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Research Report

Variations of finger dermatoglyphics among the Esan ethnic group of Edo State, Nigeria

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Abstract - Patterns in fingers, palms, and soles; a term refers to as 'dermatoglyphics', are now been studied for ethno-historic facts and ancestry tracing. However, there is paucity of information on Esan people dermatoglyphics. Hence, this study investigates the variations in finger dermatoglyphics among Esan speaking tribe of Edo State, Nigeria. A total of 500 indigenes were sampled from 3 randomly selected Local Government Areas (LGAs) and the ink method was used to collect finger-prints from both palms. The loop was the most predominant pattern (54.44%) while the whorl and arches represent 30.96% and 14.60% respectively. Overall, the loop fingerprint pattern was highest in all the LGAs. Esan West LGA presented highest in the arches fingerprints (56.44%) as compared to Esan North East LGA (24.38%) and Esan Central LGA (19.18%). The right hand was observed to present higher in the different primary fingerprints but the different was not significant. There was no significant different ($p>0.05$) in the distribution of the primary fingerprints pattern between the right and left hand in the different LGAs. There was a significant difference ($p<0.05$) in the distribution of the primary fingerprints between genders. Female represented higher in the arches pattern while male represented higher in the whorl pattern. The loop pattern was male dominant in Esan West and Esan Central LGAs but female dominated in Esan North East LGA. The findings demonstrated gender and LGAs variations of primary fingerprints among the Esan speaking tribe and may suggest different ancestry. This result could play important role for forensic anthropologist in the study area.

Keywords: Dermatoglyphics, Fingerprints, Esan, Edo State, Nigeria.

Introduction

Dermatoglyphics; the scientific study of dermal ridge counts and patterns in fingers, palms, and soles (Cummins 1926), is one field that has attracted great interest across the globe. This is so especially for researchers working in relation to genetics, medicine, and anthropology in a bid to explore genetically determined phenotypes, genotype and health diseases linkages. In this regards, Gutierez *et al.* (2012) reported fingerprints to have been used for identification and authentication because of individual peculiarities and uniqueness and according to Temaj *et al.* (2009) has served as an inexpensive and easily applied tool for estimating the genetic distances between populations. This is because fingerprint patterns are almost certainly influenced by the interaction of several genes and the ridge patterns are distinct and unique for every individual making it widely used in identification (Ismail *et al.* 2009).

Fingerprints are individual-specific and are highly heritable (Temaj *et al.* 2009), and play important role in human biology research and population studies in medical and genetic studies (Gutierez *et al.* 2012). The establishments of the epidermal ridge pattern take place from the 10th to 16th weeks of development (Hale 1951; Hirsch and Schweichel 1973; Penrose and Ohara 1973; Babler 1991) and these establish the future surface patterns which become well pronounced at the 16th week (Okajima 1975; Babler 1991; Kucken and Newell 2004). Researchers have documented three basic patterns of fingerprint ridges (David 1981; Trimpe 2006; Osunwoke *et al.* 2009; Udoaka and Udoaka 2009; Anibor *et al.* 2011). These basic fingerprint ridge patterns are: arch (plain and tented), loop (radial and ulna), and whorl (plain and others). The arch is a pattern where the ridges enter form one side of the finger, rise in the centre forming an arc, and then exit the side of the finger. The loop is a pattern where the ridge enters from one side of a finger forms a curve and tend to exit from the same side from which they enter. In the whorl pattern, ridges form circularly around a central point on the finger (Henry 1900; Langenberg 2005).

There are speculations that people in different geographic locations have particular dermatoglyphic patterns peculiar to them but this has not been verified or proven yet (Paul and Paul 2017). From the inception of the study till date, ethno-historic facts have been obtained from dermatoglyphics (Mohammed *et al.* 2014) and most

recently its usefulness in tracing ancestry (Fournier and Ross 2015). The use of friction ridge skin impressions as a means of identification has been around for thousands of years and has been used in several cultures (Jeffery 2011). They have been used as proof of a person's identity in China perhaps as early as 300 B.C., in Japan as early as A.D. 702, and in the United States since 1902 (Montalcini 1987). As friction ridge skin identification became more prevalent after experimentation proved its usefulness, fingerprints were added to anthropometric records (Jeffery 2011). Human fingerprints have been used extensively to establish one's biometric identity especially in workplaces and other legal matters but for the case of the Esan speaking people, there is paucity of study to support the claim by Paul and Paul (2017). Considering the number of ethnic groups in Nigeria, this study will be helpful such that the determination of the heritable trait of the Esan speaking people can set another step to establish their uniqueness as a distinct group of indigenous people in Edo State in particular and Nigeria at large. In this study, variations in finger dermatoglyphics was examined among Esan speaking ethnic group and the associations between gender and hand were assessed. Although finger dermatoglyphics have been studied among a variety of ethnic groups in Nigeria, this study is the first extensive population study among Esan speaking ethnic group in the South-South part of Nigeria.

Materials and Methods

Study Area

The study was conducted among the Esan speaking communities in Edo State, Nigeria. Located in south-south geopolitical zone of the country (See **Fig. 1**), Edo State was created in 1991 and has an estimated population of 5 million in 2014 (Niger Delta Budget Monitoring Group 2019). The population structure is made up of 49.5% female and 50.5% male with over 59.3% within the age range of 15 to 64 years (Population Statistics 2016). The state is made up of 5 major ethnic groups; namely the Bini, Esan, Etsako, Owan and Akoko Edo with each constitute 57.14%; 17.14%, 12.19%, 7.43%, and 5.70% of the population respectively (Wikipedia 2020).

The modern Esan nation (on the whole 35 established kingdoms) is believed to have been organized during the 15th century, when citizens, mostly nobles and princes, left the neighbouring Benin Empire for the northeast; there they formed communities and kingdoms called *eguares* among the aboriginal peoples whom they met there

(*Idoasky* 2018). The Esan speaking people are currently administratively arranged under five Local Government Areas (LGAs); namely Igueben, Esan North-East, Esan South East, Esan Central and Esan West LGAs (See **Fig. 1**). It is estimated that the Esan people who reside in Esan land number about 1.5 million citizen in Nigeria (Rolle 2012). Using balloting, 3 LGAs were selected and the selected were the Esan Central LGA, Esan North East LGA and Esan West LGA.

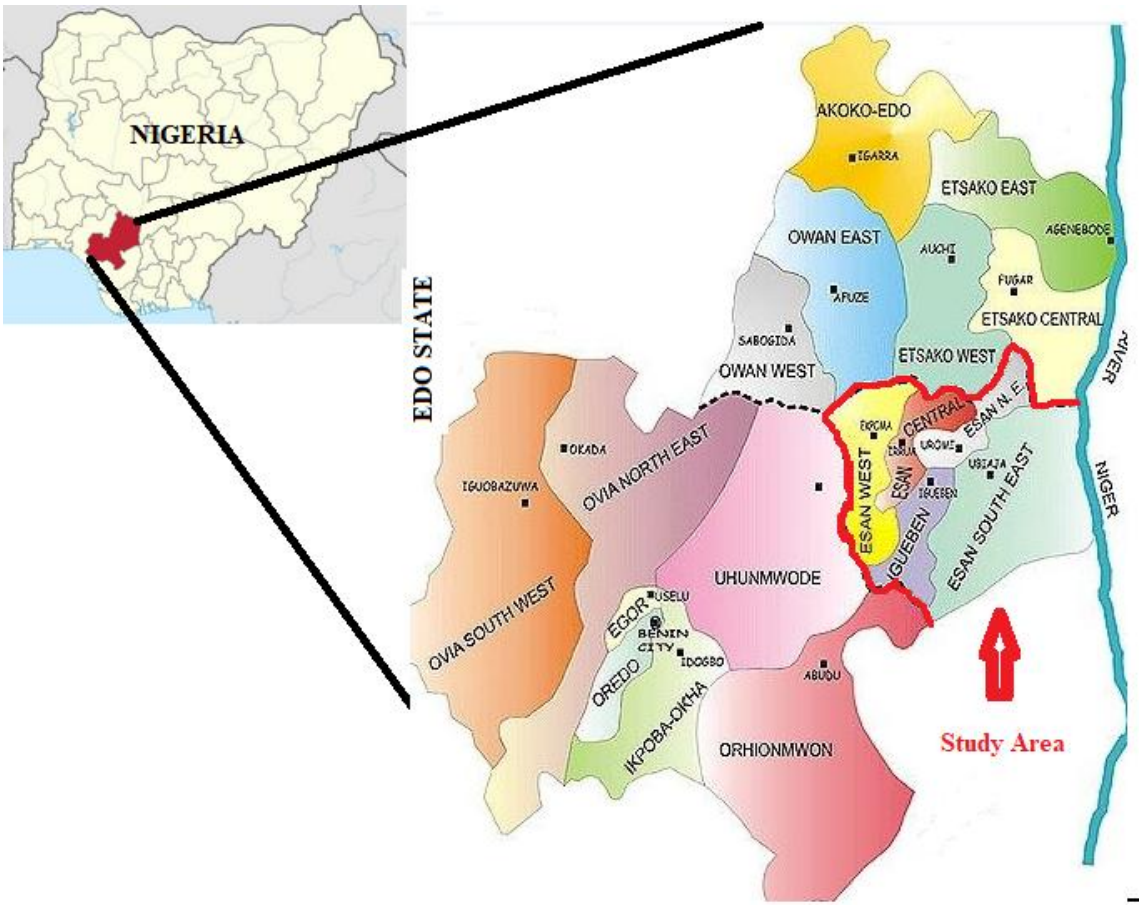

Fig. 1 Map of Nigeria showing Edo State and the study area in Edo State (Note Study area is mapped in red colour)

Esan Central LGA lies between 6^0 34' – 6^0 44'N and 6^0 08' – 6^0 25'E of the Greenwich Meridian with Irrua as the administrative headquarters. The area has a population of 137,900 people with a population density of 545.1 Km^2 in an area of 253 Km^2 (Population Statistics 2016). Majority of people are civil servants, traders, business men and women, farmers and teachers by occupation. Irrua Specialist Teaching Hospital is the only functional government owned hospital in the local government.

Esan North East is located on longitude 3° 24' E and latitude 6° 27' N with Uromi as the administrative headquarters. With an estimated population of 159,800 and population density of 472.8/Km^2, it has an area of 338 Km^2 (Population Statistics 2016). Majority of people are farmers, teachers, traders, business men and women, and artisans by occupation.

Esan West LGA lies between latitude 6^0 45 North of Equator and longitudes 6^0 5 and 6^0 8' East of the Greenwich Meridian with Ekpoma as the administrative headquarters. The LGA has an estimated population of 167,300 people and population density of 333.3/Km^2 in an area of 502 Km^2 (Population Statistics 2016). Majority of people are farmers, teachers/lecturers, civil servants, traders, business men and women, and artisans by occupation. The LGA houses the State owned University; Ambrose Alli University.

Ethical consideration

Ethical permission for this study was sought and obtained from Ambrose Alli University Research and Ethics Committee and informed consent of participating students were obtained. Data collection was in compliance with the Declaration of the Right of the subject (WMA 2000).

Inclusion criteria

Indigenes of the selected LGAs between the ages of 18 and 60 years who gave consent and had no loss/deformation of the limbs or digits were included in this study.

Sampling techniques

The sampling techniques used in the study for selection of participant was the purposive sampling technique where participants were selected based on characteristics of a population and the purpose of the study. Five hundred subjects were recruited for this study with 200 subjects from Esan North East, 150 from Esan Central and 150 from Esan West LGAs.

Instrument for data collection

Using self-structured research questionnaires, social demographic profile were collected. The Indian ink method by Cummins (1961) was used to collect digital prints on fingers. Briefly, the subjects were asked to clean their hands with soap and water and allowed to dry but with some moisture. Requisite amount of ink was rubbed on the stamp pad and was uniformly spread. The left hand of the subject was placed on the

stamp pad which is placed on a hard surface. The fingers printed the tip of the fingers was rolled from the radial to ulnar side to include all the patterns. The same procedure was repeated for the right hand. The ink removed from the subject hands with the aid of about 1% HCL which will neutralize the ink. The prints were analyzed and classified with the help of a hand lens.

Data analysis

Data obtained were coded and entered into Statistical Package for Social Scientists (SPSS) version 20.0 software spread sheet and then analyzed. Test of significance was done using the chi-square. All tests were at 95% confidence level.

Results

Fingerprints distribution among Esan people of Edo State

There was equal male and female participation in the study except in Esan West where male constituted 52.67%. In all the LGAs, Christianity was the basic religion with over 87% of occurrence. Farming, business/trading, self-employed and a few of civil servants were the major occupations of the participants. The distribution of the primary fingerprint types among the 500 participants revealed the loop type comprises of 54.44% while whorl and arches represent 30.96% and 14.60% respectively. Figure 2 represents the pattern of distribution of the primary fingerprints between LGAs. Overall, the loop fingerprint type was highest in all the LGAs and this was followed by the whorl and then the arches. Esan West LGA presented highest in the arches fingerprints, (56.44%) followed by the Esan North East LGA (24.38%) and lastly Esan Central LGA (19.18%). In the loop type of fingerprints, Esan North East was highest (45.46%), followed by the Esan Central LGA (33.47%) and then the Esan West LGA (23.07%). In the whorl fingerprints, Esan North East presented highest (41.28%) and then Esan West LGA (27.72%) and then Esan Central LGA (29.01%).

Figure 3 represents pattern of fingerprints within LGAs. The occurrence of the arches type of fingerprints was 27.47% as compared with the whorl fingerprint type that is 30.67% among the Esan West LGA while the loop was 41.87%. On the other hand, there was a different in occurrence of the different fingerprints in Esan North East (8.90%; 59.15%; 31.95% for arches, loop and whorl respectively) and Esan Central (9.33%; 60.73%; 29.93 for arches, loop and whorl respectively) LGA.

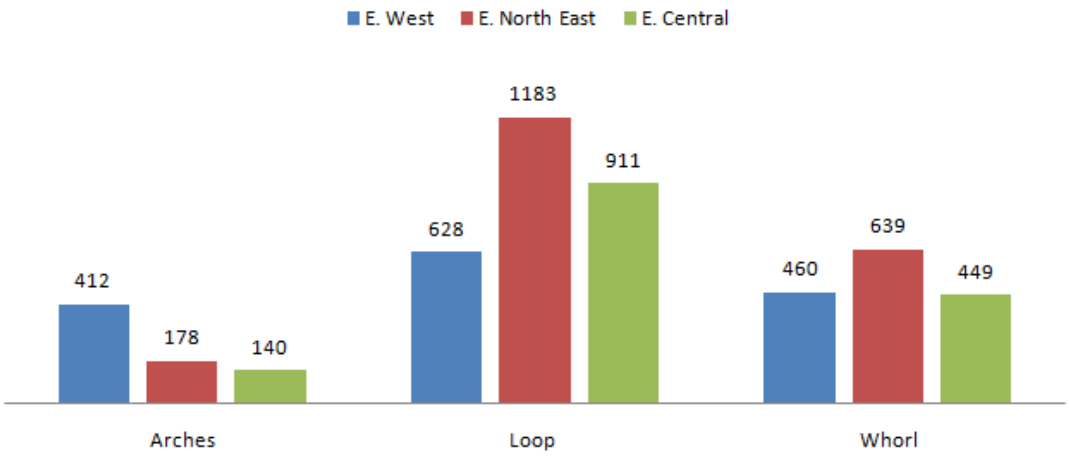

Fig. 2 Fingerprints pattern between LGAs among Esan people of Edo State

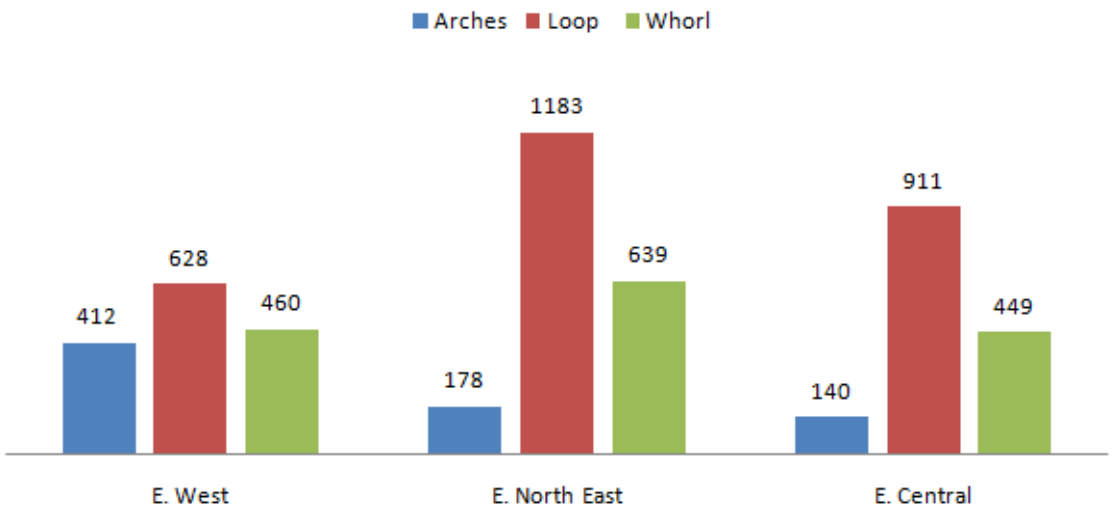

Fig. 3 Fingerprints pattern within LGAs among Esan people of Edo State.

Relationship between right and left hands and the pattern of fingerprints among Esan people of Edo State

On the relationship between finger dermatoglyphics and right and left hands of the selected LGAs (**Fig. 4** and Table **1**), the right hand was observed to present higher in the

different primary fingerprints but the different was not significant (**Fig. 4**). Between LGAs, the arches and whorl fingerprints were higher in the right hand among the Esan West and Esan Central LGAs but in the left hand of Esan North East LGA. However, loop fingerprint type was higher in the right hand in all the LGAs. There was no significant different ($p>0.05$) in the distribution of the primary fingerprints pattern between the right and left hand in the LGAs (Table **1**).

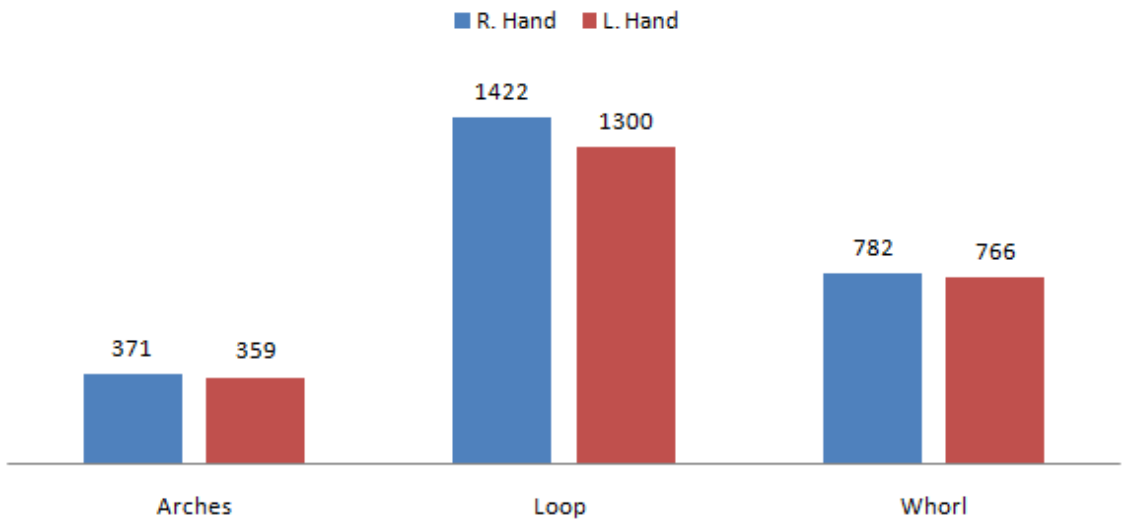

Fig. 4 Differences between right and left hands pattern of primary fingerprints

Table 1. Chi-square statistics of the association between finger dermatoglyphics and the right and left hands in the selected LGAs

LGA	Hand	Arches	Loop	Whorl	X^2	p-value
E. West	**Right**	212	362	236		
	Left	200	266	224	3.65	0.118
E. North East	**Right**	84	599	317		
	Left	94	584	322	0.791	0.673
E. Central	**Right**	75	461	229		
	Left	65	450	220	1.178	0.348

Relationship between gender and the pattern of fingerprints among Esan people of Edo State

On the relationship between finger dermatoglyphics and gender of Esan people, female represented higher in the arches fingerprint while male represented higher in the loop and whorl types of fingerprints (**Fig. 5**). In all the LGAs, female represented higher in the arches fingerprints while male represented higher in the whorl. The loop fingerprint was male dominant among the Esan West and Esan Central LGAs but female dominated among the Esan North East LGA. Statistically, there was a significant difference ($p<0.05$) in the distribution of the primary fingerprints between gender in Esan West (x^2 = 15.0; p=0.001), Esan North East (x^2 = 21.94; p=0.000) and Esan Central (x^2 = 10.897; p=0.002) LGAs (Table **2**).

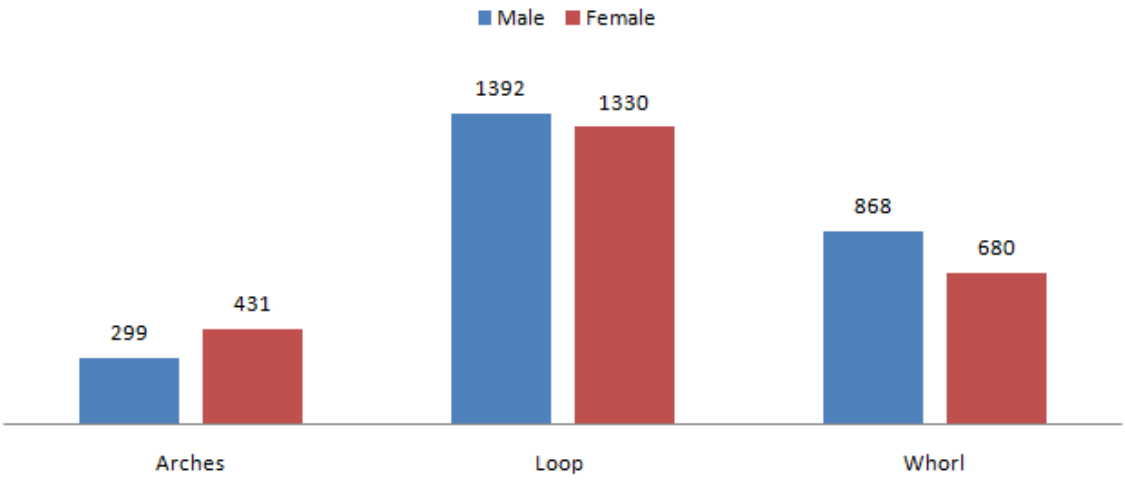

Fig. 5 Differences between gender and pattern of primary fingerprints distribution.

Table **2.** Chi-square statistics of the association between gender and finger dermatoglyphics in the selected LGAs

LGA	Hand	Arches	Loop	Whorl	X^2	p-value
E. West	Male	174	342	274		
	Female	238	286	186	15.0	0.001
E. North East	Male	63	585	352		
	Female	115	598	287	21.94	0.000
E. Central	Male	62	465	242		
	Female	78	446	207	10.897	0.002

Discussion

Ethnic differences in finger dermatoglyphics have been studied extensively in the developed world (Holt 1986). The results from the present study indicate the prevalent fingerprint pattern of the Esan speaking tribe of Edo State to be loop (54.44%), followed by the whorl (30.96%) and then arches (14.60%). This is consistent with the documented fact that 60–65%, 30–35% and 5 % constitute of the loop, whorl and arches fingerprints respectively by Wijerathne *et al.* (2013) and with other studies conducted in Nigeria, which also observed loop as the highest frequency, followed by whorl and then arch pattern (Ekanem *et al.* 2009; Jaja *et al.* 2008) but with variations in percentages.

For example, in a study comparing fingerprint patterns of the Itsekiri and Urhobo ethnic groups in Warri, South Southern Nigeria by Jaiyeoba-Ojigho *et al.* (2019) found the arches, whorl and loop patterns to be respectively seen in 18.0%, 19.8% and 62.1% of the Itsekiri ethnic group and 13.0%, 26.0% and 61% of the Urhobo ethnic group. In another study to assess the dermatoglyphic pattern of Annangs ethnic group in Akwa Ibom State in Nigeria, Ekanem *et al*. (2008) and revealed arches frequency of 22.6%, loop frequency of 46.3% and whorl frequency of 31.2%. Among the Kanuri ethnic group of North Eastern Nigeria, fingerprint patterns of 33.80% as whorls, 59.10% as loops and 7.07% was reported (Mohammed *et al.* 2014).

Compared with the dermatoglyphics of other African countries, Namouchi (2011) reported loops were the most common pattern followed by whorls and arches in Tunisian population. Also, higher frequencies of loops followed by whorls and arches have also been reported among the Kenyans and Tanzanians (Igbigbi and Msamati, 2005), Zimbabwean (Igbigbi and Msamati 2002) and North African populations (Algeria, Libya, Tunisia) (Sabir *et al.* 2005). However, in Malawians, arches were found to be the most predominant digital pattern (Igbigbi and Msamati 1999)

Compared with dermatoglyphics data of ethinic groups outside of Africa, Rao (1972) reported among the Aborigines in Australian fingerprint frequency of 64.79%, 32.25% and 1.42% for whorl, loop and Arch respectively. In a study among healthy young adults residing in Districts Shimla and Solan of Himachal Pradesh state of north India, Baryah and Krishan (2020) reported Loops followed by whorls, composites and finally arches as the most commonly occurring patterns in both ethnic groups. Gauldi – Russo *et al.* (1982) reported among the Bolognese in Italy a whorl frequency of 31.20%,

loop frequency of 63.33% and arch frequency of 5.47%. Among the Tibetans people in the East Asian ethnic group, Tiwan and Chaltopadhyay (1986) reported whorl frequency of 54.46%, loop frequency of 44.06% and an Arch frequency of 1.48%. Among the Japanese, Mastunga and Kumi (1986) documented a whorl frequency of 45.95%, loop frequency of 52.38% and Arch frequency of 1.82%. This disparity in dermatoglyphic data between ethnic groups within Nigeria, Africa and the rest of the world, could be attributed to ethnic variations.

Specifically, even within the Esan speaking tribe there were variations between LGAs with the Esan West LGA presenting higher arches frequency of 27.47% as compared to the frequencies of 8.90% and 9.33% among the Esan North East and Esan Central LGAs. Also, the frequency of loop pattern was lower among the Esan West LGA (41.87%) as compared to the 60.73% and 59.15% of the Esan Central and Esan North East LGAs respectively. Comparatively the fingerprint pattern of the indigenes of Esan West LGA is comparable to that observed by Ekanem *et al.* (2008) among the Annangs ethnic group in Akwa Ibom State and the Itsekiri and Urhobo of Warri, Delta State South Southern Nigeria by Jaiyeoba-Ojigho *et al.* (2019). This indicates therefore that the Esan West LGA indigenes may be diverse in ancestry as compared to the Esan Central and Esan North East LGAs. This assertion is based on the fact that dermatological signs have been widely used throughout the world, especially in recent decades, to establish inter-population diversity (Khan and Kapoor 2014; Tabhane *et al.* 2014; Kahleel 2017).

The study of dermatoglyphics has its medico legal value in the identification of individuals, sex, and ethnic differences (Ekanem *et al.* 2009). Overall, male presented higher in the loop and whorl fingerprints while females were higher in the arches pattern. Significant sexually dimorphic trait was observed in the three LGAs. Arches pattern was higher in female while the whorl pattern was higher in male in the three LGAs. However, the loop pattern was higher in Esan West and Esan Central LGAs males and in the Esan North East females. The sexually dimorphic pattern of fingerprints observed in this study disagree with the study by Jaiyeoba-Ojigho *et al.* (2019) who observed the loop pattern occurred more among the Itsekiri females. Igbigbi and Msamati (2002) have reported predominant whorls pattern in males and arches in females with no statistically significant difference between sex in Zimbabwean subjects. Among Malawians, Igbigbi and Msamati (1999) demonstrated no significant difference in the digital patterns between sexes even though it was found that the radial loops were

predominant in men and whorls in women. The significant sexually dimorphic pattern of fingerprints in this study indicates that when the whorl pattern is seen within the LGAs, there is a probability that such a person is a male while the arches pattern shows feminism. However, the presence of the loop pattern in Esan West and Esan Central point toward the probability of a male but female in Esan North East.

Conclusively, the findings from this study showed that fingerprints of the Esan speaking tribe demonstrated differences between LGAs and significant difference between genders. Thus, the findings could play a vital role for forensic anthropologist when studying the area under study.

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Conflicts of Interest: The author declares no conflict of interest.

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