ORIGINAL ARTICLE

The study of dermatoglyphic pattern of thumb and its correlation with academic performance of medical students

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Abstract

Background: Dermatoglyphics is the study of fingerprint pattern which is unique for every individual and remains unchanged after birth. This has been used in criminology for decades together. In the recent past, its role in screening various medical conditions is established. The dermatoglyphic had a well-established correlation with the cognitive ability which can be used as a predictor of academic potential. *Aim and Objectives:* This study was conducted to study the dermatoglyphic pattern of thumb and its correlation with the academic performance of medical students. *Material and Methods*: A cross-sectional observational study was conducted on 200 (94 male and 106 female) undergraduate medical students. The fingerprint patterns were obtained by the standard ink method. *Results*: In the present study the commonest pattern of fingerprint in both right and left thumbs in male and female students was whorl. The most remarkable finding was the absence of an ulnar loop with a central pocket in the left thumb. In the present study correlation of the fingerprint pattern of the thumb to the marks scored in National Eligibility Cum Entrance Test (NEET) showed that the higher academic performers had more frequency of whorl and composites whereas low performers had a high frequency of loops and arches in the thumb. However the same findings were not reflected in performance in first-year university examination and no correlation could be substantiated with marks scored in Anatomy, Physiology, and Biochemistry in the preliminary examination. *Conclusion:* Though present study is small scale involving a single institution, it indicates definite correlation of finger print pattern of thumb with academic performance of medical students which can be used as predictor of low performers so as to initiate necessary measures.

Keywords: Predictor, Academic Potential, Cognitive Ability, Screening

Introduction

In 1823, a Czech physiologist and biologist, Joannes Evangelista Purkinje began the study of papillary ridges over the palms and the soles [1]. The anatomist from Tulane University, Harold Cummins coined the term 'dermatoglyphics' which means the study of the epidermal ridges and their various patterns. Man, apes, and monkeys are characterized by the ridges of the volar skin and these ridges are prominent over palms and soles preventing slippages and useful for gripping and improving touch sensation [2].

An epidermal ridge pattern appears on the mounds of the skin first in the early months of intrauterine life. Different patterns of the epidermal ridges can

be observed over the tips of the fingers, in the four interdigital parts, thenar and hypothenar eminences of the palms and the soles but during the third to the fourth month of intrauterine life, the process of formation of the epidermal ridge along with the decrease in the size of the mound start that concentrate the appearance of the patterns of the epidermal ridge. During this period, any hereditary and environmental factors causing disturbance in the fetal growth will cause modifications in the configuration of epidermal ridge pattern, as patterns once formed never alters except in its size [3].

After birth, the environmental factors do not significantly influence the dermatoglyphic patterns [4]. Dermatoglyphic is the method of obtaining and studying the impression of the papillary ridges of the fingertips and palms. The narrow parallel or curved arrays formed by these ridges are divided by the narrow furrows. Along the top part of each mountain, at regular intervals, there opens ducts of the sweat glands [5]. On the inner surface of the epidermis, undulation occurs with ridges and furrows at the beginning of 12 weeks of development [6-7].

Every individual possesses unique fingerprint as epidermal ridges are genetically defined and their particular pattern remains constant throughout life. Hence it has a diagnostic significance for genetic disorders as well as in the identification of a person. Fingerprints have a polygenic pattern of inheritance [8-10]. Many scientific evidences suggest close association between dermatoglyphic prints (finger prints and palm prints) and brain functions (as the development of brain and that of epidermal ridge of the hand from embryonic ectoderm occurs at the same period) [11].

Hence genetic diseases affect both brain and hand. Most known association is the presence of palmar Simian and Sydney creases and intellectual disability in individuals with Down syndrome, Trisomy 18 (Edward's syndrome), Trisomy 13 (Patau's syndrome) and Rubinstein-Taybi syndrome. Delayed developmental problems, learning difficulties and behavioural disorders are the common problems faced by the affected individuals [12].

The learning (cognitive) capability of the students determines their educational achievements [13-14]. These cognitive abilities such as memory, speaking and hearing skills are the features of the cerebral cortex [15]. Academic achievements also represent the degree of reasoning and understanding [16]. The academic brain activity of the student is also mirrored in the qualitative and quantitative evaluation of students' success in academics [17-18].

Research studies till date have suggested correlation between specific dermatoglyphic pattern and intelligence and academic excellence. In the present study, an effort was made to find out whether a particular dermatoglyphic pattern on thumb exists in association with the academic performance of the medical students.

Material and Methods

This cross-sectional observational study was conducted on 200 (94 male and 106 female) first-year undergraduate medical students of Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi (Meghe), Wardha, after clearance from the Institutional Ethics Committee (IEC) of Datta Meghe Institute of Medical Sciences (DMIMS) (DU)/IEC/Jun-2019/8042. Students were recruited using complete enumeration technique, after taking written informed consent and those with skin disease involving palm and deformities of

hands were excluded. Materials used included stamp pad, glass slab, pressure pad, roller, tissue papers, Kores Camel duplicating ink, white paper sheets, soap, clean towel, scale, pencil, lens, protractor, and needle

Procedure: To remove any oil or dirt, students were told to wash their hands with soap and water and dry them with a clean towel. The required quantity of ink was poured over the glass slab and equally spread with the help of a roller. The washed and dried palms of each subject were pressed over the inked slab from the proximal to the distal end, at the root of fingers, as well as on the dorsum of the thenar and hypothenar eminences, and care was taken to be gentle between interdigital grooves. To see whether the ink was evenly distributed or not, each palm was thoroughly examined. With the help of cotton puffs, the un-inked areas and furrows were inked. To get an even and clear palm print each student was asked to place their right hand from proximal to distal end on the sheet of paper (kept over the pressure pad). The palm was gently pressed between interdigital grooves at the root of fingers and the dorsum of the thenar and hypothenar regions and was then lifted from the paper in reverse order i.e. from distal to proximal. The fingertip prints were obtained by using the rolled fingerprint method separately below the palmer print. The fingers were rolled to include all the patterns from the radial to the ulnar side. For the left side, the same process was repeated using different sheets of paper. These printed sheets were coded with the roll number and gender of the students. With the aid of magnifying hand lenses, these prints were subjected to extensive dermatoglyphic examination. The parameters studied were a. Arches b. Radial loop c. Ulnar loop d. Whorl (Figure 1). The parameters analyzed to study the academic performance of the participants were marks scored in National Eligibility Cum Entrance Test (NEET), the First MBBS Preliminary examination with subject-wise marks obtained, and the overall marks scored in the First-year University examination.

Statistical analysis

The statistical analysis was done by using the arithmetic mean, Standard Deviation (SD), Chi-square test, and one-way ANOVA.

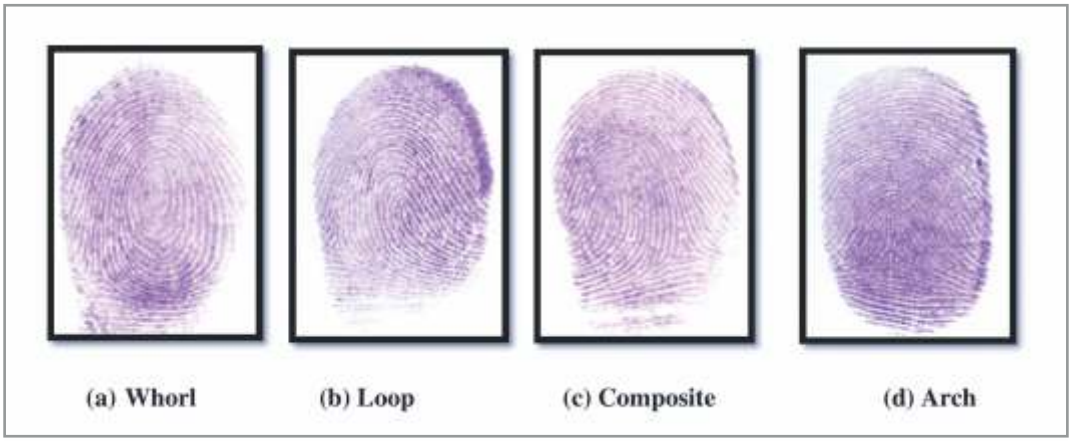

Figure 1: Different finger print patterns

Results

In the present study, the fingerprint pattern of the right and left thumb in male and female students was statistically non-significant (Right thumb p=0.88, NS; left thumb p=0.97, NS). The commonest fingerprint pattern in right and left thumb was whorl. The least observed pattern in the right thumb was the ulnar loop with a central pocket (1.5%) (Table 1).

It was noted that the left thumb had no ulnar loop with central pocket. This suggested that fingerprint pattern of right and left thumb was asymmetric and difference was statistically highly significant (p= 0.0002) (Table 2).

By using one way ANOVA, statistically significant variation was found in NEET marks with respect to thumb finger print pattern of the students (F value = 3.60, p =0.002) (Table 3).

The analysis of correlation of fingerprint pattern to marks scored in NEET showed that the higher academic performers had more frequency of whorls and composites in thumb whereas low performers had high frequency of loops and arches and this difference was statistically significant (Table 4).

The analysis of correlation of fingerprint pattern to marks scored in Anatomy, Physiology and Biochemistry in preliminary examination showed no statistically significant difference in performance (Tables 5 and 6).

The variations in marks scored in first year university examination related to thumb fingerprint pattern of the students were statistically non-significant (Table 7).

The analysis of correlation of fingerprint pattern to marks scored in first MBBS university examination showed no statistically significant difference in performance (Table 8).

Table 1: Symmetry between right and left fingerprint patterns

Finger	Side	Fingerprint pattern							Total	$\chi 2$	p
		Ulnar loop with CP*	Ulnar loop without CP*	Radial Loop with CP*	Radial Loop without CP*	Composite	Whorl	Arch			
Thumb	Right	3	10	29	22	17	64	55	200	83.85	0.0002, S**
	Left	0	44	3	6	31	79	37	200		

**CP- Central Pocket, **S- Significant.*

Table 2: Symmetry between right and left finger print patterns

Finger	Side	Fingerprint pattern							Total	$\chi 2$	*p*
		Ulnar loop with CP*	Ulnar loop without CP*	Radial Loop with CP*	Radial Loop without CP*	Composite	Whorl	Arch			
Thumb	Right	3	10	29	22	17	64	55	200	83.85	0.0002, S**
	Left	0	44	3	6	31	79	37	200		

**CP- Central Pocket, **S- Significant*

Table 3: Distribution of fingerprint pattern with marks scored in National Eligibility Cum Entrance Test (NEET)

Fingerprint Pattern on Thumb (Right + Left)	Marks (Mean ± SD)
Ulnar loop with CP*	207.66 ± 82.03
Ulnar loop without CP*	309.79 ± 72.75
Radial Loop with CP*	332.96 ± 60.74
Radial Loop without CP*	318.78 ± 66.41
Composite	337.10 ± 46.96
Whorl	334.32 ± 54.02
Arch	315.88 ± 72.724
Total	324.96 ± 63.53
F-value	3.60
p	0.002,S**

**CP- Central Pocket, **S- Significant*

Table 4: Correlation of marks scored in National Eligibility Cum Entrance Test (NEET) with dermatoglyphic pattern

	Marks	Ulnar loop	%	Radial Loop	%	Composite	%	Whorl	%	Arch	%	Total	χ2	*p*
Thumb (Right + Left)	115- 300	14	25.00	10	17.86	2	3.57	13	23.21	17	30.36	56	16.26	0.039,S*
	301-400	40	13.25	44	14.57	39	12.91	114	37.75	65	21.52	302		
	401-500	3	7.14	6	14.29	7	16.67	16	38.10	10	23.81	42		

**S- Significant*

Table 5: Correlation of marks scored in anatomy, biochemistry and physiology in preliminary examination and dermatoglyphics pattern

Dermatoglyphics pattern	Anatomy	Physiology	Biochemistry
Thumb (Right +Left)	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Ulnar loop with CP*	46.50 ± 19.15	59.25 ± 9.52	46.41 ± 24.65
Ulnar loop without CP*	45.37 ± 12.76	55.14 ± 10.01	53.58 ± 15.20
Radial Loop with CP*	44.80 ± 14.67	56.12 ± 11.88	53.85 ± 15.86
Radial Loop without CP*	44.08 ± 11.76	52.73 ± 8.78	52.67 ± 13.93
Composite	43.08 ± 9.35	56.17 ± 15.28	51.45 ± 13.31
Whorl	45.77 ± 11.35	55.35 ± 9.05	54.12 ± 11.84
Arch	44.21 ± 12.93	54.21 ± 9.81	51.60 ± 14.85
Total	44.84 ± 12.03	55.07 ± 10.47	52.97 ± 13.75
F-value	0.39	0.57	0.56
p	0.88, NS**	0.75, NS**	0.75, NS**

**CP- Central pocket, **NS- Non-significant*

Table 6: Correlation of preliminary marks scored in anatomy, biochemistry and physiology in preliminary examination and dermatoglyphic pattern

Dermato-glyphic pattern over thumb	Marks in Anatomy	Ulnar loop	%	Radial Loop	%	Composite	%	Whorl	%	Arch	%	Total	χ2
	< 50	37	14.23	39	15.00	37	14.23	89	34.23	58	22.31	260	6.91 *p*=0.54 NS*
	50-60	10	11.36	12	13.64	9	10.23	36	40.91	21	23.86	88	
	⩾61	10	19.23	9	17.31	2	3.85	18	34.62	13	25.00	52	
	Marks in Physiology	**Ulnar loop**	**%**	**Radial Loop**	**%**	**Composite**	**%**	**Whorl**	**%**	**Arch**	**%**	**Total**	**χ2**
	< 50	14	12.73	20	18.18	14	12.73	34	30.91	28	25.45	110	44.76 *p*=0.78 NS*
	50-60	26	15.66	22	13.25	16	9.64	63	37.95	39	23.49	166	
	⩾61	17	13.71	18	14.52	18	14.52	46	37.10	25	20.16	124	
	Marks in Biochemistry	**Ulnar loop**	**%**	**Radial Loop**	**%**	**Composite**	**%**	**Whorl**	**%**	**Arch**	**%**	**Total**	**χ2**
	< 50	20	12.20	26	15.85	22	13.41	49	29.88	47	28.66	164	8.68 *p*=0.36 NS*
	50-60	15	13.89	16	14.81	13	12.04	44	40.74	20	18.52	108	
	⩾61	22	17.19	18	14.06	13	10.16	50	39.06	25	19.53	128	

**NS- Non significant*

Table 7: Distribution of fingerprint pattern of thumb with marks scored in first MBBS university examination

Fingerprint Pattern	Thumb (Mean ± SD)
Ulnar loop with CP*	66.70 ± 6.06
Ulnar loop without CP*	64.48 ± 5.58
Radial loop with CP*	66.53 ± 5.42
Radial loop without CP*	64.30 ± 4.64
Composite	61.97 ± 10.33
Whorl	63.65 ± 6.98
Arch	64.21 ± 5.09
Total	63.95 ± 6.74
F-value	1.43
p	0.19,NS**

**CP- Central Pocket, **NS- Non-significant*

Table 8: Correlation of marks scored in first MBBS university examination and dermatoglyphic pattern

Finger	Marks	Ulnar loop	%	Radial Loop	%	Composite	%	Whorl	%	Arch	%	Total	$\chi 2$
Thumb	< 50	11	19.64	10	17.86	6	10.71	17	30.36	12	21.43	56	5.87 p=0.66, NS*
	50-60	0	0.00	0	0.00	1	50.00	1	50.00	0	0.00	2	
	⩾61	46	13.45	50	14.62	41	11.99	125	36.55	80	23.39	342	

**NS- Non-significant*

Discussion

In recent years, studies on dermatoglyphics are on an increasing trend. In this study, we tried to study the association between the fingerprint pattern of the thumb and the academic performance of medical students. It was observed that the commonest pattern of fingerprint in both right and left thumbs in male and female students was whorl. The most important finding in the present study was that the ulnar loop with a central pocket was absent in the left thumb.

Kakkeri and Attar in their study on the distribution of fingerprint patterns in medical students reported that whorls were the most frequent fingerprint pattern which is similar to this study [19]. Siddapur *et al*. [20] in their study on the relationship between fingerprint pattern and intellectual performance reported that arch and composites were more frequent patterns and loops and whorls were the least. These findings are contrary to the findings of the present study. In the present study, there was no gender difference in the fingerprint pattern of the thumb.

Bhavana *et al*. [21] reported that the commonest pattern in males was whorl (57.09%) and loops in females (52.63%) followed by arches in both males and females. The findings of this study are not in accordance with our study. Mehta and Mehta [22] in their study on medical students of the Vidarbha region reported commonest fingerprint pattern with the highest percentage in males were loops (48.43%), followed by 42.71% whorls and arches (08.86%) which was same in females also with 59.71% loops and 7.86% arches. These findings are in contrast with our study. Katwal *et al*. [23] reported the commonest pattern to be loops (56.1%) followed by whorls (37.8%), arches (5.85%), and composite (0.25%) in both right and left hands among males and females, which are not in accordance with our study. Das *et al*. [24] observed that in both males and females, loop (52.3%) was the commonest fingerprint pattern followed by the whorl pattern (42.2%), which are in contrast with the findings of the present study. Rastogi reported that commonest pattern in males was whorl and loops in females [25], which are in contrast with the present study. Narayana *et al*. reported commonest pattern in males to be loops and whorls in females [26]. These findings are in contrast with our study.

Finger print pattern of thumb in right and left hand were different i.e. asymmetrical and statistically highly significant (p =0.0002). Offei *et al*. [27] reported symmetrical palm print pattern in their study which are in contrast to the findings of our study. They also observed that this symmetrical pattern was associated with higher academic performance. All the students in our study were with moderate to low scores in NEET and were with asymmetrical palm print pattern. Hence these findings are consistent with their study.

In this study, there was preponderance of whorl on right and left thumb which are similar to the findings by Das *et al*. [24]. Kanchan *et al*. [28] and Mehta [22] also reported similar findings. In our study correlation of finger print pattern to marks scored in NEET showed that the higher academic performers had more frequency of whorl and composites whereas low performers had high frequency of loops and arches in thumb. But in our study we could not substantiate correlation of finger print pattern to marks scored in anatomy, physiology and biochemistry in preliminary examination as well as First year university examination. Parker [29] had reported correlation of whorl pattern with high intelligence, similar to our findings. Siddapur *et al*. [20] concluded that the medical students with arch finger print pattern performed better which are in contrast with our study. Nayak *et al*. [30] reported that the medical students with loop pattern scored distinction and the students with other pattern scored only passing marks, which are also in contrast with the present study.

Conclusion

The present study is single institutional, but its preliminary findings suggest that there is a definite correlation between fingerprint patterns of thumb in medical students with academic performance. Further large-scale studies including and comparing medical students who scored high in medical qualifying examinations with those who are moderate or low scorers are warranted. This will help to draw a definitive conclusion regarding dermatoglyphic pattern and its correlation with academic performance and to determine the usefulness of this tool as a predictor of academic performance thereby identifying the low performer and initiating necessary interventions.

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