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Digital and Palmer Dermatoglyphic; A Bio-Indicator for Intelligence Quotient

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Abstract: Dermatoglyphic attributes once formed in the womb remains unique and persists throughout life for individuals until decomposition after death in the tombs. This research work aimed at finding the relative associations that exists between the dermatoglyphic parameters and intelligence level among the medical students of Bingham University, Karu Nigeria with ultimate purpose of using dermatoglyphic characteristics as bio-indicators for selection of categories of students into good, average and weak academic performances. A total number of 65 medical students (30 male and 35 female students) who were in 3rd year were selected for this study, students were categorised according to their academic performances in the Anatomy courses into the good, average and weak at the end of the academic session. Dermatoglyphic printings including the finger and palm prints were taken using Indian ink method. Ulnar loop pattern was prevalence in all categories of students (Right hand: good 72%, average 58%, weak 40%, Left hand: good 72%, average 50%, weak 51%) and higher symmetrical arrangement was observed in both hands (right and left hands) among the good student, however, no incidence of arch pattern was recorded among the good set of students. More than two different sets of patterns were observed to be distributed in each hand among the weak category of student and also asymmetrical arrangements were significant ($P<0.05$) on both hands among the weak. Reduction in the ridge counts, total ridge counts, absolute ridge counts and palmer tri-radial angles measured (<ATD, <DAT, <ADT) were significant ($P<0.05$) among the weak and less significant ($P<0.05$) in the average group of students. Transversality of the palmer ridges was the same in all the categories of students (good, average and weak students) as revealed by the main line index. This observed dermatoglyphic parameters may be used in the selection of students according to categories for education counselling and close monitoring especially in private institutions of learning.

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Background

Frictional ridges on the skin have unique features that are formed in the womb (Intrauterine period) before birth and remain unchanged until decomposition after death (in the tomb). These ridges skin produce impressions of corresponding unique details on the fingers, palms, soles and toes of individuals (Durham et. al., 2000). Two ridges skin impressions can be analyzed, compared, and evaluated (ACE-V) and sufficient qualities and quantities of the details that are present (or lacking) in a corresponding areas of these impressions can be observed and evaluated. The analysis, comparison, evaluation, and verification (ACE-V) of these details/parameters, combined with the quantitative and qualitative examinations, provide the framework for practical applications of the frictional ridge anatomical discipline (Dermatoglyphics) (Cummins 1965 and Durham et. al., 2000). The formation of the frictional ridge skin is unique and persistent (Slatis et. al., 1976, Dell and Munger, 1986). The basis of persistence lies in its morphology and physiology of the reproduction of the three-dimensional ridges from epidermis due to constant regulation of cell proliferation and differentiation. While, the basis of uniqueness lies in embryology; the unique features of the skin are established between approximately 10 and 16 of week's estimated gestational age (EGA).

Dermatoglyphics had been defined as a Science of frictional ridges on the skin which are found on the digits, palms, toes and soles of primates and other mammals (Cummins and Midlow, 1943). The Chinese used the finger prints for signatures a few thousand years ago (Yunyu et. al., 2002) where it was commonly used as a seal in the sale of the land. Jamison (1990) reported that dermatoglyphic formation (Frictional skin ridges) cannot be derived solely from either genetic or environmental factors; it results from an interaction of the two factors. Ridges are genetically determined and are therefore useful in Anthropological, Medico legal and Genetic studies and dermatoglyphics had been long accepted as a simple and inexpensive method for determining genetic traits and/or genetic disorders (Cummins and Midlow, 1943; Cotterman, 1951; Okajima, 1975; Misumi and Akiyoshi, 1984). General intellectual functioning is expressed by intelligence quotient. Testing intelligence quotient is reliable and valid and it takes into consideration the learning and adaptive deficits which predict later intellectual disability. This study is aimed at using the finger dermatoglyphic parameters as bio-indictors for the determining the mental capacity or intelligence level among Medical Students of the College of Health Sciences, Bingham University, Karu, Nasarawa State, Nigeria.

Subjects and Materials

Subjects

This study was carried out on 65 Medical Students (Male n=30 Female n=35) of Bingham University,

College of Health Sciences, who were to write the Second Professional Examination into the clinical classes. A comprehensive End of Course Examination (In-course) was given in Anatomy, the examination was graded appropriately and the students were grouped according to their academic performance in the examination. Students that were classified as good students scored 60% and above (n=6), those scoring between 50% and 60% were designated as the average students (n=35) while those scoring below 50% were classified as weak students (n=24)

Materials and Methods

The ink pad method was used for taking the finger and palmer print impressions with camel duplicating ink. The materials that were used include: A plain A4 paper, roller for spreading the ink, a table, a scale, a pointed H.B Pencil, a biological pointer, a protractor, soap and 70% methylate spirit for washing hands, towel and a good quality hand magnifying lens.

Ten Fingers prints capturing

The hands were washed with soap and water and the humidity was cleaned off with a clean and dry towel. A small daub of duplicating ink was squeezed out on an inking slab of the roller into a thin film for the direct inking of the fingers. The rolled finger prints were taken in the printing to obtain a complete impression of the finger prints. These prints were studied with the help of a magnifying lens for detailed observations and subsequent analysis.

Palm prints

Each palm was carefully and uniformly smeared with the ink to cover the whole area of the palm which had to be printed for the examination. The palm surface was gently pressed during printing; this method enables to record the complete imprints of the palm, these prints were studied with the help of a magnifying lens for dermatoglyphics observation

Digital quantitative parameters

Dermatoglyphic characteristics were described quantitatively by counting the number of **tri-radii** and **ridges** within a pattern types such as**;** Finger Ridge Counts, right and left, Total Ridge Counts (TRC) and Absolute Ridge Counts; Pattern Intensity Index, right and left hands, Pattern Intensity Index, both hands, Ridge counts of all patterns

Discrete traits that were measured include: Frequencies of finger pattern types and incidence in %, Frequencies of pattern combinations on the pairs of right and left homologous fingers, Frequency of pattern type combinations (%) on both hands,

Palmer quantitative parameters

Dermatoglyphic characteristics were described quantitatively by counting the number of **tri-radii** and **ridges** within a pattern such as**:** Main line index (MLI), a-b, Ridge Counts, right and left hands, A –line exit left and right, D–line exit left and right, a-b Ridge counts of the palm, a-b distance, Maximal atd angles

Discrete traits that were measured include: Percent distribution of the highest position of axial tri-radius t. Measurement of Angles in the palm: ATD, TAD and TDA (*Prabhu et al., 2014)*

Statistical Analysis

Graph pad prism version 6 statistical packages for analysis of variance was used for quantitative data, proportion was used for discrete data

RESULTS

Ulnar loop patterns were observed among all the classes of the students to be relatively higher in percentage distribution of finger patterns Table I; however the distribution of ulnar loops patterns were more expressed in percentages among the good category of students when compared to the average and the weak categories of students. Whorl patterns were relatively high with spiral whorls mostly distributed among the good subjects while the concentric whorls were mostly distributed among the average and the weak subjects. Arch patterns were not observed among the good students but were observed to be expressed in percentages among the weak students.

Table I: Percentage % (Frequency) Distribution of finger patterns among the good, average and weak categories of students

Ridge pattern	(Right)			(Left)		
	Good Freq (%)	Average Freq (%)	Weak Freq (%)	Good Freq (%)	Average Freq (%)	Weak Freq (%)
Ulnar Loops	(18)72	(74)58	(44) 41	(18)72	(75) 60	(53) 50
Radial Loops	(0)0	(2) 2	(4) 4	(0) 0	(1) 1	(3) 3
Twin Loops	(0) -	(4) 4	(7) 7	(0) -	(3) 2	(6) 6
Conc. Whorls	(1) 4	(22)17	(21)20	(1)4	(11)9	(13)12
Spiral Whorls	(3)12	(10) 8	(9)8	(3)12	(13)10	(10)10
Elliptical Whorls	(2) 8	(4) 3	(2)2	(1)4	(5)4	(2)2
Arches	(0)0	(3) 3	(10)10	(1)4	(4) 3	(7)7
Accidental Patterns	(1)4	(8) 6	(8)8	(1)4	(14)11	(10)10

There was no significant difference in the digital pattern intensity among the average and the weak students; however, differences were observed in the digital pattern intensities among the students that score above 60 marks Table II

Finger ridge counts on both the right and left hands were observed to be higher among the good categories of students when compared with the average and weak categories of students Table III. The TFRC and AFRC were relatively highest among the good candidates.

Table II: Total Pattern intensity of finger patterns among the good, average and the weak categories of students

Categories	TPI (Mean± SEM)
Good	11.83±1.6
Average	10.10±0.8
Weak	10.45±1.0

P< .05

Higher t- positions (axial tri-radial) were more distributed among all the classes relative to the position of $t^{!}$ and $t^{!!}$ in percentages, weak subjects showed highest percentage distribution of t-position. Distribution of position of $t^{!!}$ were rarely observed (4%) in average class and was not expressed in the good and average students Table IV.

Palmer angles showed inconsistence in <ATD, <DAT and <ADT. <ATD angles were relatively highest among the good category, while the <DAT among this class was lower compared to the average and the weak students which showed relatively higher <DAT. There was no statistical difference observed in the <ADT among all the classes of the students Table V.

Table VI: Ridge counts among the Good category of students were relatively higher than the average and statistically difference from the students that scored low mark.

Main line index was relatively highest among the average students when compare with the Good and the weak students Table VII.

TABLE III: Ridge count, Total finger ridge count and Absolute finger ridge count

Categories	RC (Mean± SEM)		TFRC(Mean± SEM)	AFRC(Mean± SEM)
	Right Hands	Left Hands		
Good	64.17±7.2	67.17±10.2	130.8±16.1	187.0±70.7
Average	61.65±4.3	62.29±5.1	114.3±9.8	164.5±21.2
Weak	55.74±4.8	63.91±4.7	116.8±9.7	171.8±20.3

P< .05

Table IV: Percentage (%)/Frequency distribution of axial tri-radius

t position	(Right)			(Left)		
	Good	Average	Weak	Good	Average	Weak
t	(3) 60	(15) 58	(13) 65	(3) 60	(16)59	(12)60
$t^{!}$	(2) 40	(10) 38	(7) 35	(2) 40	(10) 37	(8)40
$t^{!!}$	(0) 0	(1) 4	(0) 0	(0) 0	(1) 4	(0) 0

Table V: Palmer tri-radii angles measured

Categories	ATD (Mean± SEM)		DAT(Mean± SEM)		ADT(Mean± SEM)	
	Right	Left	Right	Left	Right	Left
Good	44.25±1.2	43.67±2.2	56.50±2.6	56.00±0.6	81.00±1.6	82.67±1.4
Average	41.32±1.6	40.82±1.0	60.23±0.9	60.12±0.9	81.09±0.8	80.91±0.7
Weak	40.78±1.2	40.44±1.4	60.56±1.2	59.17±1.2	80.17±0.9	80.50±1.4

P< .05

Table VI: a-b ridge counts and a-b distance (cm)

Categories	a-b RC (Mean± SEM)		a-b Dist.(Mean± SEM)	
	Right	Left	Right	Left
Good	41.00±3.5	43.50±3.5	2.4±0.3	2.3±0.2
Average	39.82±1.1	40.76±1.5	2.2±0.04	2.1±0.04
Weak	37.21±1.5	38.26±1.5	2.1±0.05	2.2±0.06

P< .05

Table VII: Main Line Index

Categories	MLI-Right (Mean± SEM)	MLI-Left(Mean± SEM)
Good	11.75±0.5	12.50±0.2
Average	13.08±0.4	12.92±0.3
Weak	12.76±0.4	12.50±0.4

P< .05

Figure I: A-Finger pattern with closed ulnar loop, B-Finger pattern with closed Radial loop

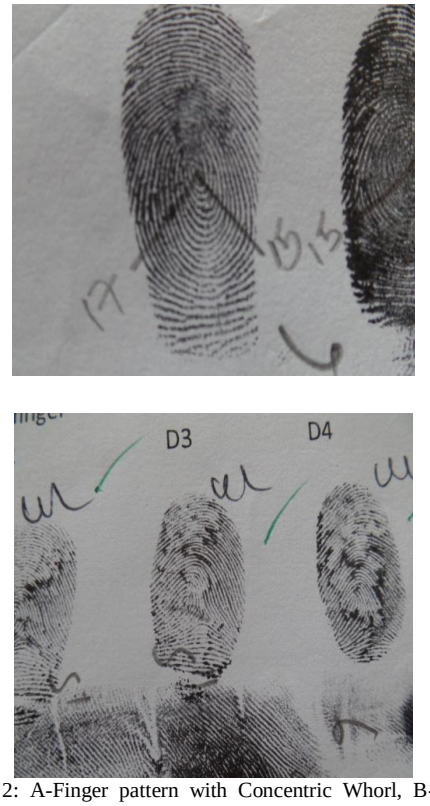

Figure 2: A-Finger pattern with Concentric Whorl, B-Finger pattern with Radial loop

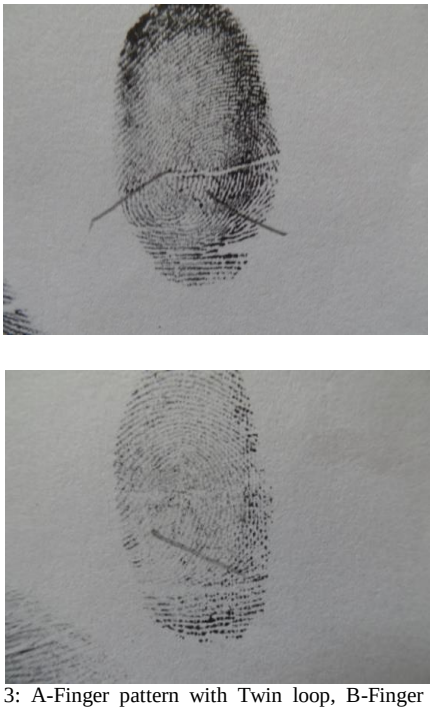

Figure 3: A-Finger pattern with Twin loop, B-Finger pattern with Ulnarl loop

Figure 4: A-Finger pattern with Arch pattern

Figure 5: Right palmar surface showing the palmer angles and the A-line of exit and D- line of exit

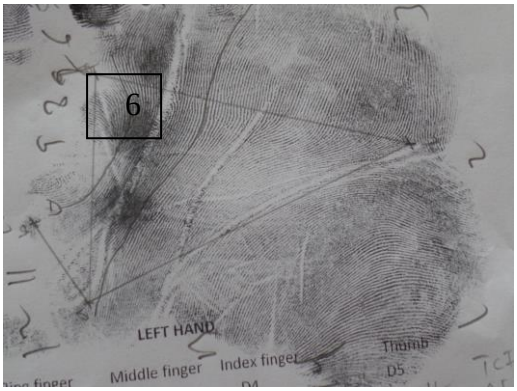

Figure 6: Left palmar surface showing the palmer angles and the A-line exit and D- line exit

Figure 7: Palmer surface with t^{I} Position

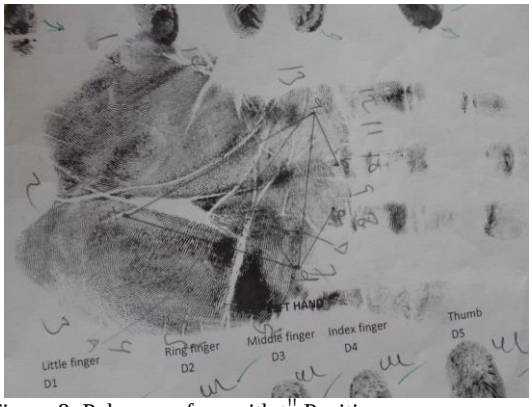

Figure 8: Palmer surface with t^{II} Position

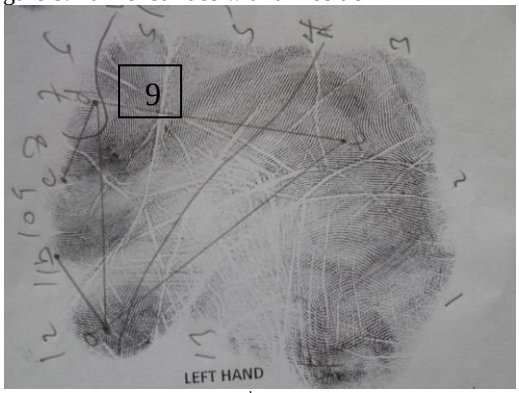

Figure 9: Palmer surface with t^{I} Position
Credit: Anthropological unit, Anatomy Dept. Olabisi Onabanjo University, 2015

DISCUSSION

This study aimed at finding the relative associations that exists between the intelligence quotient and the dermatoglyphic distributions among the Medical Students in College of Health Sciences, Bingham University, Nigeria. The distributions of the finger pattern types among the good, average and the weak categories of students as shown in Table I revealed that ulnar loops patterns followed by whorls (Concentric and Spiral) patterns were mostly distributed in percentages in both hands in all the categories of students (good, average and weak). This is in relative association with the study conducted by Kumari et. al., 2014 who show that finger prints pattern of most of the subjects that were observed include the whorls and ulnar loops. Kumari et. al., 2014, revealed that ulnar loops were prevalence in Medical Students while in Medical Lab Technology Students; whorl patterns were dominant in both hands. However, percentage distributions of ulnar loops were highest among the good category of students and no arch patterns in both hands were noticed or expressed. While among the weak and the average categories of students inconsistence in distributions of likely patterns on homologous fingers in both hands or increase patterns of asymmetry were prevalence in both hands. Percentage distributions of arch patterns were relatively higher among the weak categories of students when compared with the good categories of students; this is in line with Reed, 1979 report.

The degrees of symmetrical distributions were highest among the good category of students in both hands but among the average and the weak students though ulnar loop prevalence was higher, but usually distributed along side with whorl and arch patterns. Arch distribution was mostly noticed among the weak students. Sontakke et. al., 2010 found that there was a significant reduction in the loop patterns and increase in whorl patterns in the disease conditions with increase in the arch patterns.

Position of axial tri-radius on the palmer surface were relatively high (t) among all the categories of students while there were no distributions of low (t^{II}) position among the good and the weak students as shown in Table IV.

Sontakke et. al., 2010 reported insignificant difference in the ridge counts and in the absolute ridge count in diseases conditions and the control. This study equally observed insignificant differences in the ridge counts, total ridge counts and absolute ridge counts among all the categories of the students. Wang et. al., 2008 reported inconsistent in the total and absolute ridge counts, however, ridge counts in this study was relatively higher among the good students and among the weak categories of students than the average

students in agreement with Pour-Jafari et. al., 2003 who reported decrease in ridge counts in disease condition such as Trisomy 13 and 18 while Ashish et. al., 2013 reported slight increase in ridge counts but not significant. a-b ridge count and a-b distance on the palm surfaces have been shown to play a significant role in identification of genetic anomalies (Shiono et. al., 1977, Cam et. al., 2008). This study shows that a-b ridge counts and distance decreases in mean among the average and the weak students in line with the Sontakke et. al., 2010 who found that there was equally a reduction in the a-b ridge counts in disease condition.

A useful descriptive measure is the <ATD; the normal <ATD averages 39^o in females and 43^o in males. In Down syndrome average <ATD is 81^o, elevated<ATD are also found on individuals with other forms of Chromosomal abnormalities including trisomy 18, trisomy 13, Klinefelter syndrome (XXY) and Turner syndrome (XO) (Warda and iswanathan, 2014). Sant et. al., 1983, Platilova et. al., 1996 and Rajnigandga et. al., 2006; reported increases in the palmer angles in disease conditions. Decrease in pattern intensities and palmer angles <ATD, <DAT and < ADT were observed among the average and weak students relative to good category of students.

Main line index according to Cummins is defined as expression of the direction of the neutral line and its inclination is determined by the courses of the main lines D and A (Kumbnani, 2004). It is the summation of value of these two main lines that expresses the transversality of the ridges in the palm (Kumbnani, 2004). The main lines D and A have crucial role to play for they control the alignments of the ridges in the palm, ridges do not interrupt, intersect or cross and hence it is mandatory for the main lines C and B to remain confined within the limits of the course of main line A and D. Rathva et. al., 2013 notice increases in main line indexes among the epilepsy conditions in the right palms. This study showed slight increases in main line index in the right hands among the average and the weak students, however, on the left no observable difference were noticed

CONCLUSION

Homologous distributions of equal patterns types in all the ten fingers of both hands form reliable criteria for selection of good students for academic task related exercise. Other dermatoglyphics parameters measured such as the palmer tri-radii angles can also help in providing multiple intelligence assessment of students, parent-child communication and education, personalized education and define the most appropriate way of teaching and learning in all the categories of students.

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