

Original Article

Fingerprint Ridge Counts and Indices Among Selected Dialects of The Ebira Ethnic Group, Nigeria

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ABSTRACT

Background: Fingerprints permanency, genetic influence as well as the number of easily observable and measurable characteristics have been one of the most suitable parameters for studying population variability. This study aimed to determine the variability of fingerprint ridge counts and indices among selected dialects of Ebira ethnic group in Nigeria.

Material and Methods: This study was carried out among adolescents of Ebira ethnic group age range 13 to 17 years. 591 subjects (294 males and 297 females) were recruited for this study from selected secondary schools. Fingerprints of the subjects were collected using standard ink procedure. The fingerprints were classified and the ridge count for each digit was determined and scored. The fingerprint indices were calculated using standard formulae. Data obtained were analyzed using SPSS version 20.0. The Independent t-test was used to test for sexual dimorphism and one-way ANOVA for the differences between digit ridge counts and dialects.

Results: Fingerprint ridge count showed significant ($P < 0.05$) sexual dimorphism for Ebira-Koto and Ebira-Etuno dialects. A significant difference was seen in the fingerprint ridge count for males in the three studied dialects. The same result was also observed in females of the three dialects. Different fingerprint indices revealed varying values for the studied dialects.

Conclusion: Fingerprint ridge counts may serve as a means of identifying males and females of various Ebira dialects. The fingerprint indices showed inter dialect variations with related values in Ebira-Tao and Ebira-Etuno.

Keywords: Dermatoglyphics, Digit, Ebira, Fingerprint, Indices, Ridge count.

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INTRODUCTION

Dermatoglyphics is the study of the epidermal ridges of the skin covering the digits, palms of the hands, and soles of the feet.^{1, 2} Dermatoglyphics provide a pertinent area of research to geneticists interested in studying variation within and between populations.^{3,4} Dermatoglyphics have been used extensively to characterize and differentiate human populations, hence, are highly suitable for studying population variation.⁵

Many studies have been conducted on dermatoglyphics and it is assumed that women have 'fine' epidermal ridges while men have 'coarse' ridges; therefore, the ridge density within a given unit of space is greater in women than in men.^{6,7}

Fingerprinting has become increasingly relevant especially in the field of forensics owing to their application and indispensability based on their reliability and validity of features, easy classification and uniqueness. Fingerprint ridge counts and density have proven to be relevant in identity determination, adequate and reliable knowledge of sex with certainty as this reduces the process of identification by 60%.⁸

This is possible based on the assumption that the ridge counts and features remain intact throughout the life of an individual until destroyed by decomposition of the skin after death.^{9,10,11} However, variations in ridge dimensions and sex differences in ridge breadth have been reported.^{12,13,14} Ridges and their patterns exhibit some properties that reflect the interaction between genetic make-up and the environment of the foetus as reported by many researchers.^{15,16,17,18}

Fingerprint indices have become one of the most reliable criteria for studying population variation as they take into account proportions of different patterns obtainable in any given populations.⁵

The Ebiras are people who have been documented to have single-origin but have come to settle in different geographic locations giving rise to different groups. This study seeks to assess the level of conservation of the ancestral traits using some dermatoglyphic traits. This study aims to determine the fingerprint ridge counts distribution among three selected Ebira dialects, to assess for sexual dimorphism in fingerprint ridge counts within dialects and investigate the differences of fingerprint ridge counts across the three selected dialects. The study also seeks to determine the fingerprint indices of the three dialects.

MATERIALS AND METHODS

Study Area

Kogi is a state 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.¹⁹ Ebira, as a name is used by not less 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.²⁰ For this study, Ebira-Tao, Ebira-Koto and Ebira-Etuno were selected.

The study was carried out in selected secondary schools from Okene, Igarra and Koton Karfe local government areas. Stratified probability sampling technique was applied and a total of 591 secondary school subjects participated in this study involving males and females from the Ebira-Tao, Ebira-Etuno and Ebira-Koto dialects of Ebira ethnic group of Kogi state, Nigeria. Ebira-Tao participants were 199; 99 males and 100 females, Ebira-Etuno participants were 196; 98 males and 98 females, and Ebira-Koto participants were 196; 97 males and 99 females.

Ethical approval for the study was obtained from the Ahmadu Bello University Committee on Use of Human Subject Research with ethical clearance number ABUCUHSR/2018/001 and permissions from the schools authorities, where the study was carried out were also sought. The aim and objectives of the study were well explained to the participants and consent/assents were obtained.

Inclusion criteria were apparently healthy adolescents of ages 13 to 17 years without mixed ethnicity and dialects by noting two generations of both maternal and paternal grandparents. Subjects with mixed ethnicity and dialects, permanent tear on their fingers and palm and those with obvious hand deformities were excluded from the study.

The fingerprints were collected using standard ink and roller method of modified Cottenman's technique.²¹ Fingerprints were taken after washing the hands with soap water and complete drying. The smeared fingers of both hands were printed on a durable plain paper laid down on a pressure pad which consisted of ten different blocks for ten fingers of the right hand and left hand respectively. The pattern of fingerprint for each finger was



Figure 1: Map of Kogi state showing study areas.

observed with the help of a hand lens. The fingerprint patterns were classified into loops (ulnar and radial), whorls and arches according to classification by Penrose and Losech.¹⁵ The ridge counts on each digit were scored as the number of ridges crossing the segment that connects the triradius and the centre of the finger pattern (known as the core). If more than one ridge count was available for a finger, as in the case of whorls or double loops, only the largest ridge count was used for further analysis. The ridge count of arches was conventionally scored as zero.²²

Dermatoglyphic pattern indices were calculated as reported by Kapoor and Badiye.²³ They include:

$$\text{Furuhata's Index (FI)} = \text{Whorls} \times 100/\text{loops}$$

$$\text{Dankmeijer's Index (DI)} = \text{Arches} \times 100/\text{Whorls}$$

$$\text{Pattern Intensity Index (PII)} = 2 \times \text{Whorls} + \text{Loops}/100$$

Data obtained were analyzed using SPSS version 20.0. The

Independent t-test was used to test for sexual dimorphism and one-way ANOVA for the differences between fingerprint ridge counts and dialectal affiliation. LSD post hoc test was used for pairwise multiple comparisons. $P < 0.05$ was set as the significance level.

RESULTS

The subjects age range for the three dialects were 13 to 17 years. Their mean ages were (15.76 ± 1.19) , (15.74 ± 1.21) and (15.72 ± 1.09) for Ebira-Tao, Ebira-Etuno and Ebira-Koto respectively. The mean ridge counts from each digit for Ebira-koto subjects appeared to be more in the male subjects compared to the females for both right and left hands with significant difference ($p < 0.05$) in some digits (Table 1).

For Ebira-Etuno subjects, a similar pattern was observed as in the Ebira-Koto with more digits of the left hand showing a statistically significant difference (Table 2).

Conversely, the Ebira-Tao subjects had higher mean ridge counts in the female subjects compared to the male subjects for right hands; except, for the right thumb and higher mean ridge counts in the males for left hand; except left ring finger where the females had more counts. However, no significant difference ($p > 0.05$) was observed between sex (Table 3).

Fingerprint ridge count for the males of the three studied dialects showed significant difference ($p < 0.05$) for both hands with Ebira-Koto having higher mean counts for most digits followed by Ebira-Tao and Ebira-Etuno with the least mean counts (Table 4). A similar result was also observed among females of the three studies as in the males with significant mean differences for both hands (Table 5).

FI was higher in females for the three studied dialects compared to males although Ebira-Koto had much closer values compared to the other two dialects. DI was higher among males of Ebira-Tao and Ebira-Etuno while females of Ebira-Koto had higher DI. PII was higher among females of Ebira-Tao and Ebira-Etuno while males of Ebira-Koto had higher PII (Table 6).

Table 1: Sexual dimorphism in fingerprint ridge counts among Ebira -Koto

Digits	Right hand		t	p	Left hand		t	p
	Males (n= 97)	Females (n= 99)			Males (n= 97)	Females (n= 99)		
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ±SD		
I	11.25±5.59	10.94±5.60	0.392	0.695	11.04±5.84	10.37±5.84	0.800	0.424
II	10.26±4.22	8.57±4.69	2.654	0.009	9.75±4.58	8.66±5.17	1.569	0.118
III	10.09±4.30	9.40±4.72	1.067	0.287	10.76±4.16	9.81±5.24	1.414	0.159
IV	12.51±3.00	11.84±3.98	1.326	0.188	12.56±3.34	11.52±4.23	1.915	0.057
V	11.38±2.86	10.14±3.00	2.961	0.003	11.21±2.95	10.29±3.37	2.017	0.045

I= Thumb, II= Index finger, III= Middle finger, IV= Ring finger, V= little finger

Table 2: Sexual dimorphism in finger ridge counts among Ebira-Etuno

Digits	Right hand		t	P	Left hand		t	p
	Males (n= 98)	Females (n= 98)			Males (n= 98)	Females (n= 98)		
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
I	11.20±4.14	9.63±5.41	2.282	0.024	10.67±4.55	9.44±4.93	1.823	0.070
II	8.80±3.50	8.12±4.24	1.397	0.164	8.62±3.66	7.16±4.63	2.447	0.015
III	8.84±3.66	8.36±3.99	0.877	0.381	9.70±3.35	7.80±4.74	3.254	0.001
IV	10.68±2.81	10.19±3.80	1.027	0.306	10.94±2.77	9.56±4.24	2.691	0.008
V	8.96±2.30	8.24±3.18	1.802	0.073	9.18±2.46	8.28±3.10	2.272	0.024

I= Thumb, II= Index finger, III= Middle finger, IV= Ring finger, V= little finger

Table 3: Sexual dimorphism in fingerprint ridge count among Ebira -Tao

Digit s	Right hand		t	p	Left hand		T	p
	Males (n= 99)	Females (n= 100)			Males (n= 99)	Females (n= 100)		
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
I	11.40±3.79	10.89±4.82	0.825	0.412	10.42±4.62	10.24±4.75	0.272	0.786
II	8.30±3.57	8.86±3.36	1.112	0.268	8.94±3.55	8.83±4.21	0.194	0.847
III	8.76±3.32	9.28±3.82	1.029	0.305	9.63±3.32	9.26±4.21	0.699	0.485
IV	10.45±2.83	11.14±3.23	1.600	0.111	10.50±2.63	11.04±3.71	1.186	0.237
V	8.72±2.46	8.94±2.62	0.599	0.550	9.07±2.37	9.05±2.83	0.059	0.953

I= Thumb, II= Index finger, III= Middle finger, IV= Ring finger, V= little finger

Table 4: Comparison of fingerprint ridge counts among three Ebira dialects in males

Digits	Koto (n= 97) Mean ± SD	Etuno (n= 98) Mean ±SD	Tao (n= 99) Mean ± SD	F	P - values
Right Hand					
I	11.25±5.39	11.20±4.14	11.40±3.79	0.050	0.951
II	10.26±4.22	8.90±3.50	8.30±3.57	6.911	0.001
III	10.09±4.30	8.84±3.66	8.76±3.32	3.832	0.023
IV	12.51±3.00	10.68±2.81	10.45±2.83	14.889	<0.001
V	11.38±2.86	8.96±2.30	8.72±2.46	32.378	<0.001
Left Hand					
I	11.04±5.84	10.67±4.55	10.42±4.62	0.377	0.686
II	9.75±4.58	8.62±3.66	8.94±3.55	2.116	0.122
III	10.76±4.16	9.70±3.35	9.63±3.32	2.958	0.053
IV	12.56±3.34	10.94±2.77	10.50±2.63	12.326	<0.001
V	11.21±2.94	9.18±2.45	9.07±2.37	20.712	<0.001

One-way ANOVA test followed by LSD post hoc test. Result expressed as mean ± SD. Cells carrying the same superscript on each row are significantly different (P <0,05). I= Thumb, II= Index finger, III= Middle finger, IV= Ring finger, V= little finger

Table 5: Comparison of fingerprint ridge counts among three Ebira dialects in females

Digits	Koto (n= 99) Mean ± SD	Etuno (n = 98) Mean ±SD	Tao (n= 100) Mean ± SD	F	p - values
Right Hand					
I	10.94±5.60	9.63±5.41	10.89±4.82	1.937	0.146
II	8.57±4.69	8.12±4.24	8.86±3.60	0.779	0.460
III	9.40±4.72	8.36±3.99	9.28±3.82	1.830	0.162
IV	11.84±3.98	10.19±3.80	11.14±3.23	4.950	0.008
V	10.14±3.00	8.24±3.18	8.94±2.63	10.503	<0.001
Left Hand					
I	10.37±5.84	9.44±4.93	10.24±4.75	0.933	0.395
II	8.66±5.17	7.16±4.63	8.83±4.21	3.783	0.024
III	9.81±5.24	7.80±4.74	9.26±4.21	4.728	0.010
IV	11.52±4.23	9.56±4.24	11.04±3.71	6.182	0.002
V	10.29±3.37	8.28±3.10	9.05±2.83	10.599	<0.001

One way ANOVA test followed by LSD post hoc test. Result expressed as mean ± SD. Cells carrying the same superscript on each row are significantly different (P <0,05). I= Thumb, II= index finger, III= Middle finger, IV= Ring finger, V= little finger

Table 6: Fingerprint indices of the studied populations

Population	N	Hands	FI		DI		PII	
			Males	Females	Males	Females	Males	Females
Ebira -Tao	199	Right	10.66	101.29	42.22	2.77	102.40	147.60
		Left	8.26	92.83	86.11	4.72	101.60	143.40
Ebira -Etuno	196	Right	7.99	98.76	130.30	3.77	95.00	144.00
		Left	9.90	98.33	146.15	5.53	94.40	141.80
Ebira -Koto	196	Right	50.00	52.16	12.90	23.57	124.00	123.00
		Left	51.66	55.21	17.31	30.19	122.80	121.20

FI = Furuhatata index, DI= Dankwejer's index, PII= Pattern intensity index

DISCUSSION

Inter and intra-ethnic variation has been a subject of study among the human race. Dermatoglyphic has become one of the readily explored markers to study variations and similarities in human population this is due to its usefulness in forensic science and human biology [24,25,26]. This study assessed the fingerprint ridge count for digits as a dermatoglyphic quantitative trait and sought for sexual dimorphism in ridge

counts for each dialect as well as the relationship between ridge counts and ethnicity.

Ridge characteristics are one of the basic features of fingerprints that have to allow for efficient classification and examination which often leads to the identification or elimination of suspects involved in a crime.²³ This has led to its wide use in the fields of forensic science, medicine, biological anthropology, ethnology and population genetics for their capabilities to identify racial and ethnic differences, gender, individuals as well as congenital malformations.^{23,27}

There was significant sexual dimorphism observed in Ebira-Koto and Ebira-Etuno subjects, with males having higher mean digit ridge counts for both hands which were consistent for most of the digits. Sexual dimorphism and higher ridge count in males have also been reported by previous investigators.^{28,29,30,31,32} Ebira-Tao subjects, however, differs from the above observation though not significant. This observed differences among the three dialects could be as a result of genetic differences and also a different level of exposure to hormone *in-utero* during ridge development. This may further suggest that sexual dimorphism in fingerprint ridge counts could be a trait or phenomena peculiar to certain dialects and people.

A significant relationship was observed for males and females of Ebira-Koto, Ebira-Etuno and Ebira-Tao dialects for both hands as they appeared to share similar digit ridge count trait. This observed finding could be as a result of similarity in the inheritance pattern of the gene responsible for ridge count trait. This may indicate common ancestry of these three dialects. This is in agreement with the work of Yusuf *et al.*³³ who reported similarity in the fingerprint pattern among these Ebira dialects.

Fingerprint indices have been considered as one of the important criteria for the evaluation of biologically meaningful differences between population groups^{23, 34} as the indices take into account proportions of the population's fingerprint patterns. Three dermatoglyphic indices were calculated in this study, they include FI, DI and PII. The value of FI index was higher in females for the three dialects. The value of DI was higher in males of Ebira-Tao and Ebira-Etuno while Females had a higher value in Ebira-koto. PII value was higher in females of Ebira-Tao and Ebira-Etuno while males had higher values in Ebira-Koto. The observed result showed similarities of dermatoglyphic indices among the Ebira dialects with little variations from Ebira-Koto. Kapoor and Badiye²³ have also

reported values of pattern intensity index high in males while the values of Furuhashi's Index and Dankmeijer's index are higher in females which is in line with our values and other researchers' findings.

These findings revealed that the three studied Ebiradialects have shared dermatoglyphic characteristic with Ebira-Koto and Ebira-Etuno having related digit ridge count trait while Ebira-Tao and Ebira-Koto shared related dermatoglyphic indices.

CONCLUSION

The fingerprint ridge count for Ebira-Tao, Ebira-Koto and Ebira-Etuno were determined. There was sexual dimorphism between Ebira-Koto and Ebira-Etuno dialects. Significance differences were seen in males and females across the three studied dialects for both hands. Fingerprint indices showed varying values for the three dialects with closer values seen in Ebira-Tao and Ebira-Etuno implying related ancestry. Ebira-Tao, Ebira-Koto and Ebira-Etuno shared related dermatoglyphic traits although few variations exist.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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