ANTHROPOLOGIE • LIV/2 • pp. 155–160 • 2016

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ASSOCIATION OF FINGERPRINT PATTERNS WITH ABO BLOOD GROUPS – AN INVESTIGATION FROM INDIA

ABSTRACT: Dactylography is considered as an unequivocal tool for identification and along with blood grouping and matching remains an essential part of crime investigations. The present research evaluates the dermatoglyphic features in different blood groups and to studies the relation between fingerprint patterns and blood groups. The study was conducted on 110 students of Indian origin. The participants were explained about the procedure and rolled fingerprints were taken for all the fingers using standard techniques. Thus, a total of 1,100 fingerprints were obtained. ABO and Rh blood groups were recorded from each participant. The details of fingerprint patterns observed for each digit were entered in a datasheet and analysed using SPSS version 16.0. Pattern Intensity Index was calculated for the quantitative analysis of the fingerprint patterns. Chi-square test, one way ANOVA and student's t-test were performed to compare the variables included in the study. P-value <0.05 was considered as statistically significant. Loops were the most frequently observed pattern in each of the four blood groups followed by whorls and arches. However, the relative/proportionate distribution of fingerprint patterns varied for each blood group among males, females and total sample. The differences in the overall frequencies of fingerprint patterns in different blood groups were observed to be statistically significant among males ($\chi2 = 19.42$, $P = 0.004$), females ($\chi2 = 20.63$, $P = 0.002$), and the total sample ($\chi2 = 17.75$, $P = 0.007$). No statistically significant differences were observed for the Pattern Intensity Index among different blood groups in males, females and total sample. It is recommended that the association between blood groups and fingerprint patterns is studied on a larger sample, and in specific population groups. Apart from helping in forensic and crime scene investigations, association of fingerprint patterns and blood groups can be of interest to human biologists and physical anthropologists.

KEY WORDS: Human biology – Dermatoglyphics – Fingerprint patterns – Blood groups

Received 19 July 2014; accepted 8 December 2014.

INTRODUCTION

Fingerprints are the impressions formed by the epidermal ridges of the fingertips. The dermatoglyphic features appear early in intrauterine life (Variend 1994) and remain unchanged thereafter. These features are highly individualistic, easily recordable and are very convenient to match. Dactylography is thus, considered as an effective tool for identification. It is routinely employed in the identification of individuals. Besides, fingerprints obtained at the scene of crime can give vital clues to the identity of the perpetrator of the crime. Recently, studies have been conducted on the usefulness of fingerprint ridge density in identification (Nayak *et al*. 2010a, 2010b, Krishan *et al.* 2010, 2013). Similar studies are conducted on palmprints (Sen *et al.* 2011, Kanchan *et al.* 2013, Krishan *et al.* 2014) and footprints (Kanchan *et al.* 2012, Krishan *et al*. 2015) The Galton-Henry system of dactylography classifies fingerprint patterns as loops, whorls, and arches.

Similar to fingerprints, an individual is likely to have the same blood group throughout life. These blood groups start developing early during the intrauterine life. ABO and Rh (Rhesus) blood group systems are the most commonly employed blood group systems used in practice today (Kanchan, Krishan 2016). Blood grouping and matching remains an essential part of crime investigations, and a routine procedure during transfusion and transplantations. Besides, these provide a reliable proof of heritage and are commonly used in cases of disputed paternity/ paternity tests.

Thus, while classically the dermatoglyphic patterns and blood group systems remain unchanged throughout life, dermatoglyphics are known to provide reliable evidence to identity, and blood grouping gives an insight into the inheritance related issues in an individual. Study of the relationship of one component of the body with the other is one of the important subject areas of biological anthropology. The present research was undertaken to evaluate the dermatoglyphic features in different blood groups and to study the relation between fingerprint patterns and blood groups in Indian population.

MATERIAL AND METHODS

The study was conducted on 110 students (55 males and 55 females) of Indian origin. The age group of the participants ranged between 19 and 24 years. All the participants included in the study were apparently healthy with no history of any genetic disorders. The participants were explained about the procedure and rolled fingerprints were taken for all the fingers using standard techniques as described in literature (Kanchan, Chattopadhyay 2006). Thus, a total of 1,100 fingerprints were obtained that were analysed using a magnifying lens. The finger print patterns were identified and classified as loops, whorls and arches. In humans, there are four principal blood groups designated as A, B, AB and O based on the type of antigens that are present on the erythrocytes. Similarly based on presence or absence of D antigen, there are Rh+ and Rh- blood groups. ABO and Rh blood groups were recorded from each participant.

All the details were entered in a datasheet and analysed using SPSS (Statistical Package for Social Sciences) version 16.0. Pattern Intensity Index (PII) was calculated for the quantitative analysis of the fingerprint patterns (Purvis-Smith, Menser 1973). Chi-square test was performed to compare the variables included in the study. Male female differences for PII were analyzed using Student's t-test. One-way ANOVA was utilized for differences in PII among different blood groups in males, females and total sample. P-value <0.05 was considered as statistically significant.

RESULTS

The distribution of ABO and Rh blood groups in the study participants is shown in *Table 1*. Blood group "O" was the most common group followed by blood group "B" and blood group "A". The majority of the participants were Rh+ (94.5%). Blood group "B" was the most frequent group among males and blood group "O" among

TABLE 1. Distribution of participants for ABO and Rh blood groups. % values are shown in brackets.

Blood Group	Rh+	Rh –	Total
A	28 (96.6)	01 (03.4)	29 (100)
B	34 (94.4)	02 (05.6)	36 (100)
AB	05 (83.3)	01 (16.7)	06 (100)
O	37 (94.9)	02 (05.1)	39 (100)
	104 (94.5)	06 (05.5)	110 (100)

TABLE 2. Distribution of blood groups among male and female participants. % values are shown in brackets.

Blood Group	Male	Female	Total	Sex differences
A	13 (23.6)	16 (29.1)	29 (26.4)	χ2=0.421, P-value=0.5162
B	21 (38.2)	15 (27.3)	36 (32.7)	χ2=1.486, P-value=0.2233
AB	05 (09.1)	01 (01.8)	06 (05.4)	χ2=2.821, P-value=0.0930
O	16 (29.1)	23 (41.8)	39 (35.5)	χ2=1.947, P-value=0.1631
Total	55 (100)	55 (100)	110 (100)	

females. However, these sex differences in the frequency of blood groups were not statistically significant (*Table 2*).

Among the 1100 prints examined in the study sample, loops were the most frequently observed pattern in all four blood groups followed by whorls and arches. However, the relative/ proportionate distribution of fingerprint patterns varied for each blood group among males, females and total sample. Distribution of fingerprint patterns for different blood groups is shown in *Table 3*. It is apparent that significant differences exist in the overall frequencies of fingerprint patterns in different blood groups among males (χ2 = 19.42, P = 0.004), females (χ2 = 20.63, P = 0.002), and total sample (χ2 = 17.75, P = 0.007).

No statistically significant sex differences were observed for the Pattern Intensity Index among males and females (*Table 4*). Descriptive Statistics for Pattern Intensity Index among different blood groups in males, females and total sample is shown in Table 5. Statistically significant differences are not evident in PII among different blood groups in males (P = 0.220), females (P = 0.571), and total sample (P = 0.721). Frequency distribution of the Pattern Intensity Index among different blood groups is shown in *Figure 1*.

TABLE 3. Distribution of fingerprint patterns for each blood group in males, females and total sample. % values are shown in brackets; χ2-Chi square analysis.

	Males (N=550)				Female (N=550)				Total (N=1100)			
Pattern	A	B	AB	O	A	B	AB	O	A	B	AB	O
Loops	72	102	34	104	94	79	02	145	165	181	36	249
	(55.4)	(48.6)	(68.0)	(65.0)	(58.8)	(52.7)	(20.0)	(63.0)	(57.2)	(50.3)	(60.0)	(63.8)
Whorls	55	99	12	47	60	57	08	80	115	156	20	127
	(42.3)	(47.1)	(24.0)	(29.4)	(37.5)	(38.0)	(80.0)	(34.8)	(39.7)	(43.3)	(33.3)	(32.6)
Arches	03	09	04	09	06	14	00	05	09	23	04	14
	(02.3)	(04.3)	(08.0)	(05.6)	(03.7)	(09.3)	(--)	(02.2)	(03.1)	(06.4)	(06.7)	(03.6)
Total	130	210	50	160	160	150	10	230	290	360	60	390
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
χ2	χ2=19.42, df=6, P=0.004				χ2=20.63, df=6, P=0.002				χ2=17.75, df=6, P=0.007			

TABLE 4. Descriptive Statistics: Pattern Intensity Index (PII) among males and females. *, Male female differences for PII using Student's t-test.

PII	Male (N=55)	Female (N=55)	Total (N=110)
Mean	13.4	13.3	13.3
Standard Deviation (SD)	3.5	3.5	3.5
Minimum	07	02	02
Maximum	20	20	20
Sex differences*	t=0.218, p=0.828		

DISCUSSION

Fingerprints have shown considerable significance in morphological, biological, anthropological and forensic studies in the past (Krishan *et al*. 2013). Loops have been observed to be the most common fingerprint pattern worldwide followed by whorls. The distribution of fingerprint patterns however, is observed to vary in different population groups. Nithin *et al*. (2009) in one such study on the distribution of fingerprint patterns found ulnar loops to be the most frequent pattern among South Indian population. Distribution of fingerprint patterns among medical students has been previously described in the study group (Kanchan, Chattopadhyay 2006). Similar to dermatoglyphic patterns, the distribution of ABO and Rh blood groups are known to vary in different population and ethnic groups. While dermatoglyphic traits are inherited as individual specific trait (Londhe, Jadhav 2011), the inheritance of blood groups is well-known. Specific variations in the dermatoglyphic patterns have been studied by researchers to find suitable dermatoglyphic markers which can help in the early diagnosis of the diseases especially those having genetic predisposition. In this regard, an association between dermatoglyphic features and diseases of blood cells has been explored (Bukelo *et al*. 2011a, b).

Blood group "O" and "B" are the most frequently reported blood groups in India. In the majority of the studies from India, blood group "O" was the most frequently reported blood group followed by blood group "B" (Londhe, Jadhav 2011, Bharadwaja *et al.* 2004,

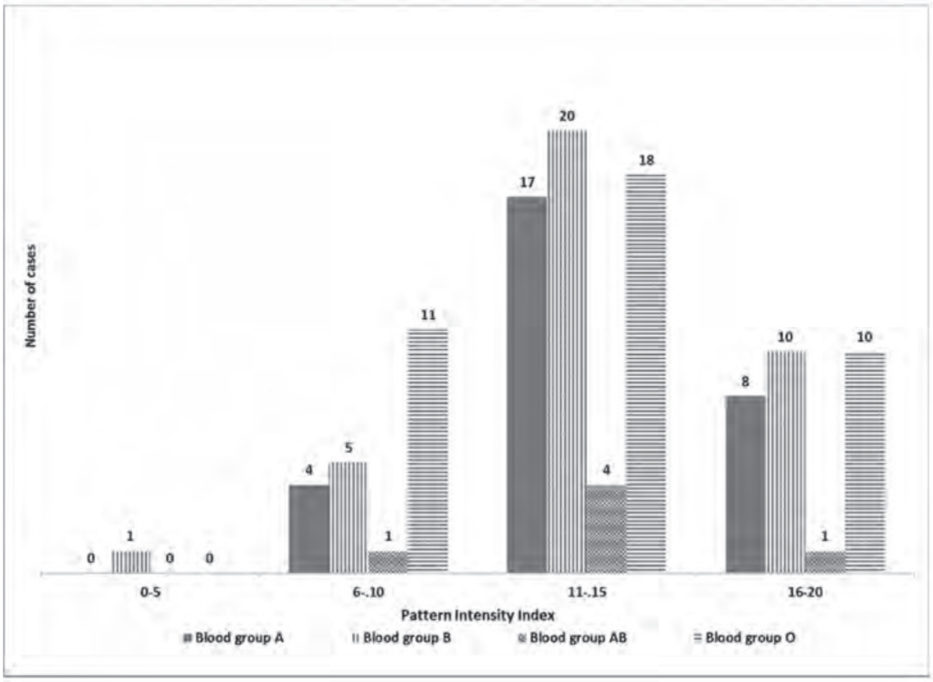

FIGURE 1. Frequency distribution of the Pattern Intensity Index in different blood groups.

Rastogi, Pillai 2010, Reddi *et al.* 1980). Our study makes similar observations in this regard. Besides, in the present investigation, statistically significant sex differences were not observed for the frequency of blood groups among the participants. A study from Rajasthan has reported a higher frequency of blood group "B" followed by blood group "O" in general population (Thamaria *et al.* 1972). In a similar study from Libya (Fayrouz *et al.* 2012), blood group "O" was the most frequently reported blood group followed by blood group "A". The variations in observations on ABO blood groups distribution in different studies is attributed to population specific differences in the ABO blood groups.

A relation between fingerprint patterns and blood groups has been explored previously by a few researchers (Londhe, Jadhav 2011, Bharadwaja *et al.* 2004, Rastogi, Pillai 2010, Fayrouz *et al.* 2012, Kshirsagar, Gundre 2012). Kshirsagar, Gundre (2012) observed a higher frequency of ulnar loops and a lower frequency of arches in Rh+ ve individuals. While Londhe, Jadhav (2011), observed a higher frequency of loops in all the blood groups, Bharadwaja *et al.* (2004) observed a higher frequency of whorls in "AB" blood group. Our observations in this regard are similar to the findings of Londhe, Jadhav (2011). A similar study from Libya, by Fayrouz *et al.* (2012) observed a higher frequency of whorls in blood group "B". With regard to the association between fingerprint patterns and blood groups in the present investigation, it is the difference in the relative frequency of different fingerprint patterns in each blood group that is responsible for the statistically significant differences in fingerprint patterns among blood groups in males, females and total sample. Analysis of Pattern Intensity Index (PII) however, does not show any differences in PII among sexes or between blood groups.

TABLE 5. Descriptive Statistics: Pattern Intensity Index (PII) among blood groups in males and females. SD, Standard deviation; *, ANOVA for differences in PII among different blood groups among males, females and total sample.

Blood	Male (N=55)			Female (N=55)			Total (N=110)		
Groups	N	Range	Mean±SD	N	Range	Mean±SD	N	Range	Mean±SD
A	13	8 – 20	13.9±3.4	16	7 – 20	13.4±3.8	29	7 – 20	13.6±3.5
B	21	7 – 19	14.3±3.4	15	2 – 18	12.8±3.7	36	2 – 19	13.7±3.5
AB	05	9 – 13	11.6±1.5	01	18 – 18	18.0±0.0	06	9 – 18	12.7±2.9
O	16	7 – 20	12.4±3.8	23	8 – 20	13.3±3.4	39	7 – 20	12.9±3.5
ANOVA*	F=1.523, df=3, P=0.220			F=0.676, df=3, P=0.571			F=0.446, df=3, P=0.721		

CONCLUSIONS

In addition to the forensic and medical applications, the present study may prove to be a useful contribution to the anthropological and human biological knowledge. Though loops were the most frequently observed pattern in each of the four blood groups followed by whorls and arches, the present research suggests that the relative/ proportionate distribution of fingerprint patterns significantly varied for each blood group among males, females and total sample. However, prediction of blood group of an individual based on fingerprint patterns alone and vice versa can hardly ever be made. Thus, opinions of these sort based on the observations of similar research should be reserved.

The limitation of the present pilot study is that the students were from different parts of the country and did not represent any particular geographic/ ethnic/ population or caste group. Thus, further studies on associations between the dermatoglyphic characteristics and the ABO blood groups are proposed on a large sample comprising of endogamous groups.

REFERENCES

BHARADWAJA A., SARASWAT P. K., AGGARWAL S. K., BANERJI P., BHARADWAJA S., 2004: Pattern of fingerprints in different ABO blood groups. *Journal of Indian Academy of Forensic Medicine* 26, 1: 6–9.

BUKELO M.J., KANCHAN T., UNNIKRISHNAN B., REKHA T., ASHOKA B., RAU A. T., 2011a: Study of finger print patterns in children with acute lymphoblastic leukemia. *Forensic Science, Medicine, and Pathology* 7, 1: 21–25.

BUKELO M. J., KANCHAN T., RAU A. T. K., UNNIKRISHNAN B., BUKELO M. F., KRISHNA V. N., 2011b: Palmar dermatoglyphics in children with acute lymphoblastic leukemia. A preliminary investigation. *Journal of Forensic and Legal Medicine* 18, 3: 115–118.

FAYROUZ N. E., FARIDA N., IRSHAD A. H., 2012: Relation between fingerprints and different blood groups. *Journal of Forensic and Legal Medicine* 19, 1: 18–21.

KANCHAN T., KRISHAN K., APARNA K. R., SHYAMSUNDAR S., 2013: Is there a sex difference in palm print ridge density? *Medicine, Science and the Law* 53, 1: 33–39.

KANCHAN T., KRISHAN K., APARNA K. R., SHYAMSUNDER S., 2012: Footprint ridge density: a new attribute for sexual dimorphism. *Homo* 63, 6: 468–480.

KANCHAN T., CHATTOPADHYAY S., 2006: Distribution of fingerprint patterns among medical students. *Journal of Indian Academy of Forensic Medicine* 28, 2: 65–68.

KANCHAN T., KRISHAN K., 2016: Blood grouping, In: J. Payne-James, R. Byard (Eds.): *Encyclopedia of Forensic and Legal Medicine* (Second Ed.). Vol. 1, pp. 425–432. Oxford: Elsevier.

KRISHAN K., GHOSH A., KANCHAN T., NGANGOM C., SEN J., 2010: Sex differences in fingerprint ridge density – Causes and further observations. *Journal of Forensic and Legal Medicine* 17, 3: 172–173.

KRISHAN K., KANCHAN T., NGANGOM C., 2013: A study of sex differences in fingerprint ridge density in a North Indian young adult population. *Journal of Forensic and Legal Medicine* 20, 4: 217–222.

KRISHAN K., KANCHAN T., SHARMA R., PATHANIA A., 2014: *Variability of palmprint ridge density in a North Indian population and its use in inference of sex in forensic examinations. Homo* 65, 6: 476–488.

KRISHAN K., KANCHAN T., PATHANIA A., SHARMA R., DIMAGGIO J. A., 2015: Variability of footprint ridge density and its use in estimation of sex in forensic examinations. *Medicine, Science and the Law*, 55, 4: 284–290.

KSHIRSAGAR S. V., GUNDRE S. D., 2012: Study of dermatoglyphics in Rh blood group. *Anatomica Karnataka* 6, 1: 70–73.

LONDHE S. R., JADHAV A. S., 2011: Digital dermatoglyphics and ABO blood groups. *Indian Journal of Forensic Medicine and Pathology* 4, 2: 77–81.

NAYAK V. C., RASTOGI R., KANCHAN T., LOBO S. W., YOGANARASIMHA K., NAYAK S., RAO N. G., KUMAR G. P., SHETTY B. S. K., MENEZES R. G., 2010a: Sex differences from fingerprint ridge density in the Indian population. *Journal of Forensic and Legal Medicine* 17, 2: 84–86.

NAYAK V. C., RASTOGI P., KANCHAN T., YOGANARASIMHA K., KUMAR G. P., MENEZES R. G., 2010b: Sex differences from fingerprint ridge density in Chinese and Malaysian population. *Forensic Science International* 197, 1–3: 67–69.

NITHIN M. D., BALARAJ B. M., MANJUNATHA B., MESTRI S. C., 2009: Study of fingerprint classification and their gender distribution among South Indian population. *Journal of Forensic and Legal Medicine* 16, 8: 460–463.

PURVIS-SMITH S. G., MENSER M. A., 1973: Dermatoglyphics in children with acute leukemia. *British Medical Journal* 4, 5893: 646–648.

RASTOGI P., PILLAI K. R., 2010: A study of finger prints in relation to gender and blood group. *Journal of Indian Academy of Forensic Medicine* 32, 1: 11–13.

REDDI A. P., MUKHERJEE B. N., RAMACHANDRAIAH T., 1980: Distribution of ABO and Rh (D) blood groups among four endogamous groups of Andhra Pradesh. *Human Heredity* 30, 5: 331–332.

SEN J., KANCHAN T., MONDAL N., 2011: A comparison of palmar dermatoglyphics in two ethnic Indian populations of North Bengal, India. *Journal of Forensic Sciences* 56, 1: 109–117.

THAMARIA J. P., MATHUR K. C., HUSAIN S. A., 1972: Frequency distribution of ABO blood groups among general population of Northern Rajasthan and among sputum positive pulmonary tuberculosis cases with particular reference to rate of in-activation of isoniazid. *Indian Journal of Tuberculosis* 19: 30–33.

VARIEND S., 1994: Fetal, perinatal and infant autopsies. In: D. W. K. Cotton, S. S. Cross (Eds.): *The Hospital Autopsy*. Pp. 99–115. Jaypee Brothers, New Delhi, India.

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