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Fingerprint Patterns Indicate Better Academic Performance Amongst Students in North Central Nigeria

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ABSTRACT

The study of dermal ridges on the palms and soles is known as dermatoglyphics. Its growth begins in the third month and is completed by the fifth month of intrauterine life. The dermal ridges have been linked to the development of the central nervous system throughout foetal life and are also affected when the central nervous system is defective. It has been reported that genetic factors influence both human intelligence and dermatoglyphics. The purpose of this study is to assess the link between fingerprint pattern, digital triradius a, axial triradius t and digital triradius d (angle atd), palmar crease and academic achievement in chosen secondary school pupils. Palm prints were obtained from 145 students (76 males and 69 females) in their third to final year (JSS3-SSS3) using a digital scanner. Microsoft Photo Viewer and AutoCAD software were used to study the dermatoglyphic patterns. Statistical analysis was performed using IBM SPSS version 25, and a $P<0.05$ result was considered statistically significant. The findings revealed that the majority of students in the study population have an 'atd' angle between 41° and 45°. Students with the ulnar loop also outperformed those with other patterns (93.1±23.35). Better academic performance was associated with the existence of an ulnar loop and whorl. Furthermore, the existence of 3 Primary lines, no Intersections/connections between the primary lines and no Complete transversal primary lines (300 PIC) model on either side of the palm was substantially associated with improved academic achievement.

Keywords: Dermatoglyphics, Fingerprint, angle 'atd'

INTRODUCTION

The term "dermatoglyphics" was invented from two words "Derma" and "Glyphe", by Harold Cummins in 1926. Cummins and his colleague Charles Midlo made substantial contributions to the subject of dermatoglyphics, which studies the unique patterns and qualities found in each person's skin ridges by analysing fingerprints, palm prints, toe prints, and sole prints[1]. Dermatoglyphics has been a significant tool in addressing basic topics in biology, medicine, genetics, and evolution for the past 150 years, in addition to being the best and most extensively used technique of personal identification[2]. Dermatoglyphics is also an important actor in anthropological studies since it may be used to describe, compare and contrast, and even anticipate occurrences and dangers for biological events[3].

From the 10th to the 12th week of pregnancy, fingerprint patterns are formed concurrently with the early development of the neocortex of the brain, which plays roles in sensory processing, motor control, cognition, memory, and language processing[3]. These fingerprints are fully formed between the 19th and the end of the 24th week[3]. The human brain is divided into two sections, with each section having five lobes –the frontal, parietal, occipital, and temporal lobes and the insular[4]. These ten lobes have distinct functions that correspond to the fingerprint patterns of each of the ten fingers[4]. The distribution of print patterns is thought to indicate the proportion and distribution of brain cells in each lobe. Alteration of dermatoglyphic patterns has been described in a number of congenital disorders, including Turner's syndrome, Down's syndrome, and others.[5,6]. The standard method established by Cummins and Mildow has discovered various sorts of fingerprint patterns[7]. The four most common kinds are the whorl (W), ulnar loop (UL), radial loop (RL), and arch (A)[8].

In dermatoglyphics, the angle 'atd' is produced by lines connecting the digital triradius (a) to the axial

triradius (t) and back to the digital triradius (d). When the axial triradius (t) is positioned further distally towards the fingertip, the angle 'atd' grows in size, demonstrating a relationship between the triradius location and this dermatoglyphic angle. These measurements are used in fingerprint analysis, genetic studies, and some pseudoscientific personality tests [9,10].

The growth of the neocortex correlates with the formation of the lines on the palm (crease), and abnormalities, abnormal formations, or even the lack of these lines are created in congenital diseases such as Down's syndrome and Patau's syndrome [11,12]. Academic achievement is determined by a student's cognitive (learning) capacity. This function is linked to the cerebral cortex and palmar dermatoglyphics [13].

Offei et al. [14] investigated the connection between palmar dermatoglyphics and academic performance. They linked 320 students' academic achievement to their palm print and fingerprint patterns. Students with symmetrical prints out-performed those with asymmetrical ones. The presence of a central pocket loop on any finger likewise correlates with improved academic performance[14]. Nagaraj [15] conducted a similar study in which he matched the academic achievement of 263 students to their fingerprint patterns. He reported that kids with more loops and mixed patterns or less arch and whorl patterns (out of 10 fingers) perform better academically[15]. Brunson and others' investigation of the reliability of the angle 'atd' in dermatoglyphics revealed that the angle can be assessed accurately by multiple readers. Rewa and Aprajita[16,17] found no direct association between academic performance and angles 'atd' in a survey of 174 students who had angle atd 35°- 46°[16,17].

MATERIALS AND METHODS

Design of sample

The subjects used in this research are secondary school students aged 10 to 18 in Ilorin, Kwara State. This study included students from the Government Secondary School and the Government Day Secondary School in Ilorin, Kwara State. Students not in their third to sixth year (JSS3-SS3) were excluded from the study. Because only willing individuals were included in the study, the purposive method of non-probability sampling was used. Students with hand malformations were barred from participating in the study.

Data collection

This study employed a digital scanner (HP Scanjet G4010) with a resolution of up to 4800x9600dpi, as indicated by Loveday and Sunday (2014) as an improvised method for dermatoglyphic data gathering that is better and requires less experience than other methods[18]. The pupils were instructed to properly position their hands on the scanning area and wait for the image to be recorded. The photos were appropriately sorted serially based on the class and gender of participants. Figure 1 showed how captured photos were upgraded to a negative greyscale mode where the patterns were obvious and easily evaluated.

Figure 1: Captured image in inverted greyscale mode

Print examination

Window Photo Viewer software was used to evaluate the fingerprint patterns. The patterns on the fingers can be easily recognised and recorded when zoomed in. The same programme was used to determine which 'PIC' system each palm belongs to. The angle 'atd' was examined using AutoCAD software. The programme was used to connect the 'a' to 't' triradii to the 'd' triradius and then to calculate the angle ‘atd’ (Figures 2A & B).

Figure 2: A. Image showing the fingerprint analysis using photo viewer. B: Image showing the measurement of angle ‘atd’ with AutoCAD software

Grading of Academic Performance

The academic results were calculated as; high (70%-100%), satisfactory (54%-69%) and low (less than 54%) according to the records provided by the administrators of the selected secondary schools[14].

RESULTS

In this study, the result system was categorised into three: high (70% - 100%), satisfactory (54% - 69%), and low (less than 54%). Our findings indicated that 50.4% of the study population were in the poor grade category, while 38.6% and 11% were in the satisfactory and high grade categories, respectively (Table 1).

Table 1: Illustration of the grade levels of the selected students

S/N	Grade	No of Students	% of students
1.	Low	73	50.4
2.	Satisfactory	56	38.6
3.	High	16	11.0
Total		**145**	**100**

The 'atd' angles of the respondents were classified into groups (30º-35º, 36º-40º, 41º-45º, 46 º-50º, 51º -55º, and 56º-60º). The 'atd' groups were then compared to their academic performance.

The 41º - 45 º angle range, followed by the 36º -40º range, had the highest prevalence of the 'atd' angle ranges. For low graders, 37% fall in the 41º-45º range in the right hand and 41.1% in the left hand, while 31.5% fall in the 36º-40º range in the right hand and 27.4% in the left hand. According to the analysis of satisfactory grades, 53.6% of the population is in the 41º-45º range in the right hand and 44.6% in the left hand, while 17.9% is in the 36º-40º range in the right hand and 23.2% in the left hand. For high grade students, a similar pattern was observed: 43.8% of the population falls in the 41-45% range in both hands, whereas 37.5% falls in the 36º-40º range in the right hand and 43.8% in the left hand (Table 2).

Table 2: Total percentage analysis of angle "atd" on the left and right palm

		Right hand		Left hand	
		No of Students	%	No of Students	%
S/N	Angle ''atd''				
1.	$30^0 – 35^0$	8	5.5	10	6.9
2.	$36^0 – 40^0$	39	26.9	40	27.6
3.	$41^0 – 45^0$	64	44.1	62	42.7
4.	$46^0 – 50^0$	21	14.5	20	13.8
5.	$51^0 – 55^0$	9	6.2	9	6.2
6.	$56^0 – 60^0$	4	2.8	4	2.8
Total		**145**	**100**	**145**	**100**

Table 2 described the overall percentage study, regardless of the marks obtained by the sample group in their annual examinations revealed that the majority of students' 'atd' angle ranged between 41° and 45°; right hand (44.1%) and left hand (42.7%). The next largest group had an 'atd' angle between 36°-40° on their right hand (27.6%) and left hand (26.7%).

The results further demonstrated that the ulnar loop pattern (93.1 + 23.35) was more common in the sample group than the whorl pattern (33.0 + 15.32) as described in Table 3. The mean academic scores for students with an ulnar loop on the ring finger (52.11 + 13.85 and 52.74 + 13.77 for left and right fingers, respectively, little finger (52.71 + 13.85 and 53.04 + 13.98 for left and right fingers, respectively), and index finger (49.69+14.47 and 51.37 + 14.15 for left and right fingers, respectively) were significantly higher than for students with other patterns.

Table 3: Fingerprint patterns distribution of the left and right palms

	Right					Left					
	RL	**RR**	**RM**	**RI**	**RT**	**LT**	**LI**	**LM**	**LR**	**LL**	
Pattern											**Mean ± S.D**
Ulnar-loop	128	92	102	81	63	62	80	104	90	129	93.1 ± 23.35
Double loop	0	1	1	3	9	7	3	1	1	0	2.6 ± 3.06
Pocket loop	2	1	1	1	0	0	3	0	3	2	1.3 ± 1.16
Whorl	11	39	24	39	53	54	38	23	38	11	33.0 ± 15.32
Arch	4	12	17	21	20	22	21	17	13	3	15.0 ± 6.93
Total	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	

The frequencies of the "PIC" palmar patterns 310 (three primary lines, one intersection between the lines, and no complete transversal primary lines) and 300 (three primary lines, no intersection between the lines, and no complete transversal primary lines) were highest both unilaterally (on one hand) and bilaterally (on both hands), while the frequencies of other "PIC" palm print patterns were lowest. 311 "PIC" (1.3% on the right palm, 0% on the left palm, and 0% bilateral); 211 "PIC" (1.3% on the right palm, 0% on the left palm, and 0% bilateral); 200 "PIC" (3.3% on the right, 4% on the left palm, and 2% bilateral); 101 "PIC" (0.67% on the left and left palm, and 0% bilateral) as described in Table 4. Figures 3 and 4 also showed the distribution of the PIC models on both palms.

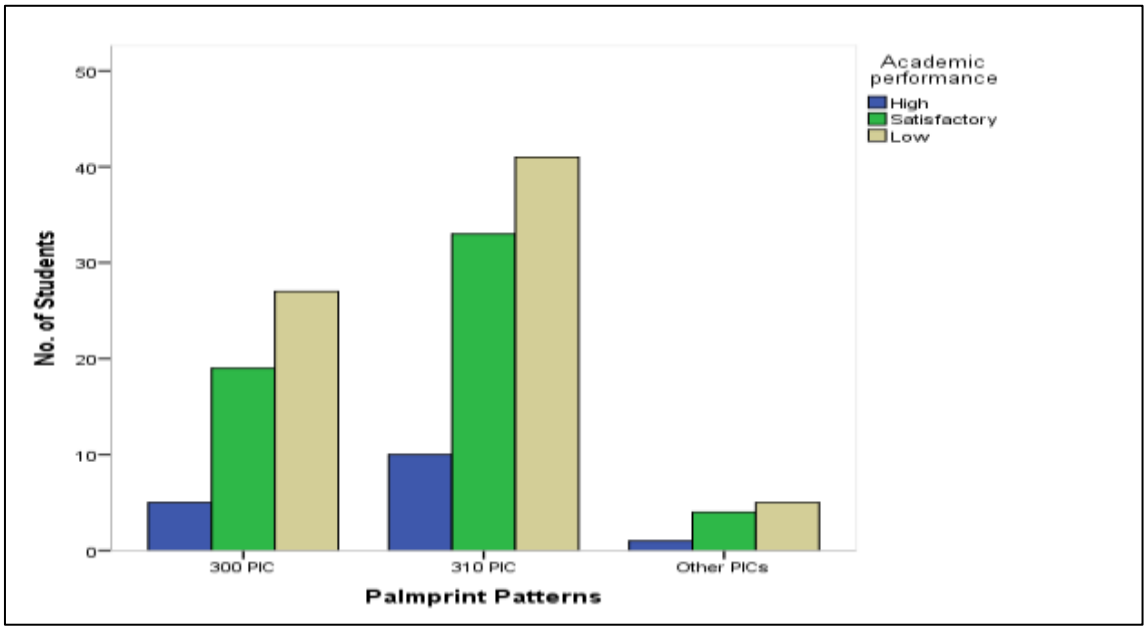
Table 4: Distribution of various palm print patterns in right, left and both hands.

Palm print patterns	**Right palm**		**Left palm**		**Bilateral**	
	No of students	**%**	**No of students**	**%**	**No of students**	**%**
311 PIC	2	1.3	0	-	0	-
310 PIC	88	58.7	97	64.7	80	53.3
300 PIC	52	34.7	46	30.7	40	26.7
211 PIC	2	1.3	0	-	0	-
200 PIC	5	3.3	6	4.0	3	2.0
101 PIC	1	0.67	1	0.67	0	-

Table 5: Academic achievement of students stratified by palm print patterns

Palm print patterns	**Right Hand**	**Left Hand**	**Both Hand**	**P-value**
311 PIC	64.00 ± 2.83	-	-	-
310 PIC	49.79 ± 62.37	49.23 ± 19.94	40.23 ± 25.90	0.004
300 PIC	45.19 ± 19.76	40.26 ± 23.22	34.60 ± 25.90	0.002
211 PIC	47.00 ± 11.31	-	-	-
200 PIC	34.63 ± 31.14	33.88 ± 22.09	17.13 ± 23.88	0.038
101 PIC	45	38	-	-
P-value	0.001	0.001	0.048	-

Table 5 showed that there was no significant difference when students' performance was classified as symmetrical or asymmetrical. The analysis of symmetrical and asymmetrical palmar creases revealed that 116 of the 145 students had symmetrical "PIC" (i.e., the same "PIC" patterns bilaterally), whereas the remaining 29 had asymmetrical "PIC" (that is, distinct "PIC" patterns in their hands) ($p>0.05$). The palmar print analysis revealed that the presence of the 300 "PIC" model ($p=0.002$) on either the right, left, or both hands correlated with academic performance twice as well as other patterns and is closely followed by the 310 "PIC" model ($p=0.004$) and 200 "PIC" ($p=0.038$).



Figures 3: Distribution of academic performance across palm print patterns on the right hands.

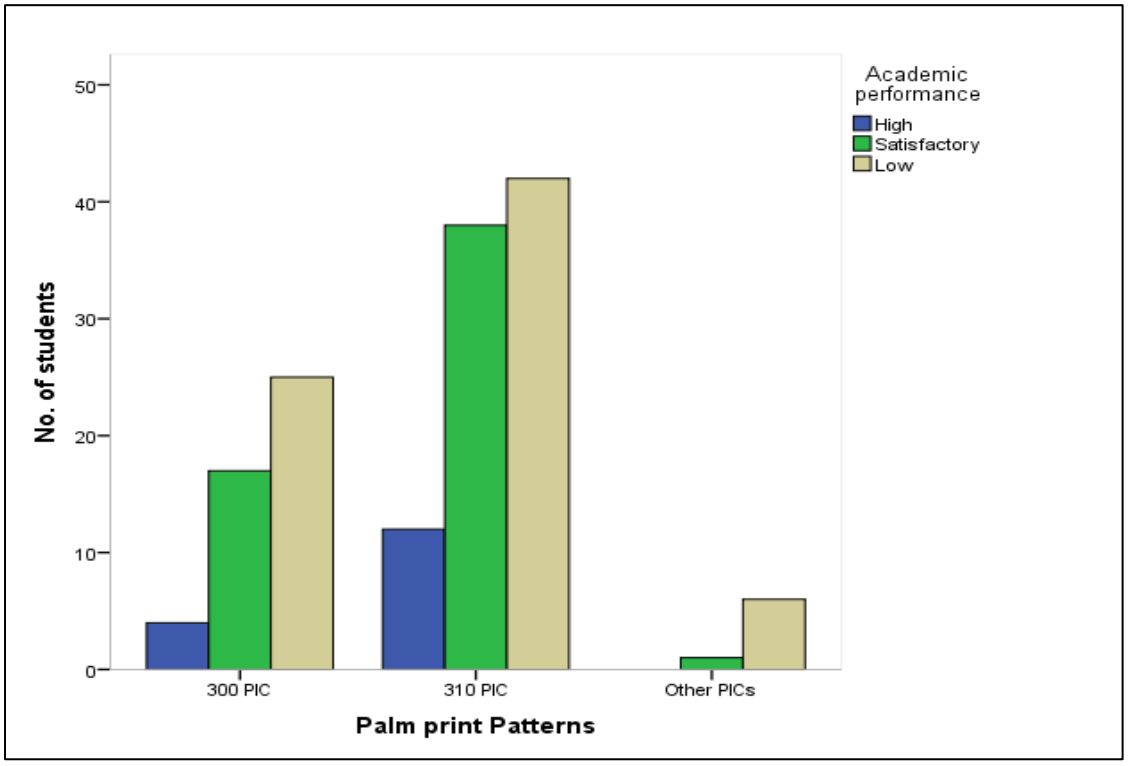


Figure 4: Distribution of academic performance across palm print patterns on the left hands.

DISCUSSION

According to previous studies, academic performance is a strong predictor of intelligence[13, 19], and students' academic performance at all levels of education show stratification[20]. This study focuses on the relationship between several palmar dermatoglyphics factors and the academic performance of pupils classified. It was hypothesised that there might be a correlation between the results of senior secondary examinations and the angles 'atd' [21], because the angle had previously been related with mental retardation[22] and athlete selection[21]. It was also hypothesised that underperforming pupils would fall within one range of normal angle 'atd,' whereas super performers and mid-range performers would fall within another.

This study revealed that the percentage of occurrence of academic performance groups with atd angle 36°-40° in both hands is in close range and that the high performance group has the highest value. A normal 'atd' angle range of 35°-40°, with only 4.2% of people having an angle more than 55° has been documented[22]. Two scientists reported a similar result in their study, with only 3.5% of applicants with the right hand and 2.5% with the left hand having an angle greater than 55° [17]. A similar study pattern was observed in the current investigation, with just 9% of applicants with both hands 'atd' above 45°. A consistent pattern emerged among the 145 participants in terms of the degree of 'atd' in the right and left hands, as determined by the average values of 'atd' angle in both hands. This was found to be 41°, which is comparable to the figure given by Rishi and Sharma [17] as 42° but lower than the figures given by Kumar and others (44.5°)[24] and 51.03° and 51.25° as on the right and left hands by other researchers[22].

The outcome of the 'atd' angle compared to academic performance in this study is consistent with the findings of the authors who observed that the 'atd' angles of the students were usually in the 41°-45° range[17]. It was also observed in this research that the 'atd' angle in right and left hand of the sample group ranged between 30° to 60° which correlates with the range of 30° - 65° obtained in the work of Vashist *et al*[22]. In contrast to our findings, the outcome of a research showed higher normal 'atd' angle range with higher upper limit of 76°[21]. Previous research had also showed that instances of mental retardation ranged from 30° to >65° [22]. In this current study, however, there was no case of an 'atd' angle of less than 30° and greater than 60° in the right and left hand in any of the academic performance grading groups. Certainly, no student utilised as a subject in this study was mentally retarded. Cesarik *et al.* [25] concluded in their study that the 'atd' angle lowers in both sexes with super intelligence. This tendency could not be demonstrated in the current study because all academic performance groups were found to have the same 'atd' angle. While working with athletes, Shao discovered that the 'atd' angles of exceptional athletes were much smaller than the 'atd' angles of the general population groups (41°-42°)[21].

Academic performance has a significant correlation with fingerprint patterns, with whorl, arch and ulnar loop having significant values of 0.0001 each. This indicates that the ulnar loop with arch or whorl pattern correlates strongly with superior academic achievement of pupils (p0.0001) when present in the little, ring, and index fingers. Parker[26] showed a statistically significant amount of whorl in both normal (IQ 90-109) and above normal (IQ 110-129) intellectual ranges compared to below normal (IQ 70-89) intellectual ranges. Our findings is also consistent with the findings of the scientists that reported the presence of arch indicates improved academic achievement[27.] Also, normal adolescents were reported to have more whorls than brilliant adolescents, but the latter had more ulnar loops than the former [28], and talented people had more radial loops than people with learning problems [28]. Furthermore, students with central pocket loop and whorl located on the ring and middle fingers performed better academically than those with other fingerprints, demonstrating a close relationship between dermatoglyphic pattern and hand and brain cognitive functions[10]. Similarly, Adekoya and colleagues[29] reported that the ulnar loop was the most common pattern among the 'intelligent' (in logic) group, and that a greater ridge count is linked with a higher level of kinaesthetic intelligence. However, the same study found no significant association between fingerprint types and tribal students' performance[29]. On the other hand, other studies agreed and disagreed with the current study by showing a higher frequency of loops and whorls in highly bright students than in the comparison group[30, 31].

Certainly, the 310 and 300 palmar patterns are prevalent in most people, as evidenced by this study and other population studies[30], implying that the current findings may reflect the predominance of the symmetrical palm prints in the sample population. The result obtained in this study in relation to the symmetrical PIC pattern was in contrast to the research reported by Offei and colleagues[14] which stated that students with symmetrical palm prints were three times more likely to obtain high scores than students with asymmetrical palm prints; this contrary opinion could be attributed to a small research sample size or a small number of students with high academic performance.

CONCLUSION

According to the findings of this study, the existence of whorls and arches on the little, index, and ring

fingers indicates improved academic success. When compared to academic achievement, the angle 'atd' is not significant and is not regarded as a good criterion for determining level of academic success (cognitive learning).

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