Digito-Palmar Dermatoglyphic Patterns among Natives of Irruan in Boki Local Government Area of Cross River State Nigeria

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ABSTRACT

Background and Objective: The uniqueness of digital-palmar dermatoglyphics patterns has made it possible for anthropological studies on ethnic differences and heritability among individuals. It has been widely studied, varying across different ethnic populations. This present study investigated the digito-palmar dermatoglyphic patterns among natives from the Irruan Clan, Boki. **Materials and Methods:** A total of 52 natives, were recruited and their prints were collected by conventional ink method, read using a hand magnifying lens. Analyses were performed using descriptive statistics, student t-test, chi-squared Test and significant set at 5%. **Results:** The loop, whorl, arch and compound distribution of fingerprint patterns were 40.4, 26.9, 19.2 and 13.5%, respectively. The frequency of loop patterns in males and females is 25% (13) and 15.4% (8), respectively. The mean total ridges count in the male's right hand and left hand were 91.6±8.3 and 90.6±6.7, respectively. The ATD angle of the male right hand and female right hand were 53.1±1.2 and 50.4±1.7, respectively. There were significant differences in the distribution of ATD angles among males and females. **Conclusion:** The dermatoglyphics patterns of selected natives of the Irruan clan. However, this study has provided baseline information for further anthropological studies.

KEYWORDS

Forensic science, dermatoglyphics, digito-palmer, fingerprint, frequency of pattern, Irruan, natives, Cross River State, Nigeria

INTRODUCTION

Human identification is an essential aspect of forensic science, anthropology and criminology. The identification can be either partial or complete, although the complete identification of individuals is relevant in crime detection, legal dispute, etc.[1-3]. Dermatoglyphics is the study of the configuration of epidermal ridges of the volar surfaces of the fingers, toes, palms and soles of humans and other

mammals[4,5]. These configurations or peculiar skin features found in humans make them unique, bringing about variations in populations[5-8]. Several studies have been conducted on dermatoglyphics patterns and morphogenetic traits in studying human diversity and variations among different ethnic groups in Nigeria[7,8-11], an important aspect of human genetics research.

Dermatoglyphics are epidermal ridges with different patterns appearing around week 13 of pregnancy and taking the shape of the receding volar pads and lastly around the 21st week after conception. The fingerprint patterns are complete and they never change or move in a lifetime[12,13]. In early embryonic development, pathological genetics and environmental factors can influence formation, thereby disrupting the development which drastically changes the dermatoglyphics causing no flexion creases on the palms of the affected individual[12,14]. Dermatoglyphics are genetically determined and are inheritable, following the polygenic pattern of inheritance (controlled by two or more genes) according to documented studies[12,15-17]. The dermoglyphic pattern is a complex pleiotropic phenotype, to which a hitherto unknown number of genes contribute by interacting with each other and the environment[15]. Disturbance by genetic factors can produce unusual abnormal dermatoglyphics during intrauterine life[18].

Dermatoglyphics have been widely employed in areas such as anthropology, genetics and evolution studies, forensic sciences, health and ethnography in characterizing populations, analyzing the nature and origin of human variability and micro-differentiation among populations[1-3,19-21]. Also, it has been proven as a useful tool in the investigation of disorders and syndromes with prenatal influences either genetic or teratogenic and post-preterm study[22-24]. Dermatoglyphics are unique to each individual and are helpful to clinicians, anthropologists and geneticists in different applications[1-3,15,22,23,25]. Several kinds of research have been conducted in different populations in Nigeria[1,7-9,20,21,26] with respect to dermatoglyphic patterns among families/ethnic groups, but none among families in Irruan, Boki Local Government Area (LGA). Therefore, this study seeks to investigate the digito palma dermatoglyphic patterns among 50 families in Irruan, Boki Local Government Area (LGA), Cross River State, Nigeria.

MATERIALS AND METHODS

Study location and population: A Cross-sectional study was adopted for selecting 50 families in Boki Local Government Area (LGA). The study was carried out at the Department of Genetics and Biotechnology, Faculty of Biological Sciences, University of Calabar, Nigeria from June 2019 to May, 2021. Boki Local Government Area of is in Cross River State, South-South Nigeria, some kilometres from Boje the local government headquarters. Her people are mostly peasant and cash crop farmers in Cocoa, Banana, Timber, etc[8]. There are endowed with a rich forest reserve. The community is about three kilometers from the Calabar-Ikom expressway. This study was carried out solely amongst natives of Irruan clan, using three communities namely: Kakwagom-Irruan, Katchuan and Esom-Achia in Boki Local Government, Cross-River State, Nigeria. A total of 52 individuals were enrolled from the study area using a random sampling technique.

Ethical consideration: Ethical approval was obtained from the Cross River State Ethics Review Committee under the auspices of the Ministry of Health, Cross River State. Copies were made available to selected participants in the study population upon request. The rudiment of the research was explained to participants and consent was obtained before data collection.

Inclusion criteria and exclusion criteria: This research work included individuals whose grandparents and parents are of Boki LGA paternally. Parentage was used as one of the exclusion criteria, as subjects with either or both parents not being of Irruan Origin. Parentage and domiciliation were used as inclusion criteria viz: Adult male and female of Irruan descent and who reside in Irruan-land at the period of the study, both parents having to be of Irruan descent. Consent was also a criterion as intending subjects gave consent to the study by signing (or as the case may thumb-printed). Parentage was used as the only exclusion criterion, as subjects with either or both parents not being Irruan. People with deformed palms and blurred prints were not allowed to participate in this research.

Dermatoglyphic pattern recording and interpretation: Finger and palm prints were recorded using the ink method described by researches[27,28]. The hands of the children included in the study were washed with soap and water to remove dirt and oil from the ridged skin and blot dried to improve the quality of the prints.

Fingerprints: The fingerprints (right and left) of all the subjects were recorded for the study by using black duplicating ink, which was applied to the fingers with a cotton swab. The digits were guided and pressed firmly against the white bond paper clipped onto a board.

Palm prints: The palm prints (right and left) of all the individuals were recorded using black duplicating ink, which was smeared on the palms and pressed on a sheet of recording paper which was kept firm. The hand-prints obtained were checked for their clarity with a magnifying glass (×2) and coded. The presence of the core and the triradii of the dermatoglyphic pattern were checked thoroughly to include the handprint in the study.

Method of reading hand-prints: The hand-prints were observed in a sequential manner under a magnifying glass with ×2 magnifications, from the left-hand 4th digit until the thumb followed by the thumb of the right hand until the 4th digit. The dermatoglyphic analysis included the following: Qualitative analysis that includes finger-tip patterns and quantitative analysis that includes finger ridge count, total finger ridge count and distal deviation of axial triradius or ATD angle. The ATD angle and finger ridges are shown in Fig. 1. The prints obtained were studied qualitatively and quantitatively. The qualitative study applies descriptive methods without the use of numerical data.

Qualitative dermatoglyphic analysis: The frequency of true patterns of loops, whorls and arches was counted on the fingertips of all the 10 digits of individuals. They were assessed for an increase or decrease in mean frequencies. A loop was recognized as a series of ridges that enter the pattern area on one side of the digit, recurve abruptly and leave the pattern area on the same side. A single triradius is present, which is located laterally on the fingertip, where the loop was closed. If the ridge opens on the ulnar side it is called an ulnar loop and if it opens toward the radial side it is called a radial loop. A whorl differs from the loop in the aspect of the concentric arrangement of ridges, with two or more triradii in the latter.
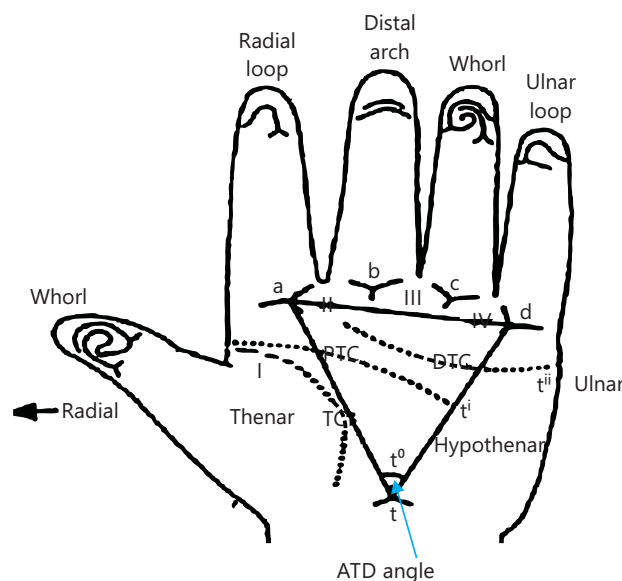

Fig. 1: Diagram showing ATD angles and finger ridges pattern[23]

A whorl may be spiral, symmetrical, double-looped, central-pocketed or accidental, depending upon the internal structure of the whorl pattern. In all the dermatoglyphic patterns observed, arches show the simplest ridge pattern, which is formed by the succession of one or more parallel ridges, which cross the finger from one side to the other without re-curving. These patterns usually do not show the presence of triradii, except when the tented arch is present that will have a triradii point near its midline.

Quantitative dermatoglyphic analysis: This analysis included total ridge count and 'ATD' or 'atd' angle. A ridge count was made by drawing a line (blue line) from the triradius (green dot) to the center (red dot) of the pattern (core) and determining the number of intersected ridges between these two points. Arche is scored zero because it has no triradius to count. A loop has one triradius. Whorls have two triradii, counts are made from each triradii and the larger one is used. A total ridge count (TRC) is the summation of the ridge count for all 10 fingers. Total ridge count was assessed for increase or decrease in average frequency in subjects investigated. The 'ATD' angle is a feature of the palm that captures the relative position of three triradii-a and d, usually located on the distal palm just inferior to the 2nd and 5th fingers, respectively and t whose location can vary on the proximal palm from just distal to the wrist, up to the center of the palm. ATD angles were measured for each palm print by drawing two straight lines through the "a" and "t" triradii and the "d" and "t" triradii and measuring the resulting angle. The ATD angles were compared and assessed for an increase or decrease in mean frequencies between the groups.

Statistical analysis: Data collected were analyzed using the Statistical Package for Social Sciences (SPSS) software version 20.0. The analysis was both descriptive and analytical, as data were presented in simple percentages or frequency, tables were applicable to analyze the distribution of digito-palmar patterns amongst the families. Chi-square (χ^2) was used to determine the frequency of occurrences and significance set at 5%.

RESULTS

Socio-demographic distribution of enrolled participants: Digito-palmar dermatoglyphic patterns among some families and individuals in the Irruan Clan, Boki Local Government Area, Cross River State was carried out using a total of 52 subjects. The participants recruited for this were 25 (48.1%) males and 27 (51.9%) the mean age was 46.51±2.13 years.

The participants enrolled were from Kakwagom-Irruan, Katchuan and Esom-Achia villages with a frequency of 36.5% (19), 40.4% (21) and 23.1% (12), respectively in Boki Local Government, Cross River State, Nigeria. The educational status of enrolled participants was 26 (50%) and 18 (34.6%) for primary school and informal education respectively, while employment status was 38 (73.1%), 9 (17.3%) and 5 (9.6%) for farmers, civil servants and unemployed, respectively. There were significant differences statistically (p<0.05) in the distribution of some socio-demographic parameters of participants like educational status, village of origin and sex (Table 1).

Dermatoglyphic patterns in the study population: The frequency distribution of print pattern in subjects recruited is shown in Table 2 where the loop was 21 (40.4%), followed by whorl at 26.9% (14) and the least was a compound pattern with 13.5% (7). The distribution of print patterns by gender is represented in Table 3. The frequency of loop patterns in males and females are 25% (13) and 15.4% (8), while the compound is 5.8% (3) and 7.7% (4), respectively. There was a significant difference in the distribution of these patterns in males and females statistically (p≤0.05).

The digito-palmar dermatoglyphic variables in both genders are displayed in Table 4. The mean total ridges count in male participant's right hand and left hand are 91.6±8.3 and 90.6±6.7, while female participants are 80.6±7.6 and 75.8±5.9, respectively. The mean a-b ridges count in male participant's right hand and left hand are 41.8±9.2 and 40.6±8.8, while female participants are 40.4±6.2 and 39.4±8.2, respectively.

Table 1: Socio-demographic characteristics of subjects recruited for the study

	Subjects (%) (n = 52)	χ^2 value	χ^2 Tabulated
Sex			
Male	25 (48.1)	01.92	12.71
Female	27 (51.9)		
Age (years)			
Mean age	46.51±2.13		
Village			
Kakwagom-Irruan	19 (36.5)	01.31	03.841
Katchuan	21 (40.4)		
Esom-Achia	12 (23.1)		
Educational status			
Tertiary	3 (5.7)	13.20	07.815
Secondary	5 (9.62)		
Primary	26 (50)		
Informal	18 (34.6)		
Occupation			
Farmers	38 (73.1)	07.04	05.99
Civil servant	9 (17.3)		
Unemployed	5 (9.6)		

±: Plus or minus standard error and Significance level: 5%

Table 2: Frequency distribution of print pattern in subjects recruited

Print patterns	Number of subjects (n = 52)	Percentage (%)
Loop	21	40.4
Arch	10	19.2
Whorl	14	26.9
Compound	7	13.5
Total	52	100

Table 3: Distribution of print patterns by gender

	Arch (%)	Whorl (%)	Loop (%)	Compound (%)	t-test cal	t-test tab
Male	4 (7.7)	5 (9.6)	13 (25)	3 (5.8)	3.19	12.71
Female	6 (11.5)	9 (17.3)	8 (15.4)	4 (7.7)		
Total	10 (19.2)	14 (26.9)	21 (20.4)	7 (13.5)		

Table 4: Mean digito-palmar dermatoglyphic variables in both genders

	Male		Female	
	Mean			
Variables	Right hand	Left hand	Right hand	Left hand
FRC 1	21.8±1.0	20.1±0.9	19.2±1.4	18.0±1.1
FRC 2	14.1±0.8	13.1±0.7	13.2±0.6	12.4±0.9
FRC 3	17.7±1.3	19.7±0.9	14.7±1.4	13.8±1.2
FRC 4	21.6±2.1	22.6±2.4	18.2±2.5	17.3±3.9
FRC 5	16.4±2.4	16.1±1.7	15.3±1.9	14.3±2.0
TFRC	91.6±8.3	90.6±6.7	80.6±7.6	75.8±5.9
a-b RC	41.8±9.2	40.6±8.8	40.4±6.2	39.4±8.2
b-c RC	21.23±1.5	21.03±1.8	20.1±2.0	20.0±1.1
c-d RC	38.4±1.70	38.7±1.20	38.1±1.5	37.1±2.5

FRC: Finger ridge count, TRC: Total ridge counts, 1: Thumb finger, 2: Index finger, 3: Middle finger, 4: Ring finger, 5: Little finger, RC: Ridge count, ±: Plus or minus standard error and Significance level: 5%

The mean axial tri-radius around 'D' of the palm (ATD) and pattern intensity index in both genders on the right hand is shown in Table 5. The ATD angle of the male participant's right hand and female participant's right hand are 53.1±1.2 and 50.4±1.7, respectively, while PII (pattern intensity index) on the male participants' right hand and female right hand are 17.2±2.6 and 13.2±3.9, respectively. Table 6 displayed the mean axial tri-radius around 'D' of the palm (ATD) and pattern intensity index in female and male

Table 5: Mean ATD angle and pattern intensity index in both gender on the right hand

	Male	Female	χ^2 Calculated	χ^2 Tabulated
Mean ATD angle	53.1±1.2	50.4±1.7	10.017	2.571
PII	17.2±2.6	13.2±3.9	4.69	3.182

ATD: Axial tri-radius around 'D' of the palm, PII: Pattern intensity index, ±: Plus or minus standard error and Significance level: 5%

Table 6: Mean ATD angle and pattern intensity index in both gender on the left hand

	Male	Female	χ^2 Calculated	χ^2 Tabulated
ATD angle	52.2±1.5	49.7±1.81	9.053	2.571
PII	18.9±1.2	12.7±2.5	4.16	3.182

ATD: Axial tri-radius around 'D' of the palm, PII: Pattern intensity index, ±: Plus or minus standard error and Significance level: 5%

participant's left hands. The ATD angle of the male participant's left hand and the female participant's left hand are 52.2±1.5 and 49.7±1.81, respectively, while PII (pattern intensity index) on the male participant's left hand and female left hand are 18.9±1.2 and 12.7±2.5, respectively. There were significant differences in the distribution of ATD angle and pattern intensity index in males and females statistically ($p \leq 0.05$).

DISCUSSION

This present study in Irruan Clan, Boki revealed that loops have a frequency of 40%, whorl (26.9%) and arch (19.2%). These findings are similar to the previously reported studies in Ekpoma, Edo State[1], Uban Clan[7], Ntamante, Boki[8], both in Northern Cross River State, Nigeria, in Rivers State[9], among the Okrika and Ikwerre ethnic groups[29] Also, the current study results are similar to the documented research among the Urhobo and Itsekiri in Warri, Delta State[6] and in Liberians[4]. In contrast, the loop finger pattern had the lowest frequency among Ghanaians[30], which is not in harmony with this present finding. Variations in fingerprint patterns of individuals may be due to differences in their ethnic groups since Cross River States is made up of diverse ethnic groups and differences in the number of subjects enrolled in the study. Deepa *et al.*[9], studied the digital dermatoglyphic patterns in Kerala, India and observed that the loops (56.72%) were the most predominant digital pattern in individuals without bronchial asthma, which is in harmony with this present finding, where loops pattern was common in males than females. The index of pattern intensity in this current study showed a higher value in males (17.2±2.6) than the females (13.2±3.9).

Sexual dimorphism was also evident with the males showing a higher value than the females in their mean ridge counts (TFRC) in this present study in Boki, using only three villages. These findings are similar to previously reported studies in Kenyan and Tanzanian populations. The distribution of the frequencies of different finger patterns may be generalized among major population groups as follows: Whorls: Mongoloids (47%) > American Indians (43%) > Europeans (36%) > Africans (27%), Loops: Africans (64%) > Europeans (60%) > American Indians (52%) > Mongoloids (51%), Arches: Africans (9%) > American Indians (5%) > Europeans (4%) > Mongoloids (2%) as documented[31], similar to current findings where the results showed a high frequency of loop patterns in three villages located in Irruan Clan, Boki LGA, Cross River State. Loop patterns were documented by researchers, followed by the arches, then the whorls in the male subjects[29,32] in different Nigerian ethnic groups which are slightly different from the trend of Loop >Whorls > Arches obtained in this study.

The mean ATD (axial tri-radius around 'D' of the palm) angle revealed that male subjects have high values (52.2±1.5) than female participants (49.7±1.81) in both hands from the results of our present study in the Irruan Clan, Boki Local Government Area using three villages. This finding is in tandem with the documented research in Delta State among the Urhobo and Itsekiri people in Warri, Edo State, Nigeria[6], in primary school individuals and Muhimimbili University College of Health Sciences students in Kenyan and Tanzanian, respectively, Indians[33] and in Liberians[4]. In contrast, the ATD angle was high in females than males among Ebira-Tao, Ebira-Etuno and Ebira-Koto tribes in Kogi State, North-Central Nigeria[5]. These variations in mean values of ATD angles between males and females may be due to ethnic differences and the diversity of humans in a Nigerian population.

This research revealed the digito-palmar dermatoglyphics patterns of individuals from Irruan clan, useful in anthropological and ethnic variation studies. The limitation of this pilot study was the small sample size:

- It is recommended that further research should be conducted on variations of digito-palmer dermatoglyphics patterns in different ethnic groups across Cross River State using a larger population size
- Also, research should be conducted on the role of digito- palmer dermatoglyphics complex as a genetic marker and diagnostic tool in human disorders in Nigeria
- Digital scanners should be used as a replacement for the conventional ink method, so as to encourage subjects to participate in this kind of research in Nigeria

CONCLUSION

The quantitative analysis of digito-palmar dermatoglyphics patterns of natives of Irruan clan, Boki Local Government Area was assessed using sampled participants enrolled from three villages. The study showed that loop, whorl, arch and compound fingerprint patterns were 40.4, 26.9, 19.2 and 13.5%, respectively. Male subjects had higher mean ATD angles than female subjects. However, this study has provided baseline information for further anthropological studies and ethnic variations in Irruan people, Cross River State and other populations.

SIGNIFICANCE STATEMENT

Dermatoglyphics are unique to each individual and are helpful to clinicians, anthropologists and geneticists in different applications. There is a paucity of documented research on dermatoglyphic patterns among families/ethnic groups in Irruan clan. Therefore, this study seeks to investigate the dermatoglyphic patterns among 50 families in Irruan, Cross River State, Nigeria. The findings revealed that loop pattern was more prevalent (40.4%), followed by whorl (26.9%) and compound fingerprint patterns (13.5%) were the least. Mean total ridges counts in the male's right hand and left hand were 91.6±8.3 and 90.6±6.7, respectively. Males had significantly higher mean ATD angles than females. These findings could be useful in future anthropological and forensic studies in Nigeria and other populations.

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