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 ($\chi^2 = 19.42, P = 0.004$), females ($\chi^2 = 20.63, P = 0.002$), and the total sample ($\chi^2 = 17.75, P = 0.007$). 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
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 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>
<thead>
<tr>
<th>Blood Group</th>
<th>Rh+</th>
<th>Rh−</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>28 (96.6)</td>
<td>01 (03.4)</td>
<td>29 (100)</td>
</tr>
<tr>
<td>B</td>
<td>34 (94.4)</td>
<td>02 (05.6)</td>
<td>36 (100)</td>
</tr>
<tr>
<td>AB</td>
<td>05 (83.3)</td>
<td>01 (16.7)</td>
<td>06 (100)</td>
</tr>
<tr>
<td>O</td>
<td>37 (94.9)</td>
<td>02 (05.1)</td>
<td>39 (100)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Rh+</th>
<th>Rh−</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>104 (94.5)</td>
<td>06 (05.5)</td>
<td>110 (100)</td>
</tr>
</tbody>
</table>
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 ($\chi^2 = 19.42,
P = 0.004$), females ($\chi^2 = 20.63, P = 0.002$), and total
sample ($\chi^2 = 17.75, P = 0.007$).

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

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Sex differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>13 (23.6)</td>
<td>16 (29.1)</td>
<td>29 (26.4)</td>
<td>$\chi^2=0.421$, P-value=$0.5162$</td>
</tr>
<tr>
<td>B</td>
<td>21 (38.2)</td>
<td>15 (27.3)</td>
<td>36 (32.7)</td>
<td>$\chi^2=1.486$, P-value=$0.2233$</td>
</tr>
<tr>
<td>AB</td>
<td>05 (09.1)</td>
<td>01 (01.8)</td>
<td>06 (05.4)</td>
<td>$\chi^2=2.821$, P-value=$0.0930$</td>
</tr>
<tr>
<td>O</td>
<td>16 (29.1)</td>
<td>23 (41.8)</td>
<td>39 (35.5)</td>
<td>$\chi^2=1.947$, P-value=$0.1631$</td>
</tr>
<tr>
<td>Total</td>
<td>55 (100)</td>
<td>55 (100)</td>
<td>110 (100)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Distribution of fingerprint patterns for each blood group in males, females and total sample. % values are shown in brackets; $\chi^2$-Chi square analysis.

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Males (N=550)</th>
<th>Female (N=550)</th>
<th>Total (N=1100)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>AB</td>
</tr>
<tr>
<td>Loops</td>
<td>72 (55.4)</td>
<td>102 (48.6)</td>
<td>34 (68.0)</td>
</tr>
<tr>
<td>Whorls</td>
<td>55 (42.3)</td>
<td>99 (47.1)</td>
<td>12 (24.0)</td>
</tr>
<tr>
<td>Arches</td>
<td>03 (02.3)</td>
<td>09 (04.3)</td>
<td>04 (08.0)</td>
</tr>
<tr>
<td>Total</td>
<td>130  (100)</td>
<td>210 (100)</td>
<td>50 (100)</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>$\chi^2=19.42$, df=6, P=0.004</td>
<td>$\chi^2=20.63$, df=6, P=0.002</td>
<td>$\chi^2=17.75$, df=6, P=0.007</td>
</tr>
</tbody>
</table>
TABLE 4. Descriptive Statistics: Pattern Intensity Index (PII) among males and females. *, Male female differences for PII using Student’s t-test.

<table>
<thead>
<tr>
<th>PII</th>
<th>Male (N=55)</th>
<th>Female (N=55)</th>
<th>Total (N=110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>13.4</td>
<td>13.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Standard Deviation (SD)</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Minimum</td>
<td>07</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>Maximum</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

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](image-url)
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. 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.

**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.

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