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Full length Research Article

The Use of Levels One and Two Dermatoglyphics for Sex Identification in University of Ibadan Community, Southwest Nigeria

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Summary: Dermatoglyphic traits are genetically determined and remain constant until death. Dermatoglyphics features are arranged from patterns, minutiae and ridgeology. This study utilized patterns and minutiae details of fingerprints as a means of sexual differentiation amongst the University of Ibadan community. Three hundred and eighty-four (192 males and 192 females) participants from the University of Ibadan community were recruited using multistage sampling technique. Fingerprints were obtained using fingerprint scanner Dermalog LF10, Hamburg, Germany. GraphPad Prism 7.0 was used for the test of mean of variables. Ulnar loop, whorl and radial loop patterns were found to be predominantly distributed in both male and female in that order. However, the arch pattern was significantly different between female and male. The male subjects had significantly higher total finger ridge count (TFRC). All the analysed minutiae were significantly different between male and female except bridge. The arch pattern, TFRC and level 2 details (minutiae) of dermatoglyphics could be used as markers for sexual differentiation.

Keywords*: Dermatoglyphics, Sexual dimorphism, Pattern, Minutiae, Ibadan, Nigeria*

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INTRODUCTION

Fingerprint had been found to be a useful tool in population studies and criminology and had been accepted as one of important means to differentiate gender (Reddy, 1975; Nte, 2012) because of its characteristic permanence, distinctiveness, reliability and accuracy. Accurate and efficient human identification or recognition have become crucial for forensic applications due to the large diversity of crime scenes, and because of the increasing need to accurately identify perpetrators in crime evidence. Identifying the gender of perpetrators from the crime scene is an important aspect in narrowing the scope of suspects in forensic investigation (Lee & Gaensslen, 2014; Abdullah *et al*., 2015).

Over the years, identification of the sex and identity of an individual has involved the use of several body features (Kumar *et al*., 2015). However, fingerprint was one of the oldest and one of the most important pieces of evidence with its infallible characteristic. Its use in forensic science has increased greatly because of the unique arrangement of the ridge on the finger of every individual which does not alter with growth and age (Gutiérrez-Redomero, 2017; Hariharan & Logeswari, 2019). Pattern details involve the use of the loop, whorl and arch, and their quantification. Minutiae features deal with specific ridge characteristics. Minutiae are minor or incidental details, and this makes level two features more unique for individual identity (Yager & Amin, 2004). Several studies (Nithin et.al; 2011, Wijerathne et.al., 2016, Paul and Paul, 2017 a & b) on dermatoglyphics have been carried out in different parts of the world including Nigeria for gender identification. But most of these studies have focused more on patterns and only few have explored the minutiae details for gender identification and most studies used the conventional ink method to obtain fingerprints samples.

The University of Ibadan is highly heterogeneous serving as habitat for people from different regions of Nigeria and other African countries. This study sought to increase the already existing knowledge, but with the use of both level one and two details of fingerprints. The study will also serve as a means of identification of latent print from crime scene in the community and may lead to creation of fingerprint data bank, as reported among Chinese sub-populations (Zhang *et al*., 2010).

MATERIALS AND METHODS

Location of Study: The University of Ibadan, occupying over 1,032 hectares of land, is in Ibadan North Local Government Area, Ibadan, Oyo State, Nigeria. The Institution was originally established on 17 November 1948 as University College, Ibadan. The name was later changed to the University of Ibadan in 1962 (Agbola *et al*., 2001).

Sampling Technique: This study was from a cross section of the population and a multistage sampling procedure was used.

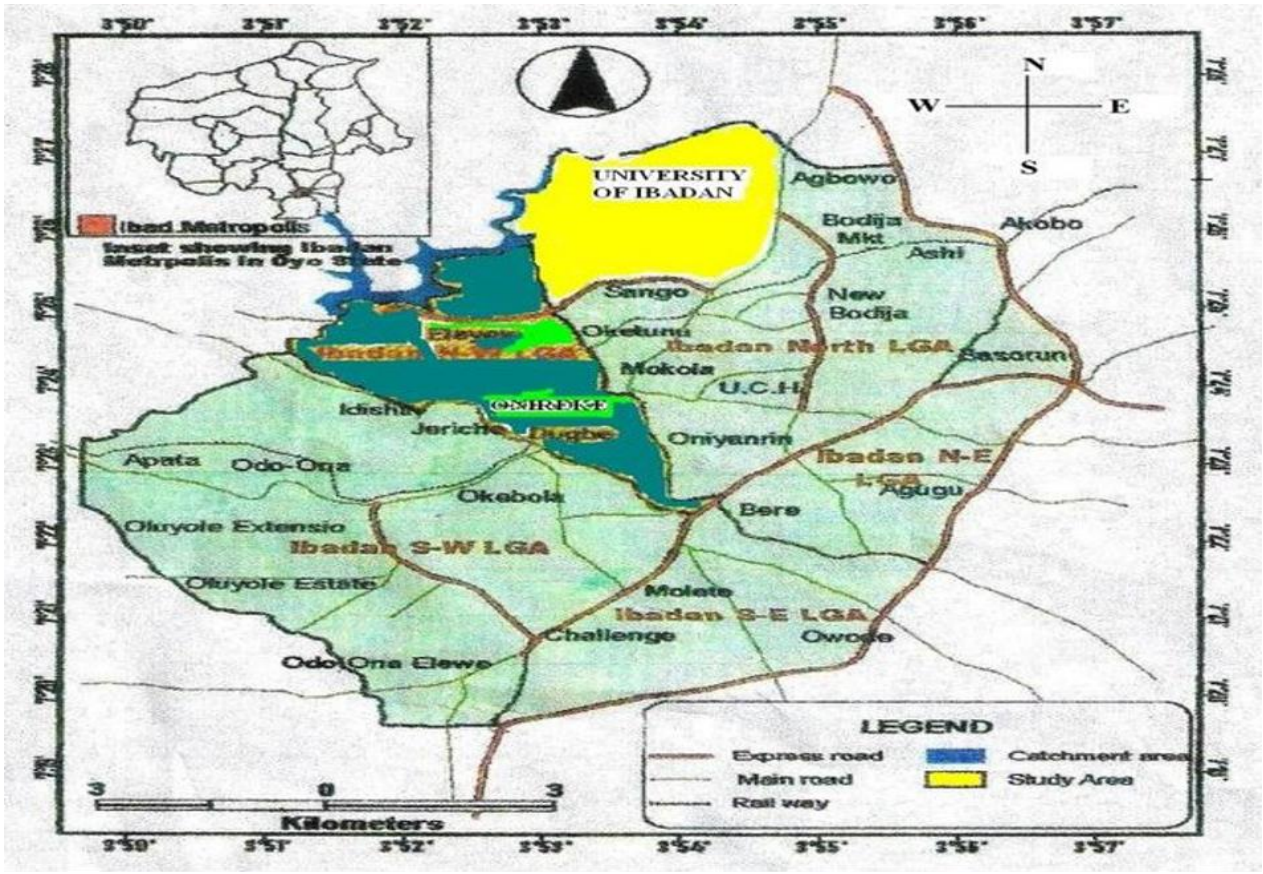

Plate 1:
Map of Ibadan Metropolis showing University of Ibadan (Mubarak & Samuel, 2015)

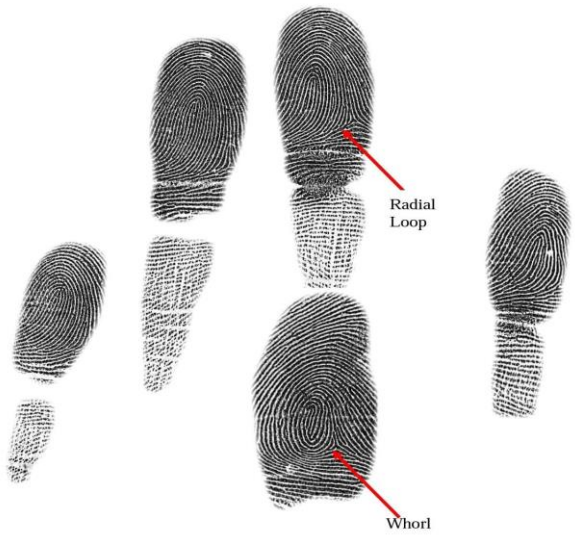

Fig. 2:
Fingers 1-5 Dermatoglyphs showing patterns.

Sample Size: Three hundred and eighty-four (384) participants, comprising 192 males and 192 females, volunteered for the study from the University of Ibadan.

Inclusion Criteria: An initial physical examination of the palmar surface of the fingers was done to exclude scarred fingers from the study.

Methodology: Bilateral digital prints of all the participants were obtained with Dermalog LF10 fingerprint scanner, Hamburg, Germany. The participants' fingers were thoroughly cleaned before prints were taken. The right and left thumbs of participants were first obtained separately for a clearer view. Each finger was pressed against the scanner with a little pressure applied for adequate contact with the scanner such that sharp fingerprints were obtained. Afterwards, the prints were adequately labelled. Interpretation of the patterns was carried out according to Cummins and Penrose (Penrose, 1969; Cummins, 1946). Automated Fingerprint Identification System (AFIS) software (Meadows, Pouratian 1999) was used to enhance the patterns and minutiae present (Fig. 2 and 3).

Fig. 3:
Fingers 1-5 Dermatoglyphs showing minutiae.

The patterns were identified and the minutiae studied were bifurcation, trifurcation, ridge ending, bridge, lake, double bifurcation, island, dot, ridge crossing, break, spur and opposed bifurcation. The parameters analysed included pattern frequency and total finger ridge count.

Statistical Analysis: GraphPad Prism 7.0 was used for statistical analysis and statistical significance was at $p \leq 0.005$.

Ethical Considerations: Ethical review guidelines of the University of Ibadan and University College Hospital (UI/UCH) relating to the use of human subjects for research were duly followed (UI/EC/19/0264). Informed consent was obtained from every volunteer before sampling.

RESULTS

The comparison of pattern type in both genders revealed significant differences between the arch pattern of males and females (Table 1). The female arch pattern was significantly higher than the male.

Table 1:
Comparison of pattern types of both hands of male and female

Pattern	Males (mean±SD)	Females (mean±SD)	P value
Ulna loop	122.3±30.0	113.0±32.8	0.52
Whorl	53.1±23.1	49.9±22.5	0.76
Arch	13.2±10.5	25.3±11.6	*0.025
Radial loop	3.4±5.4	3.8±5.1	0.87

$p \leq 0.05$

The male right and left hands ridge count were significantly higher than the female's right and left hands. There was also a significant difference of the TFRC. The male TFRC was significantly higher than the female (Table 2).
In male, the percentage distribution of minutiae characteristics in the right hand revealed that bifurcation (36.47%) and trifurcation (0.04%) were the most and least distributed respectively. In the left hands, bifurcation (35.77%) and trifurcation (0.02%) were also the most and least distributed respectively. In female, the percentage distribution of minutiae characteristics in the right hand revealed that bifurcation (35.67%) and trifurcation (0.10%) were the most and least distributed respectively. In the left hand, bifurcation (35.60%) and trifurcation (0.11%) were also the most and least distributed respectively (Table 3).

Table 2:
Distribution total finger ridge count in Male and female

	Male	Female	p-value
Digit	mean±SD	mean±SD	
Right	66.34±20.23	55.72±22.16	0.0006
Left	63.12±22.10	53.76±23.88	0.0044
TFRC	129.46±40.92	109.48±51.67	0.0001

Total Finger Ridge Count (TFRC), $p<0.005$

DISCUSSION

The ulnar loop predominance in this study is in conformity with previous studies on the Nigerian population (Adetona *et al*., 2008; Ekanem, 2008; Umana *et al*., 2014). This study showed no significant difference in the whorl, radial loops, and ulnar loop patterns between male and female, right and left hands, which agrees with previous studies (Eboh, 2012; Omuruka *et al*., 2017; Joseph & Ubaidullah, 2018; Adenowo & Dare, 2019). The arch was the only pattern in this study that showed significant gender difference with a higher distribution in female than male which was also reported by Adenowo and Dare (2019) among students of Bingham University, Nigeria and Ray *et al*., (2015) among Indian medical students. There was also a significant difference between male and female TFRC in this study. The male had higher finger ridge count than female, this was also previously reported by Anibor *et al*., (2011); Ekanem, (2008). This implies that the quantitative parameter of TFRC can be used for male and female differentiation within the population.

The minutiae revealed sexual dimorphism, there was a significant difference in the minutiae of right and left hands except the bridge.

Table 3:
Dermatoglyphic minutiae of male and female left and right hand.

	MALE				FEMALE			
MIN	**R**	**%**	**L**	**%**	R	%	L	%
BF	11461	36.47	12341	35.77	10330	35.66	11527	35.60
TF	11	0.04	6	0.02	31	0.10	36	0.11
RE	7567	24.08	8023	23.25	8398	28.99	8978	27.73
BG	324	1.03	333	0.97	290	0.99	387	1.20
LK	4960	15.79	6241	18.09	3888	13.42	4975	15.37
DBF	155	0.49	152	0.44	206	0.70	224	0.69
SR	2611	8.31	2309	6.69	2379	8.22	2032	6.28
DO	588	1.87	625	1.81	564	1.96	505	1.56
RC	16	0.05	21	0.06	71	0.23	105	0.32
OBF	324	1.03	311	0.90	164	0.56	207	0.64
BK	46	0.15	42	0.12	79	0.27	125	0.39
SP	3358	10.69	4098	11.88	2572	8.88	3272	10.11

MIN: Minutiae, R: Right hand, L: Left hand, BF: Bifurcation, TF: Trifurcation, RE: Ridge ending, BG: Bridge, LK: Lake, DBF: Double bifurcation, SR:Short ridge, DO: Dot, RC: Ridge crossing, OBF: Opposed bifurcation, BK: Break, SP: Spur

Table 4:
Comparison of dermatoglyphic minutiae of right and left hands of male and female

Minutiae	Males (Mean±SD)	Females (Mean±SD)	p value
Bifurcation	****12.40±4.16	11.38±4.09	0.0001
Trifurcation	0.01±0.09	****0.03±0.20	0.0001
Ridge Ending	8.12±3.27	****9.05±3.80	0.0001
Bridge	0.34±0.63	0.35±0.75	0.6232
Lake	****5.84±6.58	4.62±5.68	0.0001
Double Bifurcation	0.16±0.46	***0.22±0.60	0.0002
Short Ridge	*2.56±3.41	2.30±3.23	0.0134
Dot	*0.63±0.98	0.56±1.02	0.0202
Ridge Crossing	0.02±0.14	****0.09±0.35	0.0001
Opposed Bifurcatio	****0.33±0.57	0.19±0.44	0.0001
Break	0.05±0.24	****0.11±0.38	0.0001
Spur	****3.88±2.88	3.04±2.82	0.0001

p≤0.05

Bifurcation predominance and trifurcation as the least minutiae in both sexes and hands was similar to the findings of Paul and Paul, (2017a, b) among Kalabari and Ikwerre ethnic groups of Nigeria and Akpan *et al*., (2019) finding among University of Lagos community. Significant differences in the quantification of minutiae between male and female in this study had been reported by other researchers; Paul & Paul (2017a&b) among Nigerians; Thakar *et al*., (2018) among Indians; Gutierrez-Redomero *et al*., (2017) among Argentines. The lake minutiae also differentiate male and female in this study. Bridge minutiae showed no sexual dimorphism, this was also reported by Paul and Paul (2017b) among the Ikwerre ethnic group of Nigeria, and Gutierrez-Redomero *et al*., (2010) among Spanish population. All other minutiae in this study also revealed sexual dimorphism. This revealed that as previously reported and elucidated in this study, minutiae studies can be used for sexual differentiation in forensic analysis and human population studies.

In conclusion, gender disparity existed in the qualitative variable of arch pattern in University of Ibadan community, Nigeria. TFRC and minutiae details showed significant gender differences. This study can be used as a marker in conjunction with other markers in forensic investigation.

REFERENCES

Abdullah, S.F., Rahman, A.F. and Abas, Z.A. 2015. Classification of gender by using fingerprint ridge density in northern part of Malaysia. *Arpn journals of engineering and applied sciences* 10(22):10722-10726.

Adetona, M. O., Oladapo, O. O and Igbigbi, P. S. 2008. Palmar and digital dermatogylyphic patterns of the three major ethnic groups in Nigeria. *African Lournal of Medical Sciences* 37:333-337.

Adenowo, T.k. and Dare, B.J. 2019. Digital and palmar dermatoglyphic patterns of medical students of Bingham University, Karu, Nasarawa state Nigeria. *Journal of Applied Life Sciences International* 20(3): 1-10

Agbola, T., Olatubara, C.O. and Alabi, M. 2001. Students' on-campus housing at Bursting Point: A case study of the University of Ibadan. Ibadan. IFRA and African Book Builders 116-118

Akpan, U.U., Awe, T., Idowu, D.O. and Adekoya, K.O. 2019. Types and frequency of fingerprint minutiae in individuals of Igbo and Yoruba ethnic groups of Nigeria. *Ruhuna Journal of Science* 10(1)77–87.

Eboh, D.E.O. 2012. Digital dermatoglyphic patterns of Anioma and Urhobo students in two tertiary institutions of delta state, Southern Nigeria, A peer review. *Journal of biomedical sciences* 11(2):90 -96.

Ekanem, E., Eluwa, M., Udoaffah, G., Ekanem, T. and Akpantah, A. 2008. Digital dermatoglyphic patterns of Annang ethnic group in Akwa Ibom state of Nigeria. *The Internet Journal of Biological Anthropology* 3(1):1-4

Gutiérrez-Redomero, E., Galera, V., Martínez, J.M., Alonso-Rodriguez, C. 2017. Biological variability of the minutiae in the fingerprints of a sample of the Spanish population. *Forensic Science International* 172(2): 98–105.

Hariharan, R. and Logeswari, S. 2019. Fingerprint as a personal identification tool in forensic science. *Global journal for research analysis* 8(1):22-23

Kumar, P., Ritika, G., Rajinder, S. and Prakash, J. 2015. Effects of latent fingerprint development reagents on subsequent forensic DNA typing: A review. *Journal of Forensic and Legal Medicine* 32 (2015) 64e69

Langenburg, G.M. 2004. Pilot-study: A statistical analysis of the ACE-V methodology - analysis stage. *Journal of forensic identification* 54(1): 64-79.

Lee, H.C. and Gaensslen, R.E. 2001. Methods of latent fingerprint development. *Advances in fingerprint technology* 15;2(105-176):10.

Lipton, J. 2014. "Fingerprints: Unique to Us All." Jennifer Lipton, sites.psu.edu/jlipton/2014/06/03/fingerprints-unique-to-us-all/. Accessed 29 Jan. 2024.

Mubarak, A.F, and Samuel, O.O. 2015. Geophysical and geotechnical characterization of newly constructed Abadina-Ajibode road, University of Ibadan, Ibadan. *Journal of multidisciplinary engineering science* 2(1):363-378

Nithin, M.D., Balaraj, B.M., Manjunatha, B. and Shashidhar, C. 2009. Study of fingerprint classification and their gender distribution among South Indian population. *Journal of Forensic and Legal Medicine* 16:460–463

Nte, N. D. 2012. An evaluation of the challenges of forensic investigation and unsolved murders in Nigeria. *African journal of criminology and justice studies* 6(1/2)143.

Paul, C.W. and Paul, J.N. 2017a. Gender variation studies at level 2 dermatoglyphic details of the Ikwerre ethnic group in Rivers State, Nigeria. *Journal of pharmaceutical research international* 19(2): 1-8.

Paul, C.W. and Paul, J.N. 2017b. Gender variation studies at level 2 dermatoglyphic details of the Kalabari ethnic group in Rivers State, Nigeria. *Scholars journal of applied medical sciences* 5(11A):4297-4301

Reddy, G. G. 1975. Finger dermatoglyphics of the Bagathas of Araku Valley (AP), India. *American journal of physical anthropology* 42(2): 225-228.

Terhorst, P., Damer, N., Braun, A, and Kuijper, A. 2018. What can a single minutia tell about gender? International conference on information Fusion 2113-2120

Wijerathne, T.B., Robert, J.M., Thilini, C.A. and Suneth, B.A. 2015. Dermatoglyphics in hypertension: a review. *Journal of Physiological Anthropology* 34:29

Zhang, H.G., Chen, Y.F., Ding, M., Jin, L. and Case, D.T. 2010. Dermatoglyphics from all Chinese ethnic groups reveal geographic patterning. *Journal PLoS ONE* 5(1):e8783.