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Digital and Palmar Dermatoglyphic Patterns of Medical Students of Bingham University, Karu, Nasarawa State Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Dermatoglyphic traits are genetically determined and most importantly remain constant before birth until death. These traits reflect prenatal developmental stability. Dermatoglyphic features of medical students of Bingham University, Nigeria who are to proceed into clinical classes were studied to know the patterns of dermatoglyphic distributions among the male and female medical students. A total number of Sixty Two (62) medical students comprising twenty seven (27) male and thirty five (35) female students were employed for this study. Finger and palm prints were obtained according to the methods of Cummins using ink. The printink was uniformly smeared on the palmer and finger surfaces to obtain complete print of the finger tips and the palmer surfaces. Dermatoglyphic parameters were analysed with the aid of magnifying lens (X 20), the finger ridge counts (FRC), total finger ridge counts (TFRC), absolute finger ridge counts (AFRC) in male students were significantly higher than in female medical students. However, insignificant differences were noticed in palmer tri-radial angles measured (<ATD, <DAT, <ADT) and other palmer parameters such as a-

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b ridge counts, a-b distances and the degrees of transversality of the palmer ridges were relatively the same as shown by the main line index. Ulnar loop patterns followed by whorl patterns were found to be dominantly distributed in both male and female medical students, however, ulnar loops and spiral whorls were more prevalent ($P<0.05$) in male compared with female medical students. Arches were noticed to be distributed more in percentage among the female students. Therefore, in this cross-sectional descriptive study, dermatoglyphic features of presumably normal male and female individuals were found to be of great importance in basic data documentation especially in this part of the Nigeria.

Keywords: Dermatoglyphics; male and female; genetics; loops; whorls and Arches.

1. BACKGROUND

Dermatoglyphics had been used to complement the diagnosis of genetically and non-genetically related disease conditions which alter the patterns of ridge formation [1,2,3,4] and dermatoglyphic characteristics as bio-indicator of disease conditions could be an important additional diagnostic tool in the diagnosis of genetic disorder [4]. Dermatoglyphic poly-morphism results from the interaction of genetic and environmental factors during the early stage of ontogenesis.

Dermatoglyphic traits are genetically determined and conservative in their evolution. Dermal ridge patterns are formed embryologically between the 10th and 17th weeks of intrauterine life; hence, the dermatoglyphic traits may reflect prenatal developmental stability. Most importantly, dermatoglyphic features remain constant before birth until death unaffected by any genetic or environmental disturbances during the remaining fetal period. The growth and development (differentiation) of a zygote into a fully formed human is initiated by a genetic blueprint. The capacity to form frictional ridges is inherent within the developing embryo. The patterns that these ridges form are limited by nature and/or genetic quality and are defined as whorls, loops, arches, combinations and transitions of these basic patterns, or lack of a pattern (Hirsch, 1964). Although genetics may direct ridges formation by providing the blueprints for proteins, nature provides the boundaries for patterning through physical mechanisms. Ridge formation processes depend not only on the protein derived from the gene but also on the non-protein components like sugars, lipids, hormones, inorganic elements (oxygen), inorganic compounds (nitric oxide), and minerals (Ball, 1999).

Genetic has been shown to influence Dermatoglyphic pattern formation indirectly by contributing to the timing of the onset of skin ridges, the timing of the onset of volar pad regression and the growth rate of the foetus. Patterning and number of ridge are indirectly inherited and are not affected by only one developmental factor [5]. However, ridge flow and ridge count are both affected by tension across the surface of growing fetal skin. Dermatoglyphics had been used as diagnostic aids in Medical conditions [5]. Absence of dermal ridges can result from chromosomal abnormalities and also involve complete lack of ridge features on the fingers and palms of the hands as well as the toes and soles of the feet. In-view of the closer resemblance of dermatoglyphics among close relatives than among unrelated persons, the possibility of using dermatoglyphics analysis as a complementary means in establishing paternity has been suggested (Gahlot et al. 2004).

Several studies have shown that dermatoglyphics of the palm prints have close association with health and intelligence of individuals which is decided by a single gene (Schaumann and Alter, 1976; Gang and Bian, 1999 and Li et al. 2000). Traditional blood typing provide only 4 blood types, but inter-digital area demartoglyphics provide as many as 15 different types of blood group (Li et al. 2000). The Dermatoglyphic methods are not only non-invasive, but they are more accurate and inexpensive. Dermatoglyphic features had been employed in sports for selection of national candidates; the atd angles of exceptional athletes were found to be significantly smaller from the general population with atd angles ranging between 41^o and 42^o. Many types of hereditary cerebral agenesis in babies such as Mongolian idiocy 21q3 syndrome, 13q3 syndrome and XO syndrome have greater atd angles with range of 60^o-70^o [6]. Certain dermatoglyphic characteristics make it possible to identify a high-risk group for breast cancer and also serve as a valuable aids for early screening of mammary neoplasia people at risk.

This study therefore aimed at studying the distribution of dermatoglyphic parameters among the male and female Medical students in College of Health Sciences, Bingham University, Karu, Nasarawa State, Nigeria.

2. SUBJECTS AND METHODS

2.1 Subjects

This study employed a total number of 62 Medical students of College of Health Sciences, Bingham University, Karu, Nigeria**,** who gave a written informed consents to participate in the study. The students were grouped according to sex (male and female subjects). The total number of male and female subjects were 27 and 35 respectively. The student were selected from the same class of medical students who have undergone the same medical training for a period of 3 years and are qualify to write the professional examination into clinical classes.

2.2 Inclusion Criteria

The following criteria for assess for the selection of subjects for this study:

Medical student of Bingham University in 300 level

The student have written a compressive write, practical and oral examination

The students have all the Ten (10) fingers complete without any form of accident in any of the digits

The subjects give a written consent for participation in the study

2.3 Exclusion Criteria

The study exclude students that have undergone any form of surgery procedure in the hands Non-medical students and those not in the same class.

2.4 Finger prints

The hands were washed with soap and water and cleaned off with a clean and dry towel. A small portion of duplicating ink was spread out into a thin film of the ink on all the fingers and palm surface. The rolled finger prints were taken by the rotation of the distal phalanx of each finger to obtain a complete impression of the fingers. The prints from all the fingers of the hand were studied with the help of a magnifying lens.

2.5 Palm Prints

The palms were carefully and uniformly smeared with the ink to cover the whole area of the palm which had to be printed for analyses. The inked smeared palms surfaces were gently pressed in a white paper to capture the print of the palm and were then studied with the help of a magnifying lens.

2.6 Digital Quantitative Analysis

Dermatoglyphic characteristics were described quantitatively by counting the number of tri-radii and ridges within a palm and the fingers. The dermatoglyphics parameters quantitatively evaluated in the digits of both hands were finger ridge counts, total ridge counts (TRC) and absolute finger ridge counts (AFRC). Pattern intensity index (PII), pattern intensity index on both hands, ridge counts of all patterns

2.7 Discrete Traits that were Measured Include

Frequencies of finger pattern types and incidence, frequencies of pattern combinations, on the pairs of right and left homologous fingers, frequency of pattern type combinations on both hands.

2.8 Pattern Types and Pattern Classification

Finger pattern types were classified on each of the fingers according to the modified method of Galton, 1985 as shown in the figures: Fig. 1-closed ulnar loop, 1B-closed radial loop, 2-ulnar loop, 3A- twin loop, 3B-radial loop, 4A-spiral whorl and 4B-arch. Palmer dermatoglyphic characteristics were classified as quantitative and qualitative parameters as shown in the Figs. 8,9,10 and 11.

2.9 Palmer Quantitative Analysis

Dermatoglyphic characteristics were described quantitatively by counting the number of **tri-radii** or **ridges** within a pattern, main line index (MLI), A –line exit left and right, D–line exit left and right, a-b ridge counts of the palm, a-b distance and Maximal atd angles.

Dermatoglyphic features of Medical students in Bingham University

Fig. 1A. Closed ulnar loop (Left)

Fig. 1B. Closed radial loop (Right)

Fig. 2A. Right ulnar loop

Fig. 2B. Left ulnar loop

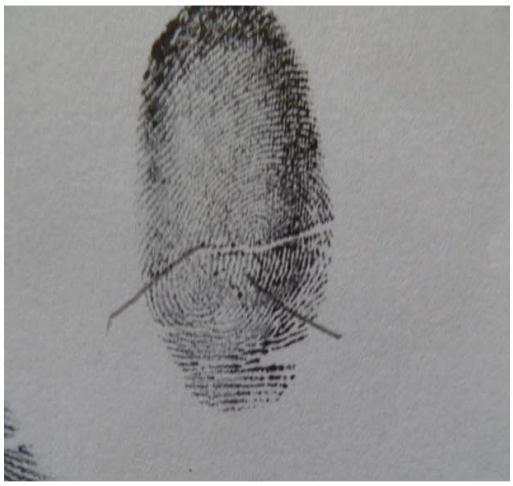

Fig. 3A. Twin loop

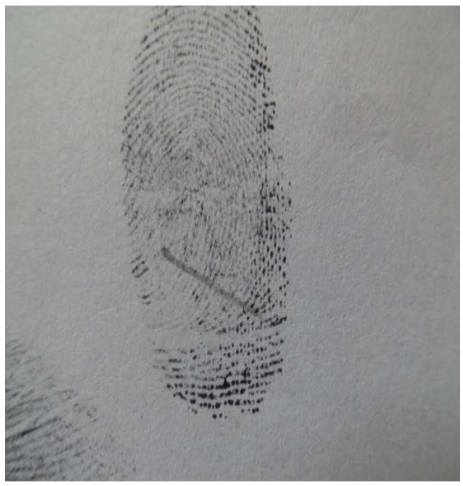

Fig. 3B. Radial loop

Fig. 4A. Spiral whorl

Fig. 4B. Arch

Fig. 5A. Left palmer surface

Fig. 5B. Ulnar loop

Fig. 6A. Elliptical whorl

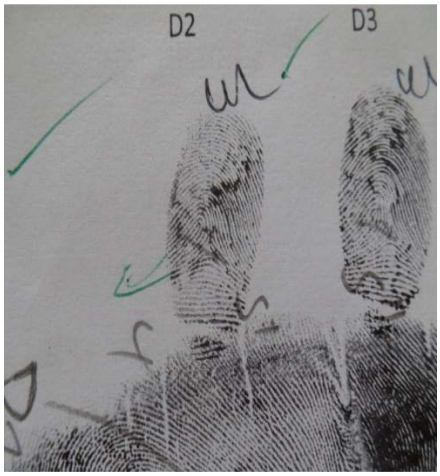

Fig. 6B. Ulnar loop

Discrete traits that was measured include, Percentage distribution of palmer patterns, percentage of sub-digital tri-radii, absence of c tri-radius, percentage distribution of sydney and simian lines, percent distribution of the highest position of axial tri-radius t. Measurement of angles in the palm: <ATD, <TAD and <TDA were measured according to Chandrasekhar-Reddy 2006 and Prabhu et al. 2014 methods.

2.10 Statistical Analysis

Graph pad prism version 6 statistical packages for student t- test were used for quantitative data, column statistics including percentage distribution and chi-square was used for discrete data

3. RESULTS

3.1 Pattern Types and Pattern Distribution

The percentage of ulnar loop and spiral whorl distribution in Male were higher than in Female on both hands. However, female subjects showed significantly higher percentage distribution of arch pattern on both hands than in male subjects. Concentric whorls were observed to be significantly higher among the female subjects in both than the male subjects. Radial loop, twin loop and elliptical whorl were low among the Medical Students of Bingham University on the both hands among candidates, Nevertheless, elliptical whorls were higher in the right hands (7%) compared to the left hand (2%) distribution in female subjects (See Table 1).

Axial tri-radius is relatively higher in both male and female with the higher percentage in male than in female subjects. $t^{!!}$ Present the lowest distribution in both male and female subjects. t position in male medical students was higher, while in female, t! was higher in distribution. Most importantly, female subjects showed no distribution of t!! position on the left hand and insignificant distribution of $t^{!!}$ on the right hand compare with the male subjects as shown in the Table 2.

Mean ridge counts (The average number of ridge counts on all the fingers obtained by counting the number of ridges that crossed the line drawn from the core or centre of the finger patterns to the tri-radii point on each of the fingers both right and left hands) in male is insignificantly different from the finger ridge count in female on both the left and the right hands, however, male subjects revealed higher ridge counts than the female subjects. More importantly, the Total Finger Ridge Count TFRC and Absolute Finger Ridge Count AFRC showed a significant difference in the male and female subjects. It is relatively higher in male than in female, see Table 3.

Finger pattern intensity in male Medical Students is higher compared to pattern intensity in female medical students as shown in Table 4.

Palmer angles in male and female Medical students show symmetrical distribution on both hands, however, mean <ATD in male Medical students in the right hand decrease insignificantly in relation to the <ATD in female Medical students. The Table 5 below show that <DAT, <ADT on both hands in male and female medical students were insignificant differences (P >0.05).

Female medical students' revealed insignificant increase in a-b ridge count in the right hand compared to male medical students, ridge count in the left hand and a-b distance on both hands in both male and female were equal see Table 6.

The degree of transversality in male and female medical students are equal, insignificant differences were observed in the main line index in both hands as shown in the Table 7.

4. DISCUSSION

This study aimed at identifying normal distribution of both digital and palmer dermatoglyphic parameters among the male and female Medical Students of Bingham University, Nigeria. Finger dermatoglyphic revealed that loop and whorl patterns were predominant in both male and female medical students, more importantly ulnar loops pattern were prevalent on both hands in both male and female, higher distribution was noticed in male medical students. While arches were found to be higher among the female medical students in relation to the male medical students. Uduak-Umana et. al., 2013 reported high percentage of loop in both male and female subjects.

Dermatoglyphic features have been general used as a maker or bio-indicator due to positive correlation that exist between dermatoglyphics formation and abnormality that result from genetic alterations. Since, the level of intelligent is partially associated with the genetic composition, alteration in genetic makeup may distort the formation of definite dermatoglyphic patterns in both male and female subjects [7].

David and Sinha, 2015 discovered that the loop pattern of finger print is highly predominant in the finger prints pattern, particular the ulnar loop.

This study showed in both male and female medical student's higher percentage incidence of ulnar loop patterns. According to Reddy et al. (1977) observation, a significant high frequency of whorls was noticed in a study population while; Pal et al (1985) observed significantly high frequency for arches and low frequency of ulnar loop. Ridges are genetically determined and the number of ridge counts have been employed in identifying genetic detail, the ridge counts in male was significantly ($P<0.05$) higher on both hands than in female medical students, this is also reflected in the total finger ridge counts and the absolute finger ridge counts. Ridge counts had been reported to be statistically higher various studies [8,9] David and Sinha, 2015). The Total Fingers Ridge Count (TFRC), Absolute Fingers Ridge Count (AFRC), and the (a-b) ridge counts were higher in all the subjects examined by Manoj Kumar and Sharma, 2012 (Eswariah and Bali, 1977; [10]; Rajnigandha, 2006 and Manoj Kumar and Sharma, 2012).

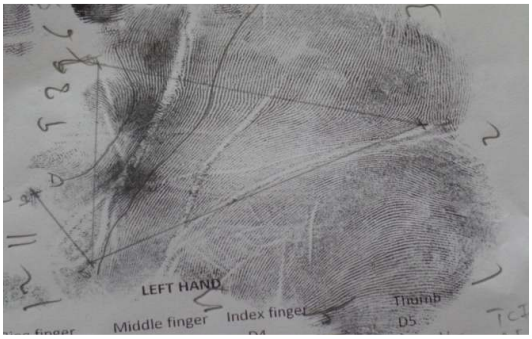

Fig. 7. Right palmer surface

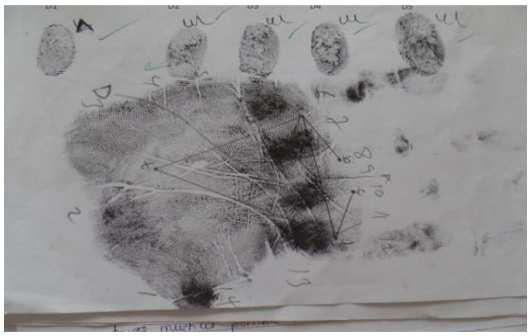

Fig. 8. Left palmer surface, with detailed A-line exit, D-line exit and t$^{!}$ Position

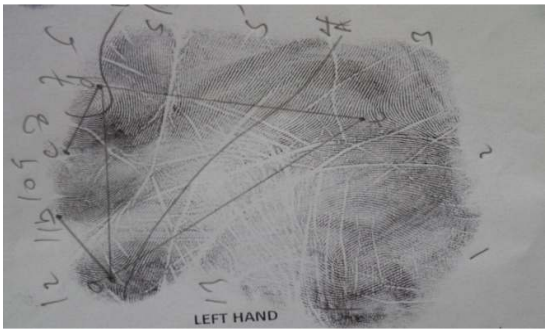

Fig. 9. Right palmer surface with detailed A-line exit, D-line exit and t$^{!}$ Position

Our study shows a higher ridge counts among the male medical students than the female medial students however, within the normal range. It is expected that when comparing ridge counts, female and male subjects should not be compared rather correlation should be made relative to same gender as the ridge count show gender variation pattern.

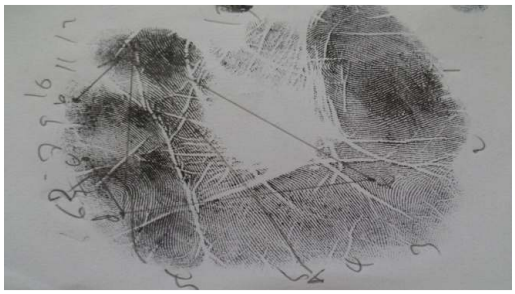

Fig. 10. Left palmer surface with detailed A-line exit, D-line exit and t$^{!}$ Position

Makol and Basu, 1994 shows that a useful descriptive measure is the atd angle, the normal atd angle averages 39^{o} among females and 43^{o} among males. People with Down syndrome have an atd angle averaging 81^{o}. Elevated atd angles are also found on individuals with other forms of Chromosomal abnormalities including trisomy 18, trisomy 13, Klinefelter syndrome (XXY) and Turner syndrome (XO) (Vormittag et al. 1986, Shao, 1992). Zhou et al. 2002 shows from his work that the general population group are usually with the <ATD angles range between 41^{o}- 42^{o} and female with much lower <ATD ranging from 39^{o} This present study is much in line with this statement, the mean <ATD in male and female medical students averages 40^{o} in the left while it is 39^{o} in the right hand in male and 41^{o} in female respectively. Therefore, both male and female medical students on both hands

demonstrated a normal range palmer angles on the palmer surface of the hand. The most frequently obtained ridge count is between tri-radii a-b and is referred to as the a-b ridge count (Figs.7, 8, 9, 10, and 11). Counting carried out along a straight line connecting both tri-radial points [11]. Palmer ridge count including the a-b ridge count and a-b distance in both the male and female medical student's present insignificant differences (P>0.05) in the left hand while, in the right hand in female, a-b ridge count is higher compared to male counterparts.

The main-line formula serves as an indication of the general direction of palmer ridge flow. The termini of two of the main lines, A and D, were observed and main-line index was calculated by the sum of the two numbers corresponding to the ends of main lines *A* and *D* according to Fang, [12]; Holt 1968 and Subir, 2011. There was insignificant difference in main line index among the medical students in both male and female. The main line indexes give the transversality of the palmer line ridge, therefore the results show that the degree of alignment in palmer ridges direction in both male and female Medical students is similar. Palmer ridges in apes usually follow a longitudinal course or alignment of the ridges. The main line index is about 2, unlike in Homo sapiens, which follow transverse alignment of the ridges expressed in the high value of the main line (Kumbnani, 2004).

Fig. 11. Left palmer surface with detailed A-line exit, D-line exit and t-position

Table 1. % Distribution of finger pattern in male and female medical students

Ridge pattern	Male				Female			
	Right		Left		Right		Left	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Ulnar Loops	75	56	74	55	89	51	91	52
Radial Loops	2	1	3	1	1	0	1	0
Twin Loops	5	4	5	4	5	3	3	2
Conc. Whorls	21	16	18	13	31	18	39	22
Spiral Whorls	18	13	17	13	10	6	6	3
Elliptical Whorls	7	5	5	4	4	2	4	3
Arches	3	2	5	4	21	12	16	9
Accidental Patterns	4	3	8	6	14	8	15	9

Table 2. % Distribution of axial tri-radius in Male and Female Students

t position	Male				Female			
	Right		Left		Right		Left	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
t	20	74	20	74	24	69	25	71
t!	4	15	5	19	10	28	10	29
t!!	3	11	2	7	1	3	0	0

Table 3. Ridge count, Total finger ridge count and Absolute Finger Ridge Count in Male and Female

Class	RC (Mean± SEM)		TFRC(Mean± SEM)	AFRC(Mean± SEM)
	Right	Left		
Male	66.04±4.2	66.57±5.1	*126.9±8.5	*175.9±19.36
Female	56.12±4.5	60.44±5.0	106.0±9.2	162.0±20.5

*P<0.05; *Significant level*

Table 4. Pattern intensity of finger in male and female

Class	PI (Mean± SEM)
Male	11.00±0.8
Female	9.70±0.8

P>0.05

Table 5. Palmer angles

Class	ATD (Mean± SEM)		DAT(Mean± SEM)		ADT(Mean± SEM)	
	Right	Left	Right	Left	Right	Left
Male	39.52±1.1	40.32±1.4	60.65±1.2	60.00±1.2	81.74±0.9	81.23±0.8
Female	41.11±0.9	40.57±0.9	60.00±0.9	60.29±1.0	80.54±0.7	79.94±1.1

P>0.05

Class	ATD (Mean± SEM)		DAT(Mean± SEM)		ADT(Mean± SEM)	
	Right	Left	Right	Left	Right	Left
Male	39.52±1.1**	40.32±1.4	60.65±1.2*	60.00±1.2	81.74±0.9	81.23±0.8
Female	41.11±0.9	40.57±0.9	60.00±0.9	60.29±1.0	80.54±0.7	79.94±1.1
P>0.05						

- **Significant (p<0.05);*
- *** Not significant (p>0.05)*

Table 6. a-b ridge counts and a-b distance

Class	a-b RC (Mean± SEM)		a-b Dist.(Mean± SEM)	
	Right	Left	Right	Left
Male	38.73±1.2	40.76±1.7	2.3±0.06	2.3±0.07
Female	40.03±1.4	40.59±1.6	2.1±0.04	2.2±0.05

P>0.05

Table 7. Main line index

Class	MLI-Right (Mean± SEM)	MLI-Left(Mean± SEM)
Male	12.79±0.4	12.58±0.3
Female	12.74±0.3	12.45±0.2

P>0.05

5. CONCLUSION

In presumably normal male and female individual variation in the dermatoglyphic traits or characteristics (finger and palmer parameters) is usually limited and within confined range. Ulnar loop and whorl (spiral in male and concentric in male and female) were predominant in both male and female medical students of Bingham University, however, ulnar loop, spiral whorl and larger count (RC, TFRC and ABFRC) were recorded in male medical students but similar palmer characteristics were observed in male and female subjects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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