Original Article

Dermatoglyphic pattern is an Indicator for Assessing the Intelligence Quotient (IQ) of Medical Undergraduates in A North Indian Medical College

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Abstract

Introduction: The intelligence quotient (IQ) levels and dermal ridge patterns on the volar surfaces of digits and palms of different individuals may be related because brain developed from 13th to 21st week and during same time-period the dermal groove developed. Neocortex is a higher center for learning and of intelligence, so there is association between Intelligence level and patterns of fingerprints. So, this study was conducted to find out the different dermatoglyphic patterns of fingers and palms and correlate them to the IQ levels of medical undergraduates. **Materials and Methods:** Fingers and palms prints of both the hands of 150 medical students of 18-24 years were collected with help of ink pad and A4 size of paper. The fingers and palms prints were studied using hand held magnifying lens and their IQ levels assessed using Raven's Standard Progressive Matrices. **Results:** The most common finger patterns e.g. single whorl in thumb, ulnar loop in index finger and middle finger of both sides and were found on participants having Grade I Intelligence. More males shown higher IQ and belonged to Class A IQ i.e. grade I and Grade II however in lower IQ the males and females were equally distributed and belonged to Class B i.e. Grade III, IV, V. Most common finger patterns i.e. single whorl in thumb and ulnar loop in index on both right and left side were found in the participants having Grade I & II Intelligence. **Conclusion:** Students with Grade I and II IQ has higher incidence of whorl followed by loop whereas in participants with IQ level of Grade III onwards, loop was the most common pattern followed by whorl. Asymmetry in patterns on both the side of fingerprint was evident in lower IQ levels. Higher values of mean 'a-b' ridge count and mean 'atd' angle was higher in individuals with low IQ level. So, it can be concluded that the dermatoglyphic pattern and IQ levels are associated.

Keywords: Dermatoglyphic patterns, finger and palm prints, intelligence quotient levels

Introduction

Fingerprints are the unique trait of an individual and do not change throughout the life.[1] During the development of epidermal ridges, unique characteristics of the fingerprint have been specified in genotype but not inherited from one generation to the next one. The fingerprints of two individuals cannot be the same even in identical twins. Because of their uniqueness, fingerprints are nowadays used in various fields such as tracing criminals, early detection of certain diseases, especially congenital, brain fingerprinting, and Dermatoglyphics Multiple Intelligence test.[2] Study of fingerprint pattern on palmar surface of fingers, palms, and soles is known as dermatoglyphic.[3]

Measurement of intelligence is a greatest endeavor in psychology which has a great role in society. Individuals with low intelligence quotient (IQ) have hitches in acquiring, thinking, and processing new information and knowledge and they need care. Low IQ has association with genetic abnormalities.[4,5] IQ and dermatoglyphics have a developmental association, as the development of epidermal ridges and the nervous system takes place in the second trimester by ectoderm. Evidence suggests that dermatoglyphics can be used along with other methods to diagnose genetic diseases.

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As their development has the same origin, dermatoglyphics can estimate the IQ range.[5,6]

Student's cognitive capabilities such as speaking and hearing skills and memory play a major role in learning and educational achievements. Cognitive capabilities are related to the cerebral cortex. Students' academic brain activity is reflected in academic evaluations (qualitative and quantitative evaluation). Many studies show an association between specific dermatoglyphic patterns and their intelligence.[7-9] Nowadays, the quality of life and education of an individual have been promoted and invested in view of to produce a high-quality labor force that can meet the needs of the economy of developing countries.[10,11] Knowledge and understanding of any relation or association between the biological indicator (dermatoglyphic pattern) and intellectual indicators (IQ) is important. It can help to make adjustments in the educational process of an individual to have a better life, so, the present study aimed to study the fingerprint patterns and compare them with the different IQ levels of the medical undergraduate students who took admission through the NEET Exam.

Materials and Methods

Study design

The present cross-sectional study was conducted on medical undergraduate students.

Study setting

A total of 150 medical undergraduate students from the medical college of North India were subjected to the research, out of 150 participants, 72 were female and 78 were male. Participants were selected by the convenient sampling technique. The study was carried out in the department of community medicine from October 2019 to September 2022. Participants who were willing to participate and giving written consent were subjected to the study whereas participants who were not give consent and had skin lesions or scars on the palmar aspect of their hands were excluded from the study.

Ethical approval

Prior ethical clearance was taken from IRB/IEC (IEC/63/2019/SEP) of the institute.

Methodology (tools and methods)

Taking finger and palmar print

Finger and palmar print of both the hands of medical students was taken by using the standard ink and roller method on plain white paper.[12] Material required – ink, ink pad, soap, water, towel, and white bond paper.

Identification of finger and palmar print

With the help of a hand lens, fingerprints of individual fingers of both the hands were observed and noted down. The following patterns were observed and classified as Galton Henry system – arch (simple and tented), loop (ulnar loop – opens on the ulnar side, radial loop – open on radial side), and whorl (concentric, spiral, central pocketed, and double loop).[13]

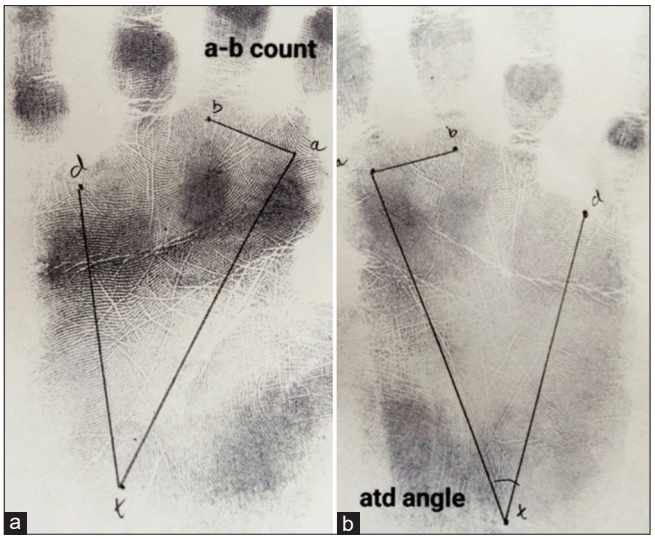

Figure 1: (a) Palm print of the left hand showing triradius points a, b, and ab-ridge count, (b) Palm print of right-hand shows in triradius point a, t, d, and atd angle

On the palmar print, triradius points a, b, and d were marked which are present at the base of the index, middle, and little finger, respectively, and axial triradius t was marked. "A-b" ridge count was done on both right and left palmar print with the help of hand lens[14] [Figure 1a]. Points a, t, and d were joined with the line, and the angle "atd" was measured with the help of a protractor[14] [Figure 1b].

Estimation of intelligence quotient level

IQ was identified by using Raven's Standard Progressive Matrices (2003),[15-17] which is based on multiple-choice questions. This test had five sets (A, B, C, D, and E), each set contained 12 multiple-choice questions (MCQs), with increasing order in difficulty. Even each set also had increasing higher degree of difficulty, so there were a total of 60 questions (MCQs), 12 in each set. There was no time limit for solving the test. SET A – had questions related to the continuity and completeness of figure, SET B – was based on the similarity and relations between the figures, SET C – was based on the continuity and logic of structural change, SET D – was based on the change of logical positioning of shapes, and SET E – determines the concept structural analysis of parts.[15]

The questionnaire was given to the participants along with answer sheets, which also contain the demographic details of the participants along with the consent form. Each correct answer was given 1 point and maximum marks were 60. Once having the standard test score, the IQ percentile was interpreted by actual points scored by participants, and grading was done according to percentile.[17]

- Grade I – ≥95th percentile, participants are intellectually superior
- Grade II – ≥75th percentile, participants are "definitely above the average in intellectual capacity," (Grade II + at 90th percentile and Grade II at 75th percentile)

- Grade III – over 25th and below 75th percentiles, participants were intellectually average, at 50th percentile
- Grade IV – ≤25th percentile, participants were definitely below average in intellectual capacity, (Grade IV + at 25th percentile, Grade IV at 10th percentile)
- Grade V – ≤5th percentile, participants were intellectually defective.

Statistical analysis

Data were tabulated in an Excel sheet and analysis was done using the SPSS software version 22.0 (IBM Corp. 2013. Armonk, New York). "Paired *t*-test" was used to compare the means of "a-b" ridge count and "atd" angle of both hands.

Results

In the present study, the participants were MBBS students of Phase II and III with an age range from 18 years to 24 years. Out of 150 participants, 72 were females and 78 were males. The mean time taken for Raven's SPM was 40 min. Various patterns were observed in the fingerprints of both the hands of individual participants (total 10 digits), (a) Simple arch or plain arch, (b) Tented arch, loops: ulnar loop and radial loop and whorls (W): Simple whorl, double, or a spiral whorl [Figures 2 and 3].

The most common dermatoglyphic pattern on fingerprints in individual digits was a single whorl in the thumb, ulnar loop in the index finger and middle finger, single whorl in the ring finger, and ulnar loop on the little finger on both the right and left side [Table 1]. The mean a-b count on the right and left side was 44.52 ± 5.70 and 41.63 ± 5.35, respectively, and the difference was statistically significant ($P < 0.05$). The mean atd angle on the right and left sides was 45.81° ± 6.06° and 42.01° ± 4.92°, respectively, and the difference on each side was not statistically significant ($P > 0.05$) [Table 2a and b].

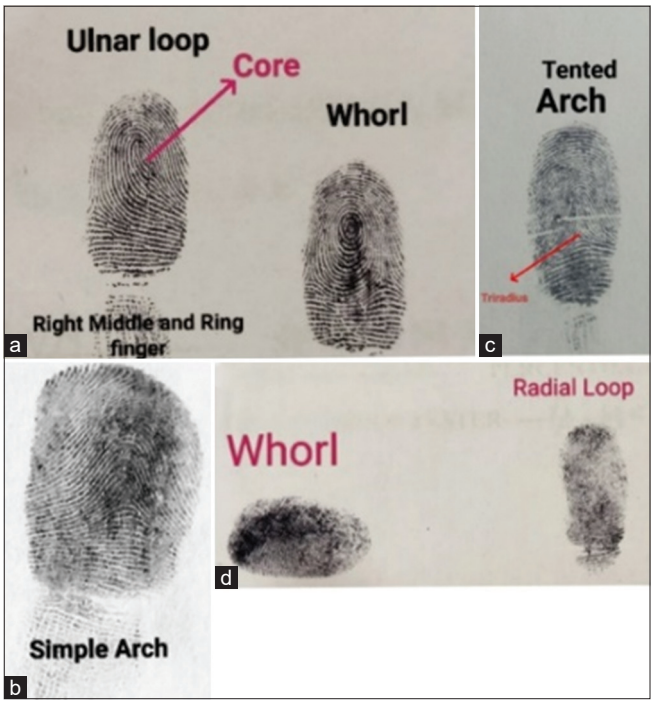

Figure 2: Various dermatoglyphics patterns on fingerprint (a) Ulnar loop and whorl, (b) simple arch, (c) Tented arch, (d) Whorl and radial loop in right fingers

Table 1: Distribution of dermatoglyphic patterns on fingertips of medical students

Dermatoglyphic patterns	Right finger patterns					Left finger patterns				
	Thumb, *n* (%)	Index, *n* (%)	Middle, *n* (%)	Ring, *n* (%)	Little, *n* (%)	Thumb, *n* (%)	Index, *n* (%)	Middle *n* (%)	Ring, *n* (%)	Little, *n* (%)
Arch										
Simple	4 (2.6)	2 (1.3)	2 (1.3)	-	-	10 (6.7)	18 (12)	10 (6.7)	-	2 (1.3)
Tented	-	6 (4.0)	2 (1.3)	2 (1.3)	-	-	4 (2.7)	2 (1.3)	-	-
Loop										
Ulnar	24 (15.9)	68 (45)	110 (72.8)	54 (35.8)	104 (69.3)	26 (17.3)	60 (40)	92 (61.3)	60 (40)	102 (68)
Radial	-	12 (7.9)	-	-	-	-	6 (4)	-	2 (1.3)	-
Whorl										
Single	110 (72.8)	56 (37.1)	36 (23.8)	92 (60.9)	44 (29.3)	100 (66.7)	52 (34.7)	40 (26.7)	88 (58.7)	44 (29.3)
Double	8 (5.3)	2 (1.3)	-	2 (1.3)	2 (1.3)	12 (8)	8 (5.3)	6 (4)	-	2 (1.3)
Mixed	4 (2.6)	4 (2.6)	-	-	-	2 (1.3)	2 (1.3)	-	-	-

Table 2a: Mean, minimum, maximum value, and standard deviation of "a-b" ridge count and "atd" angle on the palm print of medical students

Side	Parameters	*n*	Range	Minimum	Maximum	Mean±SD
Right	"a-b" count	150	28.0	32.0	60.0	44.520±5.7003
	"atd" angle	150	24.0	32.0	56.0	41.627±5.3540
Left	"a-b" count	150	33.0	31.0	64.0	45.813±6.0639
	"atd" angle	150	34.0	30.0	64.0	42.013±4.9222

SD: Standard deviation

According to Raven's SPM, out of 150 participants, 35.8% had an IQ of Grade II, 21.2% had Grade II+, and 18.5% had Grade I intelligence. However, 6.6% had Grade IV intelligence, i.e., they scored <25th percentile [Chart 1].

In class-wise distribution, 76% (114) participants were in Class A which includes Grade I and Grade II (out of which 53% (*n*=60) were males and 47% (*n*=54) were females), and 24% (36) participants were in Class B which includes Grade III onward in which distribution of male and female participant was equal i.e. 50%. [Table 3].

Most common finger patterns were found in participants having Grade I Intelligence, in the thumb single whorl, in the index finger, and middle finger ulnar loop. Single whorl was common pattern on the ring finger and ulnar loop on the little finger on both right and left sides [Table 4]. Participants having Grade II intelligence showed common patterns such as single whorl in the thumb and ring and ulnar loop in the index, middle, and little finger on both right and left sides [Table 5]. Participants with Grade II+ intelligence having the most common pattern of single whorl in both the right and left thumb and ring finger and the left index finger. Ulnar loop was common pattern on right index finger, middle, and little finger on both sides [Table 6]. Grade III was obtained by 12 participants and the common fingerprint pattern was single whorl on the thumb on both sides, and ulnar loop and single whorl were equally distributed in the right index and right and left ring finger. Ulnar loop was common on both middle and little fingers of both sides [Table 7]. Out of 150 participants, 14 had Grade III+, common pattern on the thumb and ring finger was single whorl, on middle and little finger, it was ulnar loop on both sides, whereas on the right ring finger, the distribution of single whorl and ulnar loop was equal and on the left ring finger, it was whorl [Table 8].

In Grade IV, the participants' percentile was below the 25th, the most common pattern on the thumb of both sides was single whorl, the index finger of right side had ulnar and radial loop as common pattern, whereas on the left side, ulnar loop was common pattern and no radial loop, the middle finger of both sides had ulnar loop as common pattern, on right ring finger, ulnar loop was common, and on the left side, single whorl was

Table 2b: Paired *t*-test: *P* value and *t*-value of "a-b" ridge count and "atd" angle on palm print of medical students

	Right side	Left side	SD	*t*	*P*
"a-b" ridge count	44.52	45.81	6.30	−2.513	0.013
"atd" angle (°)	41.63	42.01	4.75	−0.997	0.320

SD: Standard deviation

Table 3: Distribution of the total number of participants, male and female according to the class of intelligence

Class	Total, *n* (%)	Male, *n* (%)	Female, *n* (%)
Class A (grades I and II)	114 (76)	60 (53)	54 (47)
Class B (grade III onward)	36 (24)	18 (50)	18 (50)
Total	150 (100)	78	72

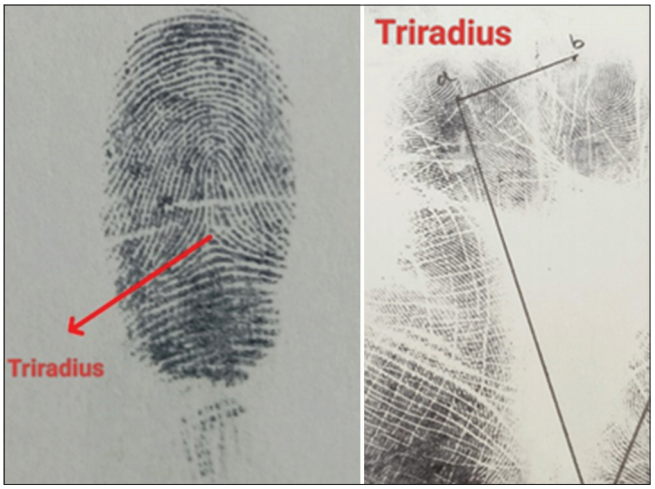

Figure 3: Triradius in fingerprint of right thumb and right palm print

Table 4: Distribution of fingertip patterns in participants with Grade I intelligence (intellectually superior: Percentile at or >95%)

Grade I (*n*=28)	Thumb			Index			Middle		Ring		Little	
	Arch	Loop	Whorl	Arch	Loop	Whorl	Loop	Whorl	Loop	Whorl	Loop	Whorl
Right	0	0	28	0	14	14	20	8	12	16	16	12
Left	2	4	22	4	10	14	18	10	10	18	20	8

Table 5: Distribution of fingertip patterns in participants with Grade II+ intelligence (definitely above the average in intellectual capacity: Percentile at or >90)

Grade II+ (*n*=32)	Thumb			Index				Middle			Ring		Little	
	Arch	Loop	Whorl	Arch	Loop	Whorl	Mixed	Arch	Loop	Whorl	Loop	Whorl	Loop	Whorl
Right	0	8	24	2	6	12	2	2	24	6	6	26	20	12
Left	6	10	16	8	8	16	0	2	18	12	14	18	22	10

Table 6: Distribution of fingertip patterns in participants with Grade II intelligence (definitely above the average in intellectual capacity: Percentile at or >75%)

Grade II (*n*=54)	Thumb				Index				Middle			Ring		Little		
	Arch	Loop	Whorl	Mixed	Arch	Loop	Whorl	Mixed	Arch	Loop	Whorl	Loop	Whorl	Arch	Loop	Whorl
Right	2	10	38	4	4	28	28	2	0	38	16	18	36	0	40	14
Left	0	8	44	2	6	28	20	0	6	28	20	24	30	2	34	18

Table 7: Distribution of fingertip patterns in participants with Grade III+intelligence (intellectually average: Percentile median or >50)

Grade III+ (*n*=14)	Thumb		Index				Middle			Ring			Little	
	Loop	Whorl	Arch	Loop	Whorl	Mixed	Arch	Loop	Whorl	Arch	Loop	Whorl	Loop	Whorl
Right	2	12	2	8	4	0	0	10	2	2	6	6	12	2
Left	4	10	4	4	4	2	4	10	0	0	4	10	12	2

Table 8: Distribution of fingertip patterns in participants with Grade III intelligence (intellectually average: Percentile 25–75)

Grade III (*n*=12)	Thumb		Index		Middle		Ring		Little	
	Loop	Whorl	Loop	Whorl	Loop	Whorl	Loop	Whorl	Loop	Whorl
Right	4	8	6	6	10	2	6	6	8	4
Left	0	12	8	4	10	2	6	6	8	4

Table 9: Distribution of fingertip patterns in participants with Grade IV intelligence (definitely below the average in intellectual capacity: Percentile at or <25)

Grade IV (*n*=10)	Thumb		Index		Middle		Ring		Little	
	Arch	Whorl	Loop	Whorl	Loop	Whorl	Loop	Whorl	Loop	Whorl
Right	2	8	8	2	8	2	6	4	8	2
Left	2	8	8	2	8	2	4	6	6	4

Table 10: Mean a-b ridge count and atd angle on palm print in various grades of intelligence

Grades	Interpretation	Score (percentile)	*n*	Right hand		Left hand	
				a-b count	atd angle	a-b count	atd angle
I	Intellectually superior	At or above the 95th percentile	28	45.36	40.14	39.86	41.5
II	Definitely above the average in intellectual capacity	At or >75 percentile	54	45.11	40.45	47.48	45.56
II+	Definitely above the average in intellectual capacity	At or >90 percentile	32	41.31	44.88	44.5	43.88
III	Intellectually average	Between 25th and 75th percentile	12	45.83	39.5	46	40.83
III+	Intellectually average	Median or >50th percentile	14	36.43	40.71	46.29	39.29
IV	Definitely below the average in intellectual capacity	At or below 25th percentile	10	51	45.4	48.4	43.6

common and in both little fingers, ulnar loop was common pattern [Table 9].

Mean a-b count and atd angle were higher in participants with Grade IV on both right and left sides [Table 10].

Discussion

In the present study, the most common fingerprint pattern in medical students with Grade I and II IQ was whorl followed by loop, whereas in participants with IQ level of Grade III onward, loop was the most common pattern followed by whorl. Asymmetry in patterns on both sides of fingerprints was evident in lower IQ levels also higher values of mean a-b ridge count, and mean atd angle was higher in individuals with low IQ levels.

The distribution of fingertip patterns reported by studies in Nepalese[18] and Indians[19,20] was almost similar to the present study [Table 11].

Table 11: Comparison of patterns present on fingertips of the present study with various other studies

	Thumb				Index				Middle				Ring			Little		
	Arch, *n* (%)	Loop, *n* (%)	Whorl, *n* (%)	Mixed, *n* (%)	Arch, *n* (%)	Loop, *n* (%)	Whorl, *n* (%)	Mixed, *n* (%)	Arch, *n* (%)	Loop, *n* (%)	Whorl, *n* (%)	Mixed, *n* (%)	Arch, *n* (%)	Loop, *n* (%)	Whorl, *n* (%)	Arch, *n* (%)	Loop, *n* (%)	Whorl, *n* (%)
Katwal *et al*., 2017[18] Nepal (*n*=200)																		
Right	6 (3)	105 (52.5)	89 (44.5)	0	23 (11.5)	97 (48.5)	79 (39.5)	1 (0.5)	13 (6.5)	146 (73)	41 (20.5)	0	3 (1.5)	75 (37.5)	122 (61)	5 (2.5)	150 (75)	45 (22.5)
Left	12 (6)	97 (48.5)	90 (45)	1 (0.5)	27 (13.5)	92 (46)	79 (39.5)	2 (1)	18 (9)	129 (64.5)	52 (26)	1 (0.5)	6 (3)	79 (39.5)	115 (57.5)	4 (2)	152 (76)	44 (22)
Mehta and Mehta, 2015[19] India (*n*=140)																		
Right	4 (2.86)	73 (52.14)	63 (45)	0	22 (15.87)	61 (44.01)	57 (41.12)	0	14 (10.1)	93 (67.09)	33 (23.81)	0	8 (5.77)	56 (40.4)	76 (54.83)	8 (5.77)	100 (72.14)	32 (23.09)
Left	4 (2.86)	85 (60.71)	51 (36.43)	0	26 (18.76)	55 (39.68)	59 (42.56)	0	14 (10.1)	83 (59.88)	43 (31.02)	0	9 (6.49)	57 (41.12)	74 (53.39)	6 (4.33)	93 (67.09)	41 (29.58)
Kumar *et al*., 2018[20] India (*n*=400)												0						
Right	24 (6)	152 (38)	224 (56)	0	48 (12)	208 (52)	144 (36)	0	12 (3)	308 (77)	80 (20)	0	4 (1)	168 (42)	228 (57)	12 (3)	300 (75)	88 (22)
Left	8 (2)	180 (45)	212 (53)	0	32 (8)	200 (50)	168 (42)	0	24 (6)	288 (72)	88 (22)	0	4 (1)	180 (48)	216 (54)	12 (3)	304 (76)	84 (21)
Present study												0						
Right	4 (2.67)	24 (15.9)	118 (78.67)	4 (2.67)	8 (5.33)	80 (53.33)	58 (38.67)	4 (2.6)	4 (2.67)	110 (72.8)	36 (23.8)	0	2 (1.3)	54 (35.8)	94 (62.67)	0	104 (69.3)	46 (30.66)
Left	10 (6.7)	26 (17.3)	112 (74.67)	2 (1.3)	22 (14.67)	66 (44)	60 (40)	2 (1.3)	12 (8)	92 (61.3)	46 (30.67)	0	0	62 (41.33)	88 (58.7)	2 (1.3)	102 (68)	46 (30.67)

Table 12: Comparison of distribution of patterns on the fingertip of the right index and right ring finger in the present study with other studies in different classes of intelligence

Authors	Class	Side	Right index finger					Right ring finger	
			Arch, *n* (%)	Radial loop, *n* (%)	Ulnar loop, *n* (%)	Whorl, *n* (%)	Mixed, *n* (%)	Ulnar loop, *n* (%)	Whorl, *n* (%)
Sathvika *et al*., 2016[16] India (*n*=97)	Class A: Grade I, II+, II	Right	2 (2.1)	5 (5.2)	41 (42.3)	49 (50.5)	0	30 (30.9)	67 (69.1)
Present study (*n*=114)		Right	6 (5.26)	8 (7.02)	50 (43.86)	44 (43.86)	6 (5.26)	36 (31.57)	78 (68.43)
Sathvika *et al*., 2016[16] India (*n*=103)	Class B: Grade III+, III and IV	Right	10 (9.7)	6 (5.8)	55 (53.4)	32 (31.1)	2 (1.9)	51 (49.5)	50 (48.5)
Present study (*n*=36)		Right	2 (5.5)	4 (11.11)	18 (50)	12 (33.33)	2 (5.56)	18 (50)	16 (44.4)

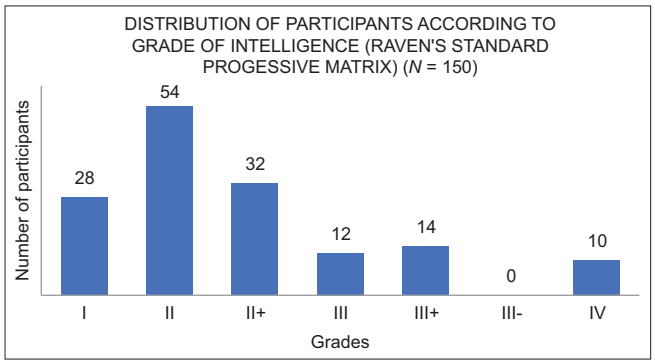

Chart 1: Distribution of participants according to the grade of intelligence

Sathvika *et al*.,[16] reported whorl as the most common pattern in class A IQ level and arch as a common pattern in class B IQ level which was similar to the present study [Table 12]. Nayak *et al*.,[21] reported that the most common fingerprint pattern was the whorl pattern, followed by radial loop and ulnar loop among the students. When they correlated the fingerprint pattern with the race of the students, they found that whorl was common pattern in Malays, Malaysian Indians, and Chinese, while radial loop was the most common pattern in the Sri Lankans. Kumari *et al*.,[22] described the whorl and ulnar loop as the most common prevalent pattern in both medical students and laboratory technicians. Ulnar loop was more prevent on the left side in medical students and whorl pattern was more on both hands in laboratory technicians. There was no major difference between both groups.

Adenowo and Dare[23] in Nigerian medical students, reported that ulnar loop was the most preventive pattern in all classes of students, arch patterns were not observed in good students but not in weak students, and atd angle was higher in good students.

Tharay *et al*.,[24] in Indian children, reported that ulnar loop was the most common pattern and showed a statistically significant association of right digits I, II, IV, and V, while in the left hand, digits I, II, and IV had a significant association with various levels of IQ. In Pakistani medical students, Rizvi *et al*.[25] reported that loop was the most common pattern which was associated with average IQ whereas arches were commonly associated with excellent IQ.

Prabhakaran *et al*.,[26] concluded that loop was most common pattern with higher, intermediate, and low IQ, ab ridge count increases as intelligence decreases and atd also increases with decrease IQ. Thute *et al*.,[15] in medical students, reported that low academic performance was associated with asymmetry in patterns between right and left fingerprint patterns. There was an association with higher atd angle with low academic performance.

Conclusions

Dermatoglyphic pattern distribution along with "a-b" ridge count and "atd" angle measurements among individuals of various IQ levels may help in the selection of educational or academic career and also provide the personalized and appropriate way of academic counseling, teaching, and learning processes. Whorl was the common pattern in students with higher IQs whereas loop was common in lower IQs, in the present study.

Limitations

The present study was done in MBBS students only, this type of study can be done with different professional students to know the IQ levels and distribution of dermatoglyphic patterns and compare them.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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