Is There any Relationship Between Fingerprints and ABO Blood Groups? A Forensic Interest

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ABSTRACT

In crime scene investigation, fingerprints and blood stains are important and can lead to identification of individuals. Several studies have previously shown a relationship between fingerprints and the ABO blood groups system. In order to look for this relationship, the present study was conducted on 300 subjects. Fingerprints were taken and blood group typing were performed. The sex ratio of our study population was 1.3. Loops were globally more common (54.4%) respectively followed by Whorls (35.9%) and Arches (9.7%). This distribution varied significantly according to gender. Considering the ABO blood groups, Loops and Whorls were most encountered in O+ subjects with respectively 29.1% and 21.6%. However, these frequencies were low in the others blood groups (A-, A+, AB-, AB+, B- and B+). Arches were predominant in persons with blood phenotype A.

Key Words: *Crime scene; Fingerprints; Loops; Arches; Whorls; Blood groups; Identification*

INTRODUCTION

Fingerprints and blood stains are commonly found on crimes scenes [1,2]. Because of their individual characteristics, dermatoglyphs are an effective tool used to identify people [3,4]. These dermatoglyphs are formed between the 11th and the 17th week of the intra uterine life and remain during the whole life of the individual [5]. Fingerprints are impressions of dermatoglyphs on a support and are classified in three patterns families namely the Loops, the Whorls and the Arches. Loops have been reported to be the most commonly encountered figures [6]. This classification into fingerprints families is the first level of comparison in the fingerprint identification process [4].

There are 33 types of blood groups including the ABO system discovered by Karl Landsteiner in 1901 [7]. ABO blood system has several applications in anthropology, human genetics and especially in criminal identification [8-10]. In forensic investigations, blood phenotypes typing doesn't allow a formal identification but may allow a suspect exclusion by comparing his blood with a bloody trace found on a crime scene. Blood groups are also important in a paternity exclusion and are a prerequisite for genetic analyses in biological filiation testing. There are 4 phenotypes in the ABO blood system: A, B, AB and O. These blood groups are genetically determined on the wall of red blood cells [7]. Many studies had previously shown a relationship between dermatoglyphs, blood groups and sex determination [11-15].

So, does this relationship really exist? The purpose of this study was to look for a probable link between fingerprints and blood phenotypes.

MATERIALS AND METHODS

This study was conducted at the Forensic department of Ouagadougou, Burkina Faso, from January to February 2019 and involved 300 volunteers. After reading the details of this study and giving their clear consent, 3 ml of blood were collected by venipuncture in an EDTA tube from each participant. ABO Blood groups were then determined using Beth-Vincent's method which is based on agglutination antigen- antibody reaction. After cleaning their hands from dust and fat, fingerprints of all participants were subsequently taken by affixing their fingers in a specific forensic ink according to the Cummins' method [16]. The fingerprints obtained were classified according to their general forms. Prior approval of Burkina Faso National Police was obtained for this study.

The data collected were analyzed by IBM SPSS statistic 20 software and chi square test was performed. Differences were significant when P values ≤ 0.05.

RESULTS

The subjects were between 21 and 65 years old with a mean age of 39.95 ± 0.8 years. Our study population was made up of 172 males (57.3%) and 128 females (42.7%) with a sex ratio of 1.3 (128/300). The global blood phenotypic frequencies were 59.7% for O, 19.3% for AB, 14.7% for A and 6.3% for B (Table 1).

Blood group O+ (58.3%) was predominant, respectively followed by B+ (17.7%), A+ (13%) and AB+ (5%). The frequencies of A- and B- groups were low (1.7%). O- group represented 1.3% (Table 2). The standard Rhesus frequency observed was 94%. The distribution of fingerprints varied generally according to gender (P<0.05) (Table 3).

Loops distribution was globally high (54.4%) and were more encountered on the little finger. The frequencies of Whorls and Arches were respectively 35.9% and 9.7%. Whorls frequency was 40.5% in males and 29.8% in females. Arches distribution was lower in males (4.7%) than in females (16.3%) (Figure 1). On the thumb, Whorls were more predominant than Loops in both the two genders (Table 4).

TABLE 1

Blood phenotypes distribution according to gender.

Phenotypes	Frequencies		
	Global	Males	Females
A	14.7	6.7	8
B	6.3	3.3	3
AB	19.3	10	9.4
O	59.7	37.3	22.3

TABLE 2

Blood groups distribution and standard Rhesus frequency.

	A^-	A^+	AB^-	AB^+	B^-	B^+	O^-	O^+	Rh^+	Rh^-
n	5	39	4	15	5	53	4	175	282	18
%	1.7	13	1.3	5	1.7	17.7	1.3	58.3	94	6

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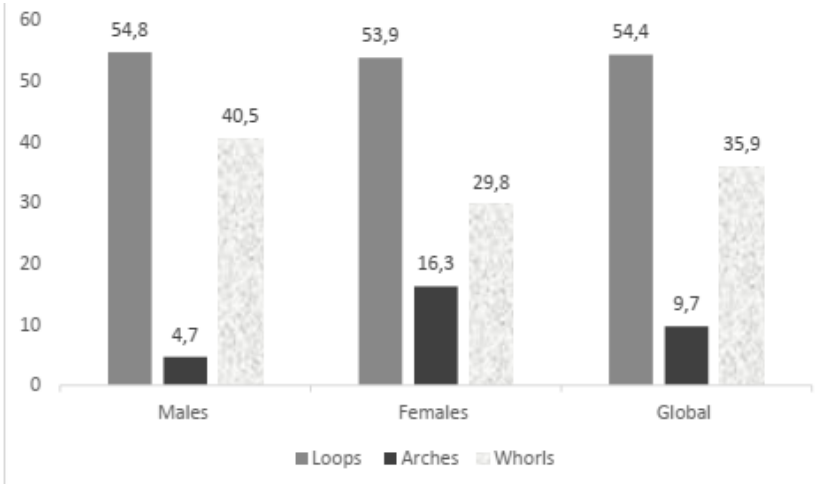

Figure 1) *Fingerprints frequencies according to gender.*

TABLE 3

Evaluation of significance degree in fingerprints distribution according to gender.

	Observed values			Expected values			Chi-square•(χ2)	P•
	Loops	Whorls	Arches	Loops	Whorls	Arches		
Males (%=57.3)	943	696	81	935.7	617.1	166.2	126.58	**P<0.05**
Females (%=42.7)	690	381	209	697.3	459.9	123.8		
Total	1633	1077	290	1633	1077	290		

TABLE 4

Fingerprints distribution according to the type of finger.

	Thumb		Forefinger		Major		Ring finger		Little finger		Global freq
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
Arches	5.7	8	9	18.3	12.3	21.3	0	14.7	0	7.3	9.7
Loops	34.3	39.7	50.3	30	68	38	68	50.7	93.7	71.7	54.4
Whorls	74.7	37.7	55.3	37	34.3	26	46.7	20	21	6.3	35.9

TABLE 5

Distribution of fingerprints patterns according to blood groups.

Fingerprints	Blood phenotypes							
	Frequencies							
	A^-	A^+	AB^-	AB^+	B^-	B^+	O^-	O^+
Arches	5.3	5.3	NIL	NIL	0.1	1.2	0.1	1.8
Loops	1	6.4	0.1	0.2	0.4	7.8	0.6	29.1
Whorls	NIL	NIL	0.3	1	1	6.3	0.6	21.6

Cross-analysis between fingerprint patterns, blood groups and the Rhesus factor" has shown that Loops were more frequent in individuals with O+ blood type (29.1%). Whorls were also more observed in O+ blood group (21.6%). Arches frequency was high in subjects with blood phenotype A. Loops and Whorls frequencies were globally low in AB blood group (Table 5). Global fingerprints distribution was significantly different in each blood phenotypes with P<0.05 (Table 6).

$\chi 2$ has been calculated using the formula $\chi 2=\sum((Oi-Ei)2)/Ei$

where Oí was the observed value and Eí the expected value.

P value is then obtained using the chi-square table

DISCUSSION

As previously shown in the literature, we found that Loops were really the most encountered forms of fingerprints. Frequencies of Whorls and Arches found in this study were also in accordance with that was previously described (intermediate for Whorls and low for Arches) [6,17-21]. But the trend of this distribution was different, considering the type of fingers. Indeed, on the thumb in males, Whorls frequency was higher than that of the Loops. Also, on the little finger in females, Whorls were less common than Loops and Arches.

This study also confirmed that there was a significant difference in the fingerprint's distribution by gender [22]. Indeed, our results showed that Loops and Whorls were common in males while Arches were predominant

TABLE 6

Evaluation of degree of variation between fingerprints distribution and blood phenotypes.

	Observed values			Expected values			Chi-square• (χ2)	P•
	Loops	Whorls	Arches	Loops	Whorls	Arches		
A (%=14.7)	264	NIL	176	211.97	154.20	42.63	1682.15	**P<0.05**
AB (%=19.3)	38	152	NIL	278.31	202.46	55.87		
B (%=6.3)	229	238	57	90.85	66.09	18.27		
O (%=59.7)	911	659	57	860.87	626.25	173.13		
Total	1442	1049	290	1442	1049	290		

in females. These findings have also been reported in the literature and could be used to determine sex of individuals [12,23,24].

Blood analysis showed that O+ frequency>B+ frequency>A+ frequency>AB+ frequency>A-frequency>O- frequency with A- frequency = B- frequency and O- frequency=AB-frequency. These results corroborate with those of other studies on blood phenotypes distribution, previously conducted in Burkina Faso. According to these studies, the phenotypic frequencies of blood groups varied by ethnic groups but the majority of populations were of the O+ group. These publications have also shown that the distribution of blood phenotypes in Burkina Faso were similar to several West African countries [10,24,25].

We found that Loops and Whorls were common in O+ subjects, low in A+ and B+ blood groups and very low in A-, AB-, AB+, B- and O- individuals. Arches frequency was low in A+ and A- groups and very low in B-, B+, O- and O+ subjects. A similar study conducted in India has described that Loops were found frequently in B+ subjects and weakly in persons who have O+ blood phenotype [14]. Our statistical analyses also revealed that fingerprints varied with blood group and the difference found was significant ($P<0.05$). This trend has also been reported [14]. The Rh+ frequency found in our study was high as mentioned in some publications on Rh distribution across African countries [10].

In this study, we did not look for a correlation between fingerprints and predisposition to some diseases but some publications have reported that fingerprints could have a link with some clinical complains [26-29].

CONCLUSION

The results of this study were in agreement with those of previous studies conducted on the same subject at several levels. First, we found that Loops were the most frequent forms of fingerprints respectively followed by Whorls and Arches. Our results also confirmed that the distribution of fingerprints was related to gender. We also found in agreement with the literature, that O+ blood group was predominant in West Africa.

Cross-analyses between fingerprints and blood groups showed that Loops and Whorls were more common in O+ individuals and few in A-, B- and AB- individuals. Arches were more common among subjects with A blood phenotype. In light of these results, we found that there could be a link between fingerprints and blood groups. This is a criminalistics interest in the exploitation of traces and clues collected on a crime scene.

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