OPEN ACCESS
Saudi Journal of Medicine
Abbreviated Key Title: Saudi J Med
ISSN 2518-3389 (Print) |ISSN 2518-3397 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com/journal/sjm/home

Original Research Article

An Investigation of Inheritance Pattern of Fingerprints of Nigerian Families Resident in Rivers State, Nigeria

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| **Received:** 01.02.2019 | **Accepted:** 11.02.2019 | **Published:** 28.02.2019
DOI: 10.36348/sjm.2019.v04i02.009

Abstract

Background: The ridge like impressions noticeable on the entire finger is called fingerprint. The study of fingerprints as a means of identification is called dactyloscopy and this process requires the comparison of the fingerprints of a yet to be identified individual to that of others within a data base to ascertain the extent of similarity; so as to draw inference of its origin. There is paucity of information on the Digital Patterns in Parents and Outcome in Offspring. ***Aim and Objective***: This research was aimed at investigating the combinations of digital patterns in parents and outcome in offspring in Nigerian families resident in Rivers State, Nigeria. This study was done specifically on the digital prints. ***Materials and Methods:*** In this study a cross-sectional study design was adopted to determine the inheritance patterns of fingerprint and lip print among 150 families in the study population. The inheritance patterns of these traits were compared to each other. Convenient sample method was used. Generally statistical analysis was performed using XLSTAT (Addinsoft Version 2015.4.01.21575). Chi-square analysis was used to analyse association, trends and distribution difference of the traits (confidence level at 95%). ***Results and Discussions***: The expressivity of the one fingerprint pattern over the other was tested using adjusted Mendelian Chi-square analysis. It was expected that if a trait is dominant over the other it will not have a distribution result that is different from the critical chi-square value of 3.841. Thus, indicating insignificance. Traits with mathematically similar pattern of distribution to that postulated by Mendel will be considered the dominant trait irrespective of its distribution. When the inheritance of the various traits was compared on the assumption of independent existence and dominant-recessive expressivity using the Mendel mathematical model, it was observed that Arch was dominant over Loop and whorl. While loop influenced Whorl in an incomplete fashion. The findings from the study suggest that the finger print pattern is tri-allelic non-codominant with a phenotypic expression of reduced penetrance. ***Conclusion:*** This suggests that the finger print pattern is tri-allelic non-codominant with a phenotypic expression of reduced penetrance.

Keywords: Patterns, Parents, Offspring, Outcome, Rivers State.

INTRODUCTION

The ridge like impressions noticeable on the entire finger is called fingerprint. The study of fingerprints as a means of identification is called dactyloscopy and this process requires the comparison of the fingerprints of a yet to be identified individual to that of others within a data base to ascertain the extent of similarity; so as to draw inference of its origin [1-5].

Fingerprints have been known to be used in crime investigation to establish the presence of a victim or a suspect in a crime scene since they are visible with the naked eyes but latent prints are not visible with naked eyes [6, 7]. Finger prints have been confirmed to be unique among individuals [8]; however, some studies have suggested that its morphological appearance and configuration depict traits that can be inherited [9-11] especially when evaluating diseases and congenital abnormalities [12-15].

Some researchers have worked on dermatoglyphics on different subjects [16-28]. There is paucity of information on the Digital Patterns in Parents and Outcome in Offspring

Aim and Objective: This research was aimed at investigating the combinations of digital patterns in parents and outcome in offspring in Nigerian families resident in Rivers State, Nigeria.

Scope of the Study: This study was done specifically on the digital prints.

MATERIALS AND METHODS

Research Design

In this study a cross-sectional study design was adopted to determine the inheritance patterns of fingerprint and lip print among 150 families in the study population. The inheritance patterns of these traits were compared to each other.

Volunteer families were conveniently selected from across Rivers State without consideration to ethnicity; as the States is multi-ethnic with families from various parts of the country due to industrialization. Although only population of Nigerian descent was selected for this study to ensure samples analysed were not of foreign origin, subjects sampled were between the ages of ten to sixty years. Each family sampled was comprised of at least father, mother and a child.

Sample and sampling techniques

Convenient sampling and Sequence generated techniques was adopted for this study. The former was used due to paucity of literature on complete family size and number within the study area while the latter was to ensure randomization.

Unique traits (parameters-fingerprint and lip print) of individuals was collected among families of Nigerian origin in Rivers State via the following techniques;

Convenience sampling

This was used as a result of the homogenous nature of the traits being studied (uniform for all population), and the inability of literature to establish or predict the complete family size and number (per stratum) within the study area. Therefore having in mind the population of the study area, 200 families was conveniently selected.

Sequence generation method

In order to ensure randomization, computer-generated random sequence of 150 families of the total 200 families was adopted using Excel sequence generated format.

Collection of Data

(Traits) was relied on informed consent of volunteer subjects. The fingerprints were obtained using print scanner (Hp G3110 Photo scanner). The scanner was powered using 500watt solar power inverter connected to 12volts rechargeable battery. Adopting Oghenemavwe and Osaat (2015) digital print model the hands of the subjects as well as the glass surface of the scanner were thoroughly cleaned with sterilized tissue wiper. The palm and fingers were placed in a way that little or no contact was made on the glass surface of the scanner. Using the photo snapping tool of the scanner the image of the palm and fingers were captured. This was to ensure that fingers (and lips) of the subjected were not contaminated and print clear and sharp yet not dented. After obtaining the fingerprint using the Hp G3110 photo scanner, the prints was magnified using the zooming tool on Hp laptop connected to the scanner via USB cords. The fingerprints pattern was observed to identify the three primary fingerprint patterns: Arch (A), Loop (L) and Whorl (W). The data gathered was computed in Excel sheet.

Criteria for Subject Selection

Inclusion criteria

- Every selected family had at least an offspring (not adopted).
- Subjects had no form of anatomical abnormality of the fingers and lip.
- Subjects selected were Nigerian by birth.
- Subjects selected were between the age of ten (10) and sixty (60).

Exclusion criteria

- Single parents or no child.
- Torn and damaged fingers or thumb and lips.
- Fingers and lips having scars.
- Families of foreign descent.
- Subjects below the age of ten (10) and above the age of sixty (60).

Method of data analysis

Generally statistical analysis was performed using XLSTAT (Addinsoft Version 2015.4.01.21575). Chi-square analysis was used to analyse association, trends and distribution difference of the traits (confidence level at 95%).

Duration of Study

This study was done from January 10- November 15, 2017.

Ethical Clearance

Ethical clearance was obtained from the Research ethics committee of the University of Port Harcourt, Nigeria.

RESULTS

Trait comparison 1: Arch vs Loop

In table 1a below, the distribution of the Arch and Loop in the offspring with respect to the parental combination was presented and it indicated that there was equal percentage outcome in the offspring.

Table-1a: The combination of arches and loops in parents and outcome in offspring

S/N	Parents	Offspring	
		Arch (A)	Loop (L)
1	Father A / mother A	7	3
2	Father A / mother L	5	7
3	Father L / mother A	10	6
4	Father L / mother L	6	17

In table 1b, when Arch was assumed to be dominant, more insignificance was observed for the two critical combinations; that is when both parents were had Arch prints and Loop prints. But Whorl only conformed to the Mendelian distribution when heterozygosity was observed (arch in father and loop in mother; X^2cal = 1.778.

Table-1b: Mendelian chi-square test of dominance between arches and loops

Parental trait combination	If arch was dominant			If loop was dominant		
	Calculated	Critical	Inference	Calculated	Critical	Inference
Arch in both parents	0.900	3.841	Insignificant*	4.900	3.841	Significant
Arch in father and loop in mother	7.111	3.841	Significant	1.778	3.841	Insignificant*
Loop in father and arch in mother	1.333	3.841	Insignificant*	12.000	3.841	Significant
Loop in both parents	1.565	3.841	Insignificant*	12.565	3.841	Significant

*Level of insignificance in loop implies that arch is dominant over loop

Trait comparison 2: Arch vs Whorl

In table 2a, the distribution of the Arch and Whorl in the offspring with respect to the parental combination showed that there was equal percentage outcome in the offspring.

Table-2a: The combination of arches and whorls in parents and outcome in offspring

S/N	Parents	Offspring	
		Arch (A)	Whorl (W)
1	Father A / mother A	7	0
2	Father A / mother W	10	5
3	Father W / mother A	3	11
4	Father W / mother W	7	20

In table 2b, when arch was assumed to be dominant, more insignificance was observed for the two critical combinations; that is when both parents were had Arch prints and Loop prints, but Loop only expressed conformance when heterozygosity was observed (Whorl in father and Arch in mother; X^2cal = 0.095).

Table-2b: Mendelian chi-square test of dominance between arches and whorls

Parental trait combination	If arch was dominant			If whorl was dominant		
	Calculated	Critical	Inference	Calculated	Critical	Inference
Arch in both parents	0.000	3.841	Insignificant*	7.000	3.841	Significant
Arch in father and whorl in mother	0.556	3.841	Insignificant*	13.889	3.841	Significant
Whorl in father and arch in mother	21.429	3.841	Significant	0.095	3.841	Insignificant*
Whorl in both parents	1.815	3.841	Insignificant*	14.815	3.841	Significant

*Level of insignificance in loop implies that arch is dominant over whorl

Trait comparison 3: Loop vs Whorl

In table 3a, the distribution of the Loop and Whorl in the offspring with respect to the parental combination was seen to have seemingly equal outcome in the offspring.

Table-3a: The combination of loops and whorls in parents and outcome in offspring

S/N	Parents	Offspring	
		Loop (L)	Whorl (W)
1	Father L / mother L	17	9
2	Father L / mother W	26	20
3	Father W / mother L	30	34
4	Father W / mother W	19	20

In table 3b, when Loop and Whorl were compared for expressivity, the only none-different distribution as postulated by Mendel was observed in Loop and it was when both parents had Loop prints pattern (X^2cal = 3.115). All other assumptions were significantly different from the Mendelian distribution.

Table-3b: Mendelian chi-square test of dominance between loops and whorls

Parental trait combination	If loop was dominant			If whorl was dominant		
	Calculated	Critical	Inference	Calculated	Critical	Inference
Loop in both parents	3.115	3.841	**Insignificant***	11.115	3.841	Significant
Loop in father and whorl in mother	8.377	3.841	Significant	24.377	3.841	Significant
Whorl in father and loop in mother	27.000	3.841	Significant	16.333	3.841	Significant
Whorl in both parents	9.256	3.841	Significant	10.256	3.841	Significant

*This implies that loop exact a slight influence over whorl but cannot be said to be completely dominant

DISCUSSIONS

The expressivity of the one fingerprint pattern over the other was tested using adjusted Mendelian Chi-square analysis. It was expected that if a trait is dominant over the other it will not have a distribution result that is different from the critical chi-square value of 3.841. Thus, indicating insignificance. Traits with mathematically similar pattern of distribution to that postulated by Mendel will be considered the dominant trait irrespective of its distribution.

When the inheritance of the various traits was compared on the assumption of independent existence and dominant-recessive expressivity using the Mendel mathematical model, it was observed that Arch was dominant over Loop and whorl. While loop influenced Whorl in an incomplete fashion. The findings from the study suggest that the finger print pattern is tri-allelic non-codominant with a phenotypic expression of reduced penetrance.

Reduced penetrance exists probably as a result from discrepancies in allelic expression, copy number variation (CNV) or additional genetic variants with modulating influence [30]. Traits that expresses reduced penetrance have been investigated to follow an autosomal dominant mode of inheritance; although can also occur in autosomal recessive traits. This is not supervising as studies has suggested that the Loop prints have two variants; ulnar and radial forms. These forms could be as a result of mutation of the Loop patterns which produced different phenotypic effects, which to a large extent depends in part upon the second allele present [31-37] that in certain conditions featured by an autosomal dominant inheritance, two non-penetrant alleles may express recessivity while copying the normal dominant form of the trait. This study observed that both Loops and Whorls were recessive to Arch. However, they were the predominant trait in the studied population.

CONCLUSION

This suggests that the fingerprint inheritance pattern is tri-allelic non-codominant with a phenotypic expression of reduced penetrance.

ACKNOWLEDGEMENTS

We want to appreciate the entire management and staff of the Department of Anatomy, University of Port Harcourt.

AUTHOR'S CONTRIBUTION

We write to state that both authors have contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Author A' (Thankgod C. Omuruka) designed the study and protocol, 'reviewed the design, protocol, 'Author B' (Chinagorom P. Ibeachu) examined the intellectual content, 'Author C' (John N. Paul) wrote the first draft of the manuscript, 'Author D' (Jenifer Jaiyeoba-Ojigho) managed the literature search and 'Author E' (Favour O. Erezil) managed the analyses of the study. All authors read and approved the final manuscript.

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