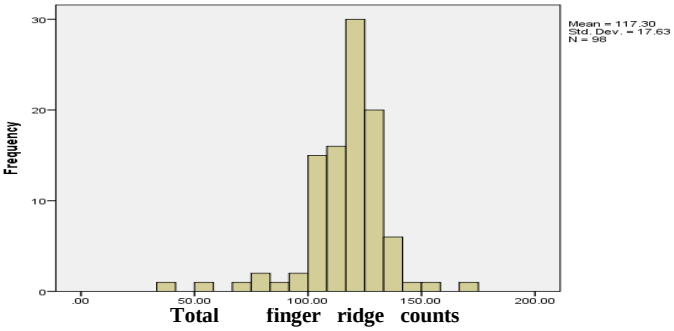

Figure 2: Frequency distribution of total finger ridge count among the Ewe males

Table 3 below shows the pattern intensity index in the Ewe populations. The Ewe population has lower index because of the high frequency of the loop pattern in the population compared.

population	Furuhata's Index =Whorls x 100/loops	● Dankmeijer's Index =Arches x 100/Whorls	Pattern Intensity Index=2 x Whorls + Loops/n
Ewe	24.6*100/170.5=**1 4.43**	4.7*100/24.6=**19.10**	2*24.6+170.5/20 0=**50.05**
Asante	45.1*100/136.9=**3 2.94**	18*100/45.1=**39.91**	2*45.1+136.9/20 0=**90.88**

Data on Ashanti population taken from Awuah et al, 2017.

Table 3: Pattern Intensity Index in the Asante and Ewe Populations

The current research focused on the distribution of pattern types in the Ewe populations which could serve as a reference material for forensic investigations in Ghana. The distribution of the finger pattern types in the Ewes is given in Table 1. It is evident that in the populations loops are the most preponderant patterns followed by the whorls and the arches. The Ewes show similarities with the populations of Kenya (Igbigbi & Msamati, 1999). These observations can only be explained on the basis of genetics since genes happen to be the dominate factor in the formation and nature of fingerprints. Human genetic diversity decreases in native populations with migration distance from Africa and this is thought to be due to bottlenecks during human migration (Manica *et al*, 2007).

The similarities in distribution of pattern types between these populations can therefore be associated with the fact that these populations are all of African origin. The females also show more loops as compared to the males; the frequency of arches is quite low in the Ewe females. The Ewes differ from the suggested frequencies of 7% arches, 28.35% whorls and 64.55% loops found for the Negros by Cummins and Midlo (Danborno and Idris, 2007). Alleles occur at different frequencies in different human populations with populations that are more geographically and ancestrally remote tending to differ more (Tishkoff & Kidd, 2004).

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The characteristics of the distribution in the Ewe population (Table 1) are however close to those of Kenya (77.66% loop, 18.4% whorl and 3.94% Arch) and Zimbabwe (78.05% loop, 8.62% whorl and 10% Arch (Igbigbi & Msamati, 2002)).

The genetic diversity decreases smoothly with migrating distance from Sub-Saharan Africa which most scientists believe to be the origin of modern humans (*Homo sapien sapiens*) and that decrease is mirrored by a decrease in phenotypic variations. Therefore populations that are more distant from African may share more phenotypic features than African populations. A large Dankmeijer's index indicates the abundance of whorls and reduced frequency of arches (Chattopadhyay & Ganeson, 1984). It is evident that Asian and European populations have more identical population index. The Dankmeijer's index for the Ewe population is 19.10 (the total frequency of arch over total frequency of whorls times 100). Furuhatas' index (the total frequency of whorls over total frequency of loops times 100), is 14.43 for the Ewes (Table 3). The pattern intensity is one parameter used by anthropologist and human biologists to elucidate the origin of an individual. As far as forensic investigations are concerned, any feature that has the ability to uniquely identify an individual or a population can be utilized in forensic identification since its expression reflects the genetic make-up (Igbigbi & Msamati, 2002).

Sexual dimorphism in dermatoglyphic patterns is attributed to heritability (Arrieta et al, 1991). A statistically significant variation in sexual dimorphism will enhance the authenticity of fingerprints in the resolution of crimes and identification of the source of unknown prints (Deopa *et al*, 2014). The sex difference on the basis of pattern type characteristics between Ewe males and Ewe females (0.013) is statistically significant (Table 2). This confirms the opinion shared by several authors that sexual dimorphism is expressed in fingerprints even though its determination failed in some populations (Arrieta et al, 1991). A study carried out by Deopa *et al*, (2014) revealed that fingerprints are very valuable parameters for sex difference identification.

The TFRC difference between the Ewe males and Ewe females are also statistically significant (p-0.000) (Table 2). It appears to be much prudent to analyze fingerprint on the basis of population before subjecting the print to sex identification. This appears to yield a greater chance of authenticity in sex identification using fingerprints. This is also true, because TFRC characteristics have proven to vary from one population to another. For example, among the Zimbabwean, males have a higher TFRC than females. However, in the Yoruba population and the Ewe population, females have a higher TFRC. It will therefore be less productive to compare characteristics of sex between populations without first considering the population characteristics.

The Ewes of Ghana when compared with a previous work published by Awuah *et al, 2017*, on the Asante population (another Ghanaian population) and in general the African community, at 95% confidence interval, the p-value for the comparison between Asante females and Ewe females is 0.000, Asante males and Ewe males is 0.027 while that between the Asante and Ewe populations is 0.014 (Table 2). This indicates that the pattern type difference between the two populations is statistically significant (α-0.05). The population variation between the Asante and Ewe females can therefore be determined on the basis of the pattern type.

A study of dermal patterns of Zimbabweans showed that, TFRC was higher in males than in females (Igbigbi and Msamati, 2002). These results were comparable to the data obtained from the Zulus population of South Africa. The situation was however different for the Yoruba of Nigeria and the Malawians (Igbigbi and Msamati, 1999). Similar results to those of Yoruba and Malawi were obtained for the Ewe population. In this study, the mean count of TFRC of the Ewe females was found to be 130.84 (Figure 3), while that of their male counterparts was (117.30). Unlike the Ewe population, the mean total finger ridge count of the Asante males was greater than that of the females. The TFRC of the Asante males was 122.87 while the value obtained for the females was 118.65 (Awuah *et al*, 2017). A statistically significant difference between the fingerprint characteristics of males and females suggest that the sex gene is expressed in the epidermis of the fingertip. This is relevant since it helps to establish the sex of the source of the fingerprint as demonstrated by Eshak *et al* (2013).

The Total Finger Ridge Count (TFRC) for the Ewe males (117) is again similar to the data on the Tanzanian population (115.05) just like the distribution of pattern types (Table 4.9). The TFRC of the females (130) are also similar to the results obtained by Igbigbi & Msamati (2002) for the Zimbabwean females (123.7).

An Ewe selected at random is likely to have about 12.3% whorls, 2.35% arches and 85.35% loops as the frequency of pattern types. A higher loop percentage is however likely to be found in the female than the average population percentage. The TFRC of an Ewe male is expected to be about 117.30 while that of a female is expected to be around 130.84. The complexity of the dermal pattern characteristics of the Ewe people makes the parameter an essential tool for forensic investigation/human identification involving an Ewe.

From the study of the Finger Pattern Types and the Total Finger Ridge Counts the following conclusions emerge out:

- ✓ The Ewes show preponderance of loops to whorls and arches.
- ✓ The frequency of loops among the Ewes is quite high especially in females than the Africa average.
- ✓ The Ewes show similarities with the populations of Tanzania, Kenya and Zimbabwe.

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