ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

FINGER AND PALMAR PATTERNS IN ABO BLOOD GROUPS: A DERMATOGLYPHIC STUDY

Forensic Medicine

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ABSTRACT

Background: Dermatoglyphic is defined as a scientific study of naturally occurring epidermal ridges and their configuration on the palms and soles apart from the flexion crease and secondary folds. These ridges once developed, remains unchanged throughout the life making them a reliable tool for personal identification. The present study is conducted to find out the dermatoglyphic patterns in ABO blood groups. **Material and methods:** This cross-sectional observational study included 201 participants with known blood group. Finger and palmar prints were collected by using ink method. Data was analyzed for all blood groups and subjected to statistical test to evaluate the patterns. **Results:** The loops were commonly encountered in all blood groups in the range of 50.7% to 60%. Whorls were higher in blood group 'O' and arches in blood group 'A'. Furuhata index was highest in blood group 'O' and Dankmeijer index in 'A'. The mean total finger ridge count and absolute finger ridge count was significantly higher in blood group 'O'. There was increase frequency of palmar pattern in hypothenar area in blood group 'O' and ID4 area in blood group 'A'. The mean ab-ridge count and atd-angle was higher in blood group 'A' and 'AB' respectively. **Conclusions:** The present study shows a significant correlation of dermatoglyphic pattern in ABO blood group. Thus, it enhances the accuracy of personal identification and in detection of crime. But it needs to be studied in depth and warrants further research on larger sample.

KEYWORDS

Dermatoglyphics; Fingerprints; Palmar Pattern; Blood Group; Identification.

INTRODUCTION:

Dermatoglyphics has long been recognized as a scientific and valuable method for medicolegal, anthropological and genetic studies. The patterns of the ridges on finger, toes, palm and foot are influenced by both genetic factors and environmental conditions during fetal development.[1] There are many diseases known to be caused by abnormal genes. Whenever there is any abnormality in the genetic make-up of parents, it is inherited to the children and is reflected in dermatoglyphic patterns.[2] The formation of these ridges begins during early stages of intrauterine life and was fully established between 11th and 24th weeks of gestation.[3] Once formed, these pattern remains unchanged throughout an individual's life, except for proportional growth to accommodate physical development.[4] This permanence and uniqueness make fingerprints an invaluable tool for identification.

Blood grouping is also one of the most reliable traditional methods of identification. The blood group was discovered by Karl Landsteiner in 1901. Till date, 19 major groups have been identified which vary in their frequency and distribution. Among them only 'ABO' and 'Rhesus' groups are of major importance.[5] Various diseases usually influence particular blood group like duodenal ulcer in 'O' and gastric ulcer in 'A' blood group.[6,7] There are two antigens and two antibodies responsible for ABO types. Blood groups are genetic traits inherited from parents, determined by specific alleles (A,B,O) that control antigens on red cells. Considering their genetic predisposition, the present study is conducted to find correlation between dermatoglyphic patterns and ABO blood groups

MATERIAL AND METHODS:

The present cross sectional observational study was carried out jointly in the department of anatomy and forensic medicine at government medical college, Nagpur during the period between 2015 and 2016. A total of 201 participants belonging to the age group of 18 years to 55 years of known blood group were randomly selected for the study after taking informed consent. There were 156 males and 45 females in the study.

The palmar and finger prints of the subject were taken on the Map Litho White paper by ink method as described by Cummins and Midlo. Kores Camel duplicating ink was spread over plain glass slab of size 12"x8" with the help of a spreading roller. Both hands were first washed with soap and water followed by soaking. Then, the palm and fingers were placed on the inking glass slab. The smeared/ inked palm and fingers of both hands were then kept on the white paper with firm pressure on the dorsum of hand and inter-digital area. Both rolled and plane prints of right and left hand were taken. Blood groups of all the subjects were also noted. The subjects with permanent scars on their fingers with any hand deformities due to injury or any known pathological disease were excluded from the study.

The dermatoglyphic patterns were thus recorded and parameters like fingertip pattern, true palmar pattern, number of palmar triradii, atd angle and ab ridge count were studied. The patterns of fingerprints were observed with the help of hand lens. The dermatoglyphic patterns on both hands were analysed for all blood groups and subjected to statistical test to evaluate the pattern. The statistical evaluation was done by chi square method and t-test. Furuhata Index (Whorls/Loop x 100) and Dankmeijer Index (Arches/Whorls x 100) were calculated from the fingerprint pattern.

RESULTS:

Table 1 Gender distribution of ABO Blood Group

Blood	Male		Female		Total	
Group	No	%	No	%	No	%
A	36	23.1	13	28.9	49	24.4
B	64	41.0	20	44.4	84	41.8
AB	15	9.6	12	26.7	27	13.4
O	41	26.3	0	0.0	41	20.4
Total	156	77.6	45	22.4	201	100.0

In the present study, predominance of male was noted in all blood groups. 'B' was the commonest blood group in both sexes (Male=41%, Female=44.4%) followed by 'A' blood group (M=23.1%, F=28.9%). 'AB' was the rarest blood group in the study population (M=9.6%, F=26.7%). Notably, 'O' blood group was exclusively present in males. (Table1).

Table 2: Digit wise distribution of FTP of both hands in different blood groups

Blood	FTP	RIGHT HAND DIGITS (201)					LEFT HAND DIGITS (201)				
Group		D1	D2	D3	D4	D5	D1	D2	D3	D4	D5
A	A	6	18	11	5	4	6	13	10	4	4
	L	26	16	32	22	39	30	21	31	23	40
	W	17	15	6	22	6	13	14	8	22	5
B	A	1	10	2	3	0	1	6	3	2	0

	L	41	36	59	28	61	40	43	57	32	66
	W	42	38	23	53	23	43	35	24	50	18
AB	A	1	1	0	0	1	1	1	0	0	1
	L	13	13	20	13	22	13	13	20	13	22
	W	13	13	7	14	4	13	13	7	14	4
O	A	0	5	5	2	2	2	7	4	1	1
	L	17	15	26	15	31	18	17	27	12	30
	W	24	21	10	24	8	21	17	10	28	10

Table 2 shows the distribution of digit-wise fingertip patterns in both hands. The arches were frequently seen in D-2 (index finger) of both hands in all blood groups, except 'AB' blood group, where it is rarely seen in any of the digit. Most numbers of loops were observed in D-5 and D-3 of both hands in all blood groups. Whereas, whorls were commonly noticed in D-4 of both hands across all blood groups.

Table 3: Distribution of total FTP of both hands in different blood groups

Blood	Side	FINGER TIP PATTERNS						FH	DM
Group		ARCH	%	LOOP	%	WHORLS	%	Index	Index
A- (49)	R	44	18.0	135	55.1	66	26.9	48.89	66.7
	L	37	15.1	145	59.2	62	25.3	42.76	59.7
	R+L	81	16.5	280	57.1	128	26.1	45.71	63.3
B- (84)	R	16	3.8	225	53.6	179	42.6	79.56	8.94
	L	12	2.9	238	56.7	170	40.5	71.43	7.06
	R+L	28	3.3	463	55.1	349	41.5	75.38	8.02
AB - (27)	R	3	2.2	81	60.0	51	37.8	62.96	5.88
	L	3	2.2	81	60.0	51	37.8	62.96	5.88
	R+L	6	2.2	162	60.0	102	37.8	62.96	5.88
O - (41)	R	14	6.8	104	50.7	87	42.4	83.65	16.1
	L	15	7.3	104	50.7	86	42.0	82.69	17.4
	R+L	29	7.1	208	50.7	173	42.2	83.17	16.8
Statistics	R	Chi Sqi=60.076; df=6; P<0.0001							
	L	Chi Sqi=53.2003; df=6; P<0.0001							

As per table 3, loops were predominantly seen in all blood groups followed by whorls and arches. Arches were frequently seen in blood group 'A' (16.5%) and rarely seen in blood group 'AB' (2.2%). The frequency of whorls was highest in blood group 'O' and 'B', and lowest in blood group 'A' (26.1%). Loops were commonly noticed in all blood groups in the range of 50.7% to 60%. The chi-square test yielded a value of 60.076 (P value of <0.0001) on right side and 50.2003 (P value of <0.0001) on left side indicating that the difference in fingerprint pattern distribution across ABO blood groups are statistically significant. In general, the higher Furhata index and lower Denkmeijer Index was seen across all blood group except blood group 'A'. Furuhata (FH) index was found to be more in blood group 'O' (83.17) and less in blood group 'A' (45.71). Whereas, Dankmeijer (DM) index was noted higher in blood group 'A' (63.3) and lower in blood group 'AB' (5.88).

Table 4: Frequency distribution of Total Finger Ridge Count (TFRC) in different blood groups

Blood	No	Group Descriptive			One-way ANOVA (Welch's)			
Groups		Mean	SD	SEM	F	df1	df2	P
A	49	125	60.3	8.62	3.41	3	81.1	0.021
B	84	155	37.9	4.14				
AB	27	149	35.7	6.87				
O	41	156	49.2	7.68				

Table 5: Frequency distribution of Absolute Finger Ridge Count (AFRC) in different blood groups

Blood	No	Group Descriptive			One-way ANOVA (Welch's			
Groups		Mean	SD	SEM	F	df1	df2	P
A	49	159	101.2	14.5	3.55	3	82.8	0.0018
B	84	213	83.2	9.08				
AB	27	194	76.3	14.7				
O	41	214	94.3	14.7				

As per table 4, the mean TFRC was found to be lowest in blood group 'A' (mean=125) and highest in blood group 'O' (mean=156). As per table 5, the mean AFRC was found to be lowest in blood group 'A' (mean=156) and highest in blood group 'O' (mean=214). The difference in the mean value of TFRC and AFRC distribution across the ABO blood group are statistically significant as per one-way ANOVA test.

Table 6: Distribution of true palmar patterns of both hands in different blood groups

Blood	No	True Palmar Patterns- Right Hand						True Palmar Pattern- Left hand					
Groups		Hypo	Thenar	Id1	Id2	Id3	Id4	Hypo	Thenar	Id1	Id2	Id3	Id4
A	49	38	20	5	4	30	31	35	37	5	1	17	39
	%	77.6	40.8	10.2	8.2	61.2	63.3	71.4	75.5	10.2	2.0	34.7	79.6
B	84	66	38	2	12	61	42	61	54	3	5	40	66
	%	78.6	45.2	2.4	14.3	72.6	50.0	72.6	64.3	3.6	6.0	47.6	78.6
AB	54	15	13	3	4	17	15	17	18	3	1	6	20
	%	55.6	48.1	11.1	14.8	63.0	55.6	63.0	66.7	11.1	3.7	22.2	74.1
O	41	35	18	0	3	28	22	35	24	3	4	20	27
	%	85.4	43.9	0	7.32	68.3	53.7	85.4	58.5	7.3	9.8	48.8	65.9
Chi Sq	--	8.64	0.28	8.33	2.18	2.15	2.23	4.66	3.11	3.21	2.77	7.27	2.65
df	--	3	3	3	3	3	3	3	3	3	3	1	3
P-value	--	0.003	0.963	0.040	0.536	0.542	0.527	0.199	0.375	0.34	0.428	0.064	0.448

Table 6 shows the distribution of true palmar pattern across ABO blood groups. The frequency of true palmar pattern was higher in hypothenar, ID3 and ID4 area of the palm. There was increase percentage of palmar pattern in blood group 'O' in hypothenar area. The palmar patter was higher in blood group 'AB' in ID3/ID4 area and blood group 'A' in ID4 area. The difference in true palmar pattern distribution across the ABO blood group are statistically significant in hypothenar and ID1 area of the palm on right side with p value of 0.003 and 0.04 respectively.

Table 7: Distribution of number of palmar triradii in different blood groups

Blood	No	Number of Palmar Triradii-Right						Number of Palmar Triradii-Left					
Groups		4	5	6	7	8	9	4	5	6	7	8	9
A	49	1	28	16	3	0	1	2	31	13	2	0	1
	%	2.0	57.1	32.7	6.1	0.0	2.0	4.1	63.3	26.5	4.1	0.0	2.0
B	84	1	54	22	4	3	0	0	49	27	7	1	0
	%	1.2	64.3	26.2	4.8	3.6	0.0	0.0	58.3	32.1	8.3	1.2	0.0
AB	27	1	14	10	2	0	0	2	13	9	2	1	0
	%	3.7	51.9	37.0	7.4	0.0	0.0	7.4	48.1	33.3	7.4	3.7	0.0
O	41	0	29	11	0	1	0	1	21	17	2	0	0
	%	0.0	35.4	13.4	0.0	1.2	0.0	1.2	25.6	20.7	2.4	0.0	0.0
Chi Sq				12.3						14.8			
df				15						15			
df				0.654						0.464			

As shown in table 7, there was increase in the frequency of '5' palmar triradii on right side in blood group 'B' and on left side in blood group 'A'. There was decrease frequency of '5' and '6' palmar triradii on both side in blood group 'O'. However, there is no statistically significant difference seen in any palmar triradii across ABO blood group.

Table 8: Statistical calculation of ab ridge count

Variables	Blood		Group Descriptive	One-Way ANOVA (Welch's)				
	Group	N	Mean	SD	SE	F	df1	df2	p
RT_a-b_RC	A	49	40.8	4.57	0.653	2.56	3	83.2	0.06
	B	84	38.3	5.63	0.614				
	AB	27	39.5	5.34	1.027				
	O	41	39.4	5.37	0.839				
Lt_a-b_RC	A	49	41	4.25	0.608	1.39	3	79.7	0.251
	B	84	39.5	5.01	0.546				
	AB	27	40.4	5.85	1.125				
	O	41	40.9	5.97	0.933				

Table 9: Statistical calculation of atd-angle in different blood groups

Variables	Blood		Group Descriptive			One-Way ANOVA (Welch's)			
	Group	N	Mean	SD	SE	F	df1	df2	p
Rt_atd_Angle	A	49	39.9	3.36	0.48	0.23	3	83	0.876
	B	84	39.8	4.52	0.493				
	AB	27	40.3	4.3	0.828				
	O	41	39.4	4.2	0.656				
Lt_atd_angle	A	49	39.5	2.99	0.427	0.422	3	82.5	0.737
	B	84	40.1	5.26	0.573				
	AB	27	40.6	5.37	1.033				
	O	41	39.7	3.56	0.556				

The mean value of ab-ridge count in blood group 'A' was slightly higher on both sides as compared to other blood group, but not statistically significant. Also, the mean value of atd angle in blood

group 'AB' was slightly higher on both sides as compared to other blood groups, but not statistically significant. (Table 8 and 9).

DISCUSSION:

The present study revealed that there was a predominance of male (77.6%) with blood group 'B' being the most prevalent group followed by blood group 'A', 'O' and 'AB' across both sexes. This result corresponds with studies carried out by other researchers.[8-14] However, other authors identified blood group 'O' as the dominant type and 'AB' as the least type of blood group.[15-23] In the present study also, 'AB' was the least prevalent blood group in the study population. Dare et al[24] (2022) reported 'A' as the commonest blood group in the study subset. These regional variations may indicate disparity in genetics and demographic differences among populations.

Amongst the fingerprint pattern in each digit (fingers), arches were frequently seen in D-2 (index finger) of both hands. Whereas, loops were usually observed in D-5 (little finger) and D-3 (middle finger); and whorls in D-4 (ring finger) of both hands across all blood groups. These findings are consistent with that of Verma et al[14] (2015) and Bharadwaja et al[15] (2004). Vankara et al[13] (2021) showed predominance of loops in D-5 and D-3, whorls in D-4, and arches in D-3. However, Londhe and Jadhav[25] (2011) noticed predominance of arches in D-2, loop in D-5 and D-3, but whorls in D-1 which is inconsistence with that of the present study.

Regarding fingerprint patterns, the frequency of loops was commonly encountered across all blood groups followed by whorls and arches. This finding is similar to that of studies carried out by other researchers.[8-16;19-23] Within the framework of ABO blood groups, loops were commonly seen in all blood groups in the range of 50.7% to 60%. Ranjan et al[8] (2025) also noted loop in the range of 52.3% to 61.2% across all blood groups. These findings are consistent with that of research conducted by Patil et al[9] (2017) and Bhavana et al[11] (2013). Other studies found the highest incidence of loops in 'B' blood group.[12,17,18] However, few studies found the highest incidence of loop in blood group 'O' and lowest incidence in blood group 'A' and 'B'.[21,26,27] Whereas, Shashikala and Ashwini[28] (2011) noted the highest incidence of loop in blood group 'AB'; and Bharadwaja et al[15] (2004) and Umraniya et al[16] (2013) noted the highest incidence in blood group 'A'. With respect to prevalence of other finger print pattern, the whorls were predominantly seen in blood group 'O' and 'B' and arches in blood group 'A'. Ranjan et al[8] (2025), Patil et al[9] (2017), Bhavana et al[11] (2013), Pratinidhi et al[12] (2023), and Deopa et al[29] (2014) noted the highest incidence of whorls in blood group 'B' and lowest in blood group 'AB'. However, other studies noted the highest incidence of whorls in 'AB" blood group. [15,17,18] Kshirsagar and Fulari[30] (2013) noticed that the arches were more common in blood group 'O' which is inconsistent with that of the present study. There was a statistically significant correlation between fingerprint patterns and ABO blood groups with p <0.0001 on both sides. This finding is corroborated by other researchers.[8,9,19-22]

With respect to indices from fingerprint pattern, Furuhata (FH) index was highest in blood group 'O' and lowest in blood group 'A'. Whereas, Dankmeijer (DM) index was highest in blood group 'A' and lowest in 'B'. Nayak and Patel[31] (1973) revealed highest FH index in blood group 'AB' and lowest in 'A'. Usually high FH index and low DM index was noted in all blood group except blood group 'A', where DM index was four times higher as compared to blood group 'O'. Susmiarsih et al[32] (2016) showed highest FH index in blood group 'O' as similar to present study. But, DM index was higher in blood group 'AB' which is inconsistent with that of the present study. However, Patil et al[33] (2014) showed highest DM index in 'AB' and lowest in 'B'; and highest FH index in 'A' and lowest in 'O'. Kshirsagar and Fulari[30] (2013) observed highest DM index in blood group 'AB' and lowest in 'B'.

The mean TFRC and AFRC of the ABO blood groups were highest in blood group 'O' and p value was significantly difference (P=0.021 and P=0.0018 respectively). Ridge count calculation was done by calculating mean of all 10 fingers in ABO blood groups. These findings are consistent with that of Susmiarsih et al[32] (2016) and inconsistent with that of Umraniya et al[16] (2013) and Gowda and Rao[34] (1996) where blood group 'A' had a significant greater number of TFRC. Bharadwaja et al[15] (2014) revealed high TFRC in blood group 'B' followed by blood group 'O'. Dare et al[24] (2024) noted higher TFRC and AFRC in blood group 'A'.

The palmar patterns were predominantly seen in hypothenar area followed by ID-3 and ID-4 area across all blood groups with statistically significant correlation seen in hypothenar and ID-1 area on right side having p value of 0.003 and 0.04 respectively. In blood group 'O', there was increase percentage of palmar pattern in hypothenar area on both sides. In blood group 'A', there was high frequency of palmar pattern in ID-4 area. Mattison et al[35] (2015) and Dare et al[24] (2024) revealed high prevalence of palmar pattern in blood group 'O'.

In the present study, there was insignificant increase in the number of '5' palmar triradii on right side in blood group 'B' and on left side in blood group 'A'. No study has been carried out previously on number of palmar triradii across different ABO blood groups. Hence, these findings could not be compared.

The mean value of ab-ridge count and atd-angle was slightly higher in blood group 'A' and 'AB' respectively. However, the differences across the ABO blood group were not statistically significant. No studies have been carried our earlier, hence could not be compared.

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