OPEN ACCESS
Scholars International Journal of Anatomy and Physiology
Abbreviated Key Title: Sch Int J Anat Physiol
ISSN 2616-8618 (Print) |ISSN 2617-345X (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Palmar Creases and Ancestry Prediction

Omuruka T. C[1*], Osunwoke, E. A[1], Edibamode, E. I[1]

[1]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria

DOI: 10.36348/sijap.2022.v05i02.003 | **Received:** 03.01.2022 | **Accepted:** 12.02.2022 | **Published:** 16.02.2022

***Corresponding author:** Omuruka T. C
Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria

Abstract

Background: The importance and usefulness of dermatoglyphics in crime investigation, anthropology and disease prediction have been stressed wide published. However, there is dearth of information on the use of palmar creases as an adjunct tool in the prediction of tribe/ethnicity and ancestral relationship among populations. Hence, this study was aimed at predicting ancestry and tribal/ethnic relationship and genetic link among the Urhobo, Isoko and Ogoni ethnic groups using palmar creases. ***Materials and Methods***: In this cross-sectional, observational and analytical study, 360 subjects- 180, 105 and 75 Urhobo, Ogoni and Isoko subjects were sampled via a multi-stage sampling technique to ensure randomization. Palm print was obtained using Oghenemavwe and Osaat (2015) dermatoglyphic capture method. Statistical analysis was performed using Statistical Package for the Social (SPSS IBM version 23.0). ***Results and Discussions:*** Using the Ogoni as a reference tribe, the study (Table 1) showed Pearson's Chi-square Analysis for tribe-associated differences in the distribution of pattern based on type/pattern of head of origin of the major palmar creases on the right and left palms, and this was not statistically significant on both palms. But in Table 2a (tribe-associated differences in the distribution of the general shape/appearance of palmar creases on the right and left palms) was observed to be statistically significant (X^2 = 73.283, P = 0.001 for right; X^2 = 47.786, P = 0.001 for left) and Table 3a showed that tribe-associated differences in the distribution of Middle longitudinal crease on the right and left palms was statistically significant (X^2 = 18.135, P = 0.001 for right; X^2 = 36.401, P = 0.001 for left). ***Conclusion***: Middle longitudinal crease in particular and general shape/appearance of palmar creases are discriminatory in distribution amongst the tribe studied and thus suggest a tribal/ethnic relationship and genetic link and common ancestry between the Isoko and Urhobo tribes.

Keywords: Urhobo, Isoko, Ogoni, Ancestry, Prediction, Palmar creases.

INTRODUCTION

Genetic anthropology investigate the transmission of genes (traits) from one generation to another and inter-population variations in view to provide scientific basis for tribe/ethnicity. Genetic anthropologist employ advances in DNA analysis, testing and profiling, and observation and modelling of morphogenetic traits as a clue to tracing the ancestry and ancestors of organisms. Two methods of DNA analysis and profiling have been suggested to help in achieving this. It include Lineage-based approaches and Admixture testing (McKinney, 1990; Fernandez *et al*., 2003; Manfred and Peter, 2011; Leslie, 2006; Banda *et al*., 2015).

Traits which are observable characteristics in humans and transmitted in unique pattern from parents to offspring, are determined by genes (Griffiths *et al*., 2000). One of the traits (phenotypical expression) suggested to be an adjunct in ancestry prediction and genetic link among populations is dermatoglyphics (Norris and Charis, 1990; Namouchi, 2011; Fournier and Ross, 2015; Paul and Paul, 2017).

The term “dermatoglyphic” (which means skin curves) was first used by Cummins to describe the ridge patterns and arrangement on dermal surfaces of the human skin (Cummins, 1926 and Sharma *et al.*, 2007) while the term “crease” are epidermal flexure lines present on palmar or plantar surfaces. They are fixed

and permanent line that is related to connective tissue attachments with the underlying structures or to the extensions of the underlying muscle fibres in the dermis of the crease site. These creases- palmar and digital flexion creases, help the hand's skin stretch and squeeze by providing a support and reinforcement for the skin to fold without bunching up and making it difficult to grab items (Mallouris *et al.,* 2012; Mekbeb, 2019). Palmar creases or palmar flexion creases are line of formations of the palm (established during the embryonic and early foetal periods- 10th to 13th weeks (Kimura, 1991 and Meštrović and Ožegić, 2017) which are readily evident at birth (Adetona *et al.,* 2012; Mallouris *et al.,* 2012; Mattison *et al.*, 2015; Omuruka, 2019). There are three Major (primary) palmar creases and Minor creases. Proximal transverse crease begins at the radial side of the palm and runs medially, slightly curving proximally to terminate at the medial border of the hypothenar eminence. Distal transverse crease begins proximal to the interdigital space between the index and middle fingers (curving gently wrist-ward) and runs to the ulnar side of the palm. Radial longitudinal crease originate at or slightly below the proximal transverse crease and runs proximally towards the wrist, curving laterally. Minor Palmar creases: Are palm creases which are narrower than the major creases and either cross major creases, lead to major palm creases or are apart from major creases. Middle longitudinal (Mid or Middle finger) crease is the minor crease in the middle or anywhere around the central region of the palm (which could be proximal to the middle finger). Other minor creases like Ring finger crease, Little finger crease; Ulnar longitudinal crease have also been identified (Park *et al.,* 2010; Okoro, 2015; Mekbeb, 2019).

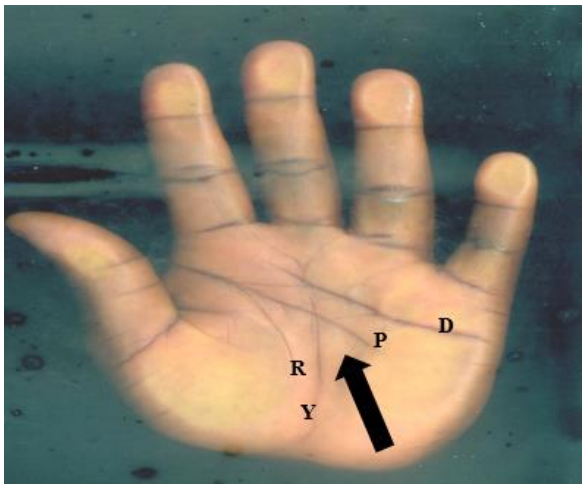


Figure 1: Major and Minor palmar creases. Radial longitudinal (R), Proximal transverse (P), Distal transverse (D) and Minor Longitudinal Creases

A tribe/ethnic group is a human population whose members identify with each other on the basis of common genealogy or ancestry (lineage) and share a common culture, language, history and religion (Cooper *et al.,* 2003; Bayar, 2009; Chandra and Nina, 2010; People and Bailey, 2010; Banda *et al.,* 2015). The Urhobos (one of the ethnic group in Nigeria) is the predominant tribe in Delta State (Ethiope East, Ethiope West, Ughelli North, Ughelli South, Okpe, Sapele, Udu, Uvwie, and Warri South Local Government Areas). They speak the Urhobo language. Their neighbors are the Bini (Edo people) to the north, the Ukwuani to the northeast, the Ijaw to the south, the Isoko to the southeast, the Itsekiri and Ijaw to the west (Ekeh, 2007). Similarly the Isoko people are distinct minority ethnic group in Delta State (Isoko North and Isoko South Local Government Areas), although widely believed to be related to the Urhobo people (by blood) particularly by language and culture leading to the labelling of Urhobo and Isoko as "Sobo or Osobo" (Aziakpono, and Ukpebor, 2013; Ubachukwu and Emeribe, 2017). The Ogoni people on the other hand are one of the major tribe in Rivers State of Nigeria found in Eleme, Khana, Gokana and Tai Local Government Areas). They are bounded on the North by the Imo River and their Igbo neighbors, on the South by the littoral flats inhabited by the Andoni, on the East by the Opobo River and the Ibibio, and on the West by the Ikwerre people of Port Harcourt. The Ogonis speak Ogoni language (Vobnu, 2001; Nkpaa *et al*., 2017; Tombari and Lekpa, 2018).

Through the age long practice of palmistry people believed that the future, family history and tribe/race of a person can be known by the observation and counting of palmar creases (Frith and Heron-Allen, 1883). The importance and usefulness of dermatoglyphics in crime investigation, anthropology and disease prediction have been stressed by scholars like Norris and Charis (1990), Namouchi (2011), and Pandey and Sharma (2016). But the use of dermatoglyphics (fingerprints) in tribal/racial prediction has been highlighted by rather few scholars (Chaube, 1977, Fournier and Ross, 2015 and Paul and Paul, 2017). Also Gwunireama and Ihemelandu (2010), Bhardwaj *et al*., (2015) and Igbigbi *et al*., (2018) have opined that substantial variation in trait being studied among ethnic groups/tribes suggest different ethnic groups while similarities could mean common ancestry, genetic link/admixture and relationship.

Despite large volume of literatures on dermatoglyphics (fingerprints) and its clinical and anthropological implications, and challenges of DNA profiling, gene mapping and admixture technique encountered by scientist and anthropologist, there is dearth of documented investigation on the use of palmar creases as an adjunct tool in the prediction of tribe/ethnicity and ancestral relationship among populations (other than relying solely on oral history, similarity in language, geographical location). Hence, this study was aimed at predicting ancestry and tribal/ethnic relationship and genetic link among the Urhobo, Isoko and Ogoni ethnic groups using palmar creases.

MATERIALS AND METHODS

Study Sample

In this cross-sectional, observational and analytical study, 360 subjects- 180, 105 and 75 Urhobo, Ogoni and Isoko subjects were sampled via a multi-stage sampling technique to ensure randomization. According to their census population figure, the sample size of each tribe was determined using Cochran, (1963) sample size (SS) determination formulae;

$$SS = \frac{z^2 x\ p\ x\ q}{d^2}$$

Where
SS = Sample Size
p = Proportion of family size
z = Z value = 1.96 (for 95% confidence level)
q = 1-p
d = Confidence interval = 3% (tolerance level of confidence of 0.03)

Criteria for Subject Selection

- An individual was considered to participate in the study (being a member of a particular tribe) if the parents, grandparents and great grandparents are of the same ethnic group.
- Subjects selected were between the ages of five (5) and seventy (70).
- Subjects selected had no form of anatomical abnormality of any of the palms and creases.

Ethical Consideration

Ethical clearance was sort from the Research Ethic Committee of the University of Port Harcourt and an approval was given with the reference number UPH/CEREMAD/REC/MM71/007. Informed consent letter was also issued to the participants before being recruited for this study.

Methods of Data Collection

Palm print was obtained using Oghenemavwe and Osaat (2015) dermatoglyphic capture method. In this procedure the palms were placed on the scanning surface of Hp G3110 Photo (print) scanner connected to a laptop via a USB cord and powered with 100watt solar power inverter connected to 12volts rechargeable battery. The stored captured palm image was magnified and the variant pattern types of palmar creases were observed, identified and recorded thus;

Variant based on pattern of origin of major palmar creases: Type 1- a single (one) head of origin or fusion of Radial longitudinal, Proximal transverse and Distal transverse Creases at their point of origin; Type 2- a single (one) head of origin or fusion of Radial longitudinal and Proximal transverse, and a separate origin of Distal transverse Creases; Type 3- separate heads of origin or non-fusion of Radial longitudinal, Proximal transverse and Distal transverse Creases.

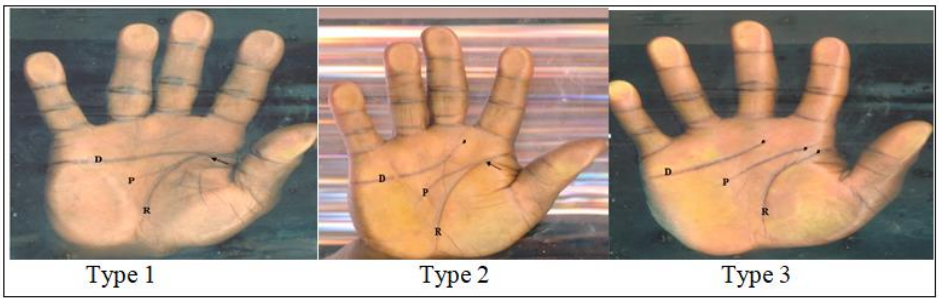


Figure 2

Variant based on pattern shape/appearance of palmar creases: Type M- shape resembling letter "M"; Type V- any other appearance/shape other than letter "M".

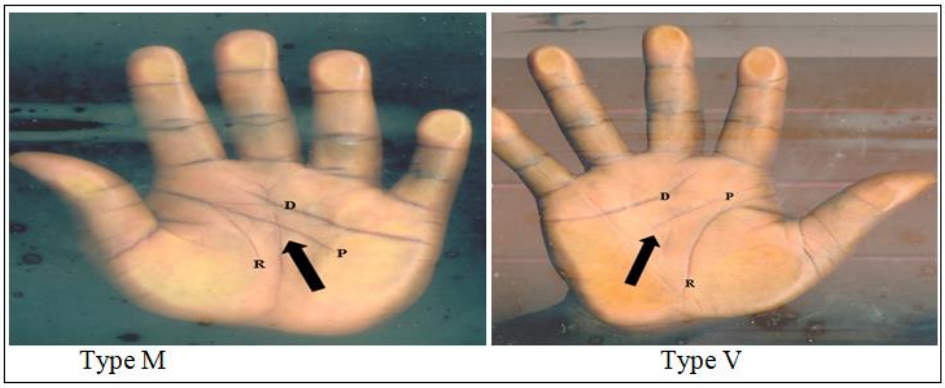


Figure 3

Variant based on presence/absence of middle longitudinal crease: Type Y- Middle longitudinal crease is present; Type X- Middle longitudinal crease is absent.

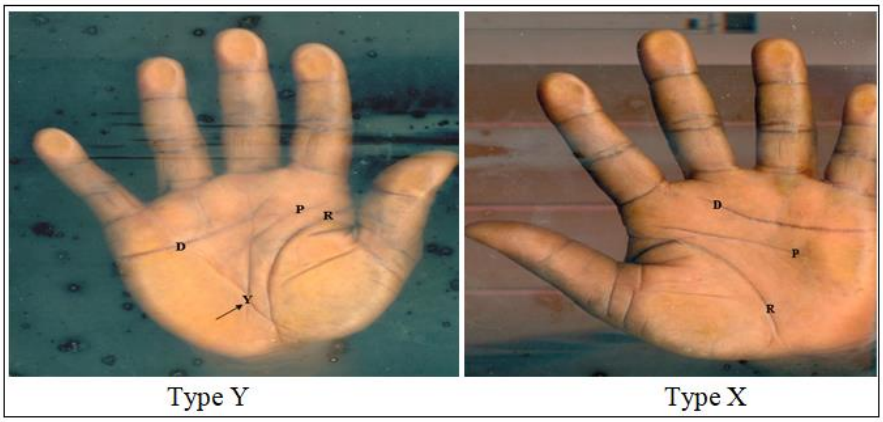


Figure 4

Methods of Data Analysis

Statistical analysis was performed using Statistical Package for the Social (SPSS IBM version 23.0). Chi-square (X^2) analysis of association was used to determine association of palmar creases (each pattern type) with tribe using the Ogonis as a reference tribe. Discriminant function analysis was used to evaluate the relationship and discriminatory pattern distribution of palmar creases variant types that exist amongst the tribes, and thus used to infer and predict tribal relationship, genetic link and ancestry. All analyses were carried out at 95% confidence level and significance was taken at P<0.05.

RESULT

Table 1a: Tribe-associated differences in the distribution of pattern based on type/pattern of head of origin of the major palmar creases on the right and left palms

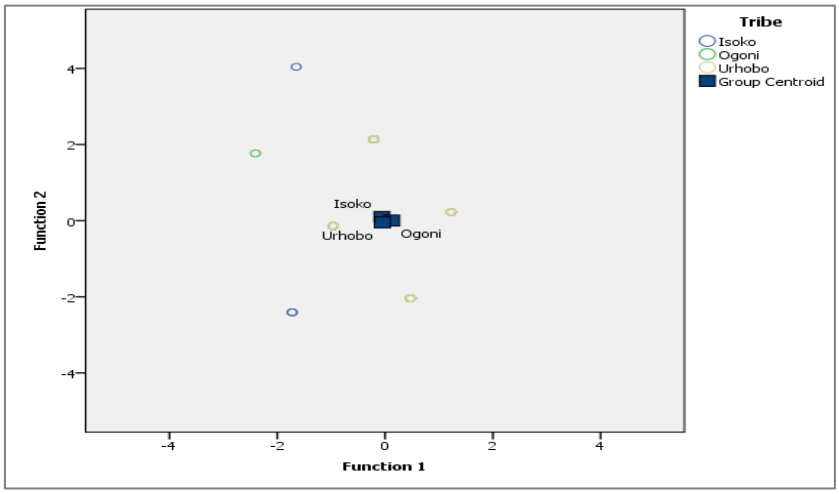
Tribe	Crease Pattern			Pearson's Chi-square Analysis		
	Type 1	Type 2	Type 3	df	Chi-square	P-value
Right Side						
Isoko	1 (1.3)	44 (58.7)	30 (40.0)	4	4.769	0.312
Ogoni (Ref)	1 (1.0)	53 (50.4)	51 (48.6)			
Urhobo	0 (0)	103 (57.2)	77 (42.8)			
Left Side						
Isoko	2 (2.7)	38 (50.7)	35 (46.7)	4	10.161	0.138
Ogoni (Ref)	0 (0)	54 (51.4)	51 (48.6)			
Urhobo	0 (0)	108 (60.0)	72 (40.0)			

Not significant at P<0.05

Table 2b: Group prediction using centroids (Discriminant Function) for Types 1/2/3

Tribe	F_C 1	F_C 2
Isoko	-0.059	0.1
Ogoni	0.126	0.004
Urhobo	-0.049	-0.044

F_C: Functions at the centroids



Graph 1: Canonical Discriminant Function for group categorization using Type 1/2/3

Table 2a: Tribe-associated differences in the distribution of the general shape of the palmar creases on the right and left palms

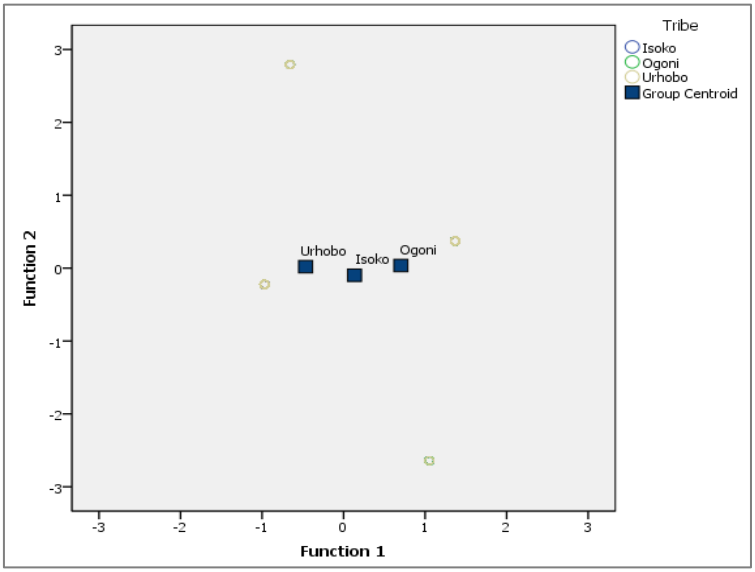
Tribe	Crease Pattern		Pearson's Chi-square Analysis		
	Type M	Type V	df	Chi-square	P-value
Right Side					
Isoko	39 (52.0)	36 (48.0)	2	73.283	0.001*
Ogoni (Ref)	30 (28.6)	75 (71.4)			
Urhobo	142 (78.9)	38 (21.1)			
Left Side					
Isoko	42 (56.0)	33 (44.0)	2	47.786	0.001*
Ogoni (Ref)	35 (33.3)	70 (66.7)			
Urhobo	135 (75.0)	45 (25.0)			

* = significant at P<0.05

Table 2b: Group prediction using centroids (Discriminant Function) for Types M/V

Tribe	F_C 1	F_C 2
Isoko	0.134	-0.098
Ogoni	0.703	0.036
Urhobo	-0.466	0.020

F_C: Functions at the centroids



Graph 2: Canonical Discriminant Function for group categorization using Types M/V

Table 3a: Tribe-associated differences in the distribution of Middle longitudinal crease on the right and left palms

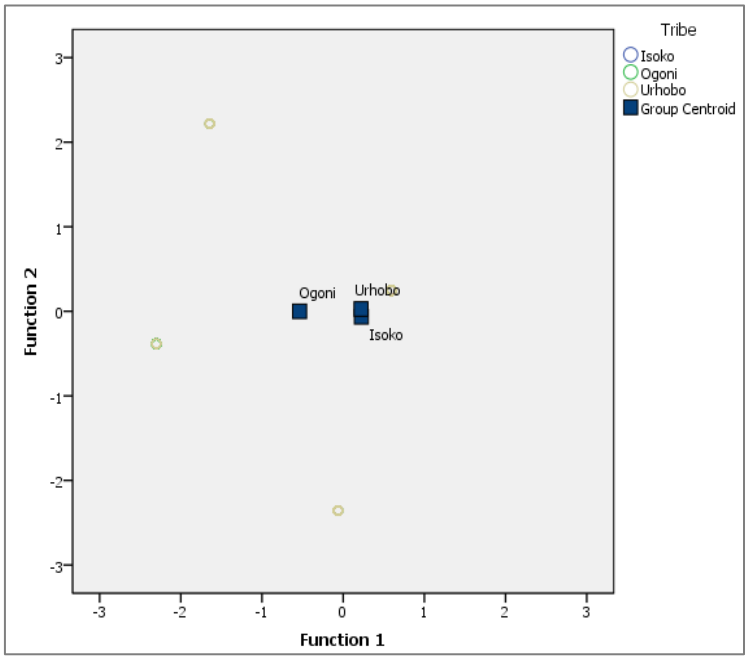
Tribe	Crease Pattern		Pearson's Chi-square Analysis		
	Type X	Type Y	df	Chi-square	P-value
Right Side					
Isoko	15 (20.0)	60 (80.0)	2	18.135	0.001*
Ogoni (Ref)	45 (42.9)	60 (57.1)			
Urhobo	31 (17.2)	149 (82.8)			
Left Side					
Isoko	8 (10.7)	67 (89.3)	2	36.401	0.001*
Ogoni (Ref)	41 (39.0)	64 (61.0)			
Urhobo	21 (11.7)	159 (88.3)			

* = significant at P<0.05

Table 3b: Group prediction using centroids (Discriminant Function) for Types X/Y

Tribe	F_C 1	F_C 2
Isoko	0.224	-0.065
Ogoni	-0.537	0.000
Urhobo	0.220	0.027

F_C: Functions at the centroids



Graph 3: Canonical Discriminant Function for group categorization using Types X/Y

Using the Ogoni as a reference tribe, Table 1a showed Pearson's Chi-square Analysis for tribe-associated differences in the distribution of pattern based on type/pattern of head of origin of the major palmar creases on the right and left palms, and this was not statistically significant on both palms. But in Table 2a (tribe-associated differences in the distribution of the general shape/appearance of palmar creases on the right and left palms) was observed to be statistically significant (X^2 = 73.283, P = 0.001 for right; X^2 = 47.786, P = 0.001 for left) and Table 3a showed that tribe-associated differences in the distribution of Middle longitudinal crease on the right and left palms was statistically significant (X^2 = 18.135, P = 0.001 for right; X^2 = 36.401, P = 0.001 for left).

Also, summary of results of Discriminant Function analysis for each variant types are presented in Tables 1b, 2b and 3b, and Graphs 1, 2 and 3. Discriminant Function (Group prediction using centroids) for Types 1/2/3 (Table 1b) showed that the Fc 1 (function at centroid 1) is -0.059 and Fc 2 is 0.1 for the Isoko tribe, Fc 1 is -0.049 and Fc 2 is -0.044 for the Urhobo tribe, and Fc 1 is 0.126 and Fc 2 is 0.044 for the Ogoni tribe; for Types M/V (Table 2b) the Fc1 and Fc 2 values for Isoko are 0.134 and -0.098 respectively, Fc 1 is -0.466 and Fc 2 is 0.020 for the Urhobo tribe, and that of Ogoni is Fc 1 = 0.703 and Fc 2 = 0.036; for Types X/Y (Table 3b), Isoko Fc 1 is 0.224 and Fc 2 is -0.065, Urhobo Fc 1 is -0.537 and Fc 2 is -0.000, and that of Ogoni is Fc 1 = 0.220 and Fc 2 = 0.027.

DISSCUSION

Using the Ogoni as a reference tribe (comparing Isoko and Urhobo tribes against Ogoni), variant types of palmar creases based on type/pattern of origin of major palmar creases showed no tribe-associated difference in each of the palms, and subjecting this observation further to Discriminant function analysis/graph it was evident that the group centroids of the three tribes have value (same pattern for all tribes) that are within the same centroid range which is indicative of non-discriminatory pattern. This suggests that palmar creases at this level (pattern of origin of major palmar creases) may be a non-discriminatory parameter for predicting tribal relationship among the study populations. This supports the study of Omuruka (2019) who posited that level 1 dermatoglyphic features may not be a reliable indicator for predicting paternity.

Interestingly there is tribe-associated difference in the distribution of the general shape/appearance of the palmar creases (Types M/V) on the right and left palms. From the Discriminant function test Types M and V variants of palmar creases showed distribution values that have different centroid ranges for the three tribes. However, the centroid for the Urhobo and Isoko tribes are on the negatives at different functions (Fc 1 and Fc 2 respectively) while the Ogoni tribe seem to have distribution that differs from Isoko and Urhobo tribes (but closer to the Isoko). Thus, pattern type of palmar creases based on general shape/appearance seem to be discriminatory amongst the tribes but suggest that there may have been brief interaction between the Isokos and Ogonis than between the Ogonis and Urhobos. Therefore, according to Gwunireama and Ihemelandu (2010), this depicts that Types M/V palmar crease pattern is different from each of the tribes studied, suggesting that they are different heterogeneous groups since there is substantial variation amongst the tribes. But this however, may not be strong enough to come to the conclusion of common ancestry or genetic link amongst the tribes.

Similarly, associated between Middle longitudinal crease (Types X/Y variant) and the tribes studied proved to be significant in both palms. The Discriminant function test also illustrated that this variant (Types X and Y) are highly discriminatory because the group centroids value of the Ogoni tribe is far away from that of Isoko and Urhobo tribes (which have similar centroid ranges- within Fc 1 negatives). Thus, the distribution of Middle longitudinal crease for the Ogoni tribe is discriminatory from Isoko and Urhobo since the distance between the centroid values for the Ogoni tribe is visibly larger when compared to the distance between the Isoko and Urhobo tribes. In other words, Middle longitudinal crease establish tribal relationship and genetic/ancestral link between Isoko and Urhobo tribes, and that the Ogoni tribe is a distinct group from them. Chaube (1977), Bhardwaj *et al*., (2015) and Igbigbi *et al*., (2018) had opined that if there are substantial similar characteristic patterns of inheritable features seen among tribes it then suggests that a relationship exists between them and Gwunireama and Ihemelandu (2010) and Koneru *et al.*, (2013), opined that substantial variation of traits between tribes suggest no genetic link between them. This explains that palmar crease particularly Middle longitudinal crease could be a pointer to predicting racial grouping, ancestry and tribal/ethnic relationship amongst different populations. The findings of Fournier and Ross (2015) and Paul and Paul (2017) on their work on Level 2 fingerprints agrees with this assertion. The report of Sharma *et al.*, (2007) on the dermatoglyphics variation of Indian populations also supports this observation.

CONCLUSION

Middle longitudinal crease in particular and general shape/appearance of palmar creases are discriminatory in distribution amongst the tribe studied and thus suggest a tribal/ethnic relationship and genetic link and common ancestry between the Isoko and Urhobo tribes. It may therefore be postulated that palmar creases (although not all variant types) may be an adjunct for tribal and racial grouping, and predicting genetic link/relationship, admixture and ancestry among populations.

ACKNOWLEDGEMENTS

We appreciate the subjects who consented to participate in this study, our research assistants and the entire Department of Anatomy, University of Port Harcourt, Nigeria.

Conflict of Interest: Authors declare that no conflicting interest exist.

Source of Funding: Self-funding.

AUTHOR'S CONTRIBUTION

We write to state that all authors have contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Authors A' (Omuruka, ThankGod C) designed the study and protocol, wrote the first draft of the manuscript; 'Authors B' (Osunwoke, Emeka A 'reviewed the design, protocol; 'Author C' (Edibamode, Innocent E) examined the intellectual content of the manuscript. All authors read and approved the final manuscript.

REFERENCES

- Adetona, M. O., Oladapo, O. O., & Akinyemi, J. O. (2012). Palm flexion creases variants among Nigerians. *African Journal of Biomedical Research*, 15(2), 93-96.
- Aziakpono, O. M., & Ukpebor, E. E. (2013). Baseline, spatial and temporal variation of total

suspended particulate (TSP) matter in Isoko land. *Journal of Environmental Chemistry and Ecotoxicology*, 5(5), 129-135.

- Banda, Y., Kvale, M. N., Hoffmann, T. J., Hesselson, S. E., Ranatunga, D., Tang, H., ... & Risch, N. (2015). Characterizing race/ethnicity and genetic ancestry for 100,000 subjects in the Genetic Epidemiology Research on Adult Health and Aging (GERA) cohort. *Genetics*, *200*(4), 1285-1295.
- Bayar, M. (2009). Reconsidering Primordialism: An alternative approach to the Study of Ethnicity. *Ethnic and Racial Studies*, 32(9), 1639-1657.
- Bhardwaj, N., Bhardwaj, P., Tewari, V., & Siddiqui, M. S. (2015). Dermatoglyphics analysis of fingertip and palmar print patterns of obese children. *International Journal of Medical Science and Public Health*, 4, 946-949.
- Chandra, F., & Nina, T. H. (2010). A New Conceptualization of Ethnicity for Social Epidemiologic and Health Equity Research. *Social Science & Medicine*, 71(2), 251-258.
- Chaube, R. (1977). Palmar creases in population studies. *American Journal of Physical Anthropology*, 47, 7-9.
- Cooper, R. S., Kaufman, J. S., & Ward, R. (2003). Race and Genomics. *New England Journal of Medicine*, 348, 1166-1170.
- Cummins, H. (1926). Epidermal ridge Configurations in Developmental Defects, with particular Reference to the Ontogenetic Factors which condition Ridge direction. *American Journal of Anatomy*, 38, 89-151.
- Ekeh, P. P. (2007). The Urhobo People of the Niger Delta. Urhobo Historical Society, Nigeria. Pp. 102-300.
- Fernandez, J. R., Shriver, M. D., Beasley, T. M., Rafla-Demetrious, N., Parra, E., Albu, J., ... & Allison, D. B. (2003). Association of African genetic admixture with resting metabolic rate and obesity among women. *Obesity research*, *11*(7), 904-911.
- Fourner, N, A., & Ross, A. H. (2015). Sex, Ancestral, and Pattern Type Variation of Fingerprint Minutiae: A Forensic Perspective on Anthropological Dermatoglyphics. *American Journal of Physical Anthropology, 160(4), 625-632.*
- Frith, H., & Heron-Allen, E. (1883). Chiromancy or the Sevience of Palmistry. George Roitledge and Sons. Pp. 20.
- Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., and Gelbart, F. eds (2000). Genetics and the Organism-Introduction: An Introduction to Genetics Analysis. 7th edition. H. Freeman. New York. Pp. 280-350.
- Gwunireama, I. U., & Ihemelandu, E. C. (2010). Geographical Influence on Digit ratio (2D:4D): A Case Study of Andoni and Ikwerre Ethnic Groups in Niger Delta, Nigeria. *Journal of Applied Biosciences*, 27, 1736–1741.
- Igbigbi, P. S., Ominde B. S., & Oyibojoba O. A. (2018). Dermatoglyphic Patterns of Schizophrenic Patients in a Nigerian Population. *International Journal of Anatomy and Research*, 6(2.1), 5114-5121.
- Kimura, S. (1991). Embryologic Development of Flexion creases. *Birth defects*, (27)2, 113-129.
- Koneru, A., Nellithady, G. S., Ramesh, D. N. S. V., & Patil, R. (2013). Comparison of lips print in two different populations of India: Reflection based on preliminary examination. *Journal of forensic Dental Sciences*, 5(1), 11-15.
- Leslie O. H. (2006). Genetic Genealogy- Scientific Proof that Egyptians are descendants of Annunaki Alien Race. http://www.abovetopsecret.com/forum/thread1197575/pg3. Retrieved September. 20, 2018.
- Mallouris, A., Yiacoumettis, A., Thomaidis, V., Karayiannakis, A., Simopoulos, C., Kakagia, D., & Tsaroucha, A. K. (2012). A record of skin creases and folds. *European Journal of Plastic Surgery*, *35*(12), 847-854.
- Manfred, K., & Peter, K. (2011). Improving Human forensics through advances in Genetics, Genomics and Molecular biology. *Nature Reviews*, 12, 179-192.
- Mattison, S. M., Brunson, E. K., & Holman, D. J. (2015). Palmar Creases: Classification, Reliability and Relationships to Fetal Alcohol Spectrum Disorders (FASD). *Coll. Antropology*, 39(3), 769-774.
- McKinney, M. L. (1990). Classifying and Analysing Evolutionary Trends. Belhaven, London. Pp. 28-58.
- Mekbeb, A. (2019). Prevalence of the Different Types of Palmar Creases among Medical and Dental Students in Addis Ababa. *Ethiopia. Ethiopian Journal of Health Sciences*, 29(3), 391.
- Meštrović T., & Ožegić O. (2017).Variations of Interdigital flexion creases: Inciting the curiosity of the Researchers, Professionals and the Public. *International Journal of Anatomical Variation*, 10(2), 28-29.
- Namouchi, I. (2011). Anthropological significance of dermatoglyphic trait variation: an intra-Tunisian population analysis. *International Journal of Modern Anthropology*, 4, 12-27.
- Nkpaa, K. W., Amadi, B. A., & Wegwu, M. O. (2017). Trace elements levels in drinking water from Gokana, Ogoni land, River State, Nigeria. *International Journal of Hydrology*, 1(2), 55–57.
- Norris, M. D., & Charis, C. P. (Eds). (1990). Trends in Dermatoglyphic Research. Kluwer Academic Publishers: Dordrecht/Boston/London. Pp. 4.

- Oghenemavwe, E. L., & Osaat, R. S. (2015). An improvise Easy Digital Method for Palmar and Plantar Dermatoglyphics. *Bioscience and Bioengineering*, 1(3), 85-89.
- Okoro, I. O. (2015). The Hand that Handles the Scalpel. Babcock University Press. Ilishan-Remo, Ogun State, Nigeria. Pp. 15-18.
- Omuruka, T. C. (2019). Genetics of Fingerprints and Lip print: Inheritance patterns, Genetic Linkage and Gender Influence. Lap Lambert Academic Publishing. Pp. 95-99.
- Pandey, A., & Sharma, A. N. (2016). Formulation of Transverse Flexion Creases: Validation of Inheritance, Twin Diagnosis and Ethnic. *Variation. Journal of Humanities and Social Science*, 21(5), 41-49.
- Park, J. S., Shin, D. S., Jung, W., & Chung, M. S. (2010). Improved analysis of palm creases. *Anatomy and Cell Biology*, 43,169-177.
- Paul, C. W., & Paul, J. N. (2017): Comparison of Digital Patterns at Level 2 of Ikwerre and Kalabari People of Southern Nigeria. *European Journal of Pharmaceutical and Medical Research*, 4(12), 9-13.
- People, J., & Bailey, G. (2010). Humanity: An Introduction to Cultural Anthropology. 9th edition. Wadsworth Cengage Learning Publisher. Pp. 389.
- Sharma, P., Gautam, A., & Tiwari, P. (2007). Dermatoglyphic variations in five ethno-geographical cohorts of Indian populations: A Pilot Study. *The Internet Journal of Biological Anthropology*, 2(1), 1-7.
- Tombari, B., & Lekpa, K. D. (2018). The Petroleum Exploitation and Pollution in Ogoni, Rivers State, Nigeria: The Community Perspective. *European Scientific Journal*, 14(32), 197-212.
- Ubachukwu, N. N., & Emeribe, C. N. (2017). The 2012 Flooding in Selected Parts of Isoko South, Delta State: Assessment of Socio-Economic Impacts. *Mediterranean Journal of Social Sciences*, 8(1), 353-358.
- Vọbnu, S. K. (2001). Origin and languages of Ogoni people. Boori, KHALGA: Ogoni Languages and Bible Center.