

## Research Article

**Relationship between pattern of fingerprints and blood groups**

Harem Othman Smail\*, Dlnya Ahmed Wahab and Zhino Yahia Abdullah

*Department of Biology, Faculty of Science and Health, Koya University Koya KOY45, Kurdistan Region – F.R. Iraq.*

**Abstract:** Dactylography or the fingerprint system relies on the study of stratum ridges and their configurations [Dermatoglyphics (Derma = skin + Glyph = carving)] in the fingers, palms and soles. Estimates that probably there are chances of two people with identical finger impressions are about one in sixty four thousand million. Heredity and environment arbitrate in combination effects the pattern of ridges.

We have conducted a study with 450 individuals among which 224 were male and 226 were female subjects, having different ABO blood groups and belongs to different age groups. This study was carried out in different faculties of Koya University. All the 10 fingerprint patterns were divided into Loops, Whorls and Arches. The fingerprints were taken with the help of stamp pad imprinting the finger ridges over A4 size white papers.

The general distribution of the pattern of fingerprint showed high frequency (49.62%) of loops, whereas whorls were moderate (42.48%) and arches were least (7.88%) in frequency. Almost same order was noticed in both Rh-positive and Rh-negative individuals or A, B, AB and O blood groups. Loops are dominated in all the blood groups of both Rh-positive and Rh-negative individuals.

The aim was to study the pattern of fingerprints on all the fingers of both hands and to study the association between fingerprints and blood groups among university students in different faculties of the Koya university with statistical analysis. The study suggests an association between fingerprint pattern and blood group A, B and AB, however, there is no association found between fingerprints and blood group O based on statistical analysis of chi-square test when results combined between both genders. This study concludes that distribution of primary pattern of fingerprints is related to individual digits.

**Keywords:** Fingerprint, Blood group, Rh-positive, Rh-negative.

**1. Introduction**

Through decades of research project, a hand has been recognized as a strong tool within the identification of psychological, medical, and genetic conditions. The term dermatoglyphics was coined by Harold Cummins in 1926 that is employed in the studies of stratum ridges on the hairless part of the palm, fingers, toes, and soles (Sudikshya *et al.*, 2018). It's supported the principle that the individual peculiarities of the patterns formed by the arrangement and distribution of the outgrowth or stratum ridges on the fingertips are completely constant, protected throughout life, from infancy to adulthood and patterns of two hands doesn't match with another. Even the fingerprints of twins aren't similar (Subrahmanyam, 2001).

The skin on the palm and plantar surface is unendingly wrinkled with slender, minute ridges

referred to as friction ridges. A fingerprint is a bearing of the friction ridges on all components. At first fingerprints patterns seems on the human fingers, palms, soles, and toes from twelfth to sixteenth week of embryonic development and their formation get completed by the fourteenth week, i.e. regarding the sixth vertebrate month (Radhika, 2016). Numerous physical evidence are used for identification is fingerprints, deoxyribonucleic acid identification, lip marks, footprints, bite marks, etc. Fingerprints are constant and individualistic and one of the best reliable criteria for identification. Fingerprints follow Locard's Principle of Exchange. The secretions within the fingerprints contain residues, numerous chemicals and their metabolites which may be detected and used for the forensic purpose (Bhavana *et al.*, 2013).

Generally, human fingerprints classified into three main types; loops, whorls and arches (Kanchan & Chattopadhyay, 2006). 'ABO' system is further

classified as A, B, AB, O people types according to presence of corresponding antigen in plasma. 'Rhesus' system is classified into 'Rh-positive' and 'Rh-negative' according to the presence or absence of 'D' antigen (Mehta & Mehta, 2011).

## 2. Materials and Methods

The present study was carried out at the faculty of Science and Health and at the faculty of Humanities and Social Sciences, Koya University throughout the period of October 2018 to January 2019. 450 students (224 male & 226 female) belonging to the age group 18-25 years were randomly chosen for the study. Performa was ready on a sturdy white paper divided into two parts, marked as right and left, and further divided into 5 columns for taking thumb, index, middle, ring and little finger impression. The fingerprints were taken using the stamp pad of Horse Company of size 45×35 millimeter.

Fingerprints were taken after cleaning the hands with tissue paper to completely take away the dirty substances. Each rolled and plane prints of right and left hands were taken. The patterns of fingerprints (loops, whorls and arches) were determined with the assistance of a hand lens. When taking the fingerprints the essential details such as name, age and sex were additionally gathered. Blood groups of all the persons were also noted for further study. Two types of blood group system were used:

1. ABO system – Subjects were classified into four blood teams → A, B, AB and O.
2. Rh blood group system – Subjects were classified into 2 blood group → Rh-positive and Rh-negative blood type.

### 2.1 Procedure: (Nayak *et al.*, 2015)

1. Cleaned both hands to remove any dirty substances from the surface of the fingers.
2. Relaxed and further look at some object not in their hands.
3. Stood to the left of the students while printing the right hand. Stood to the right of the students while printing the left hand.
4. Held the finger at the circus tent below the nail and at the root of the finger on third joint.
5. The direction of rolled the finger should be from the most awkward position to the easiest portion.
6. Individually rolled impression is made by placing the side of the stamp pad of the finger upon the inking plate and rolling to the other side until its face the opposite direction.

7. Ink and print each finger (both odd and right hands) one by one in succession.
8. Plain impression took simultaneously consists of right and left fingers.
9. Results are recorded for determining cases of fingerprints from different types of blood groups.

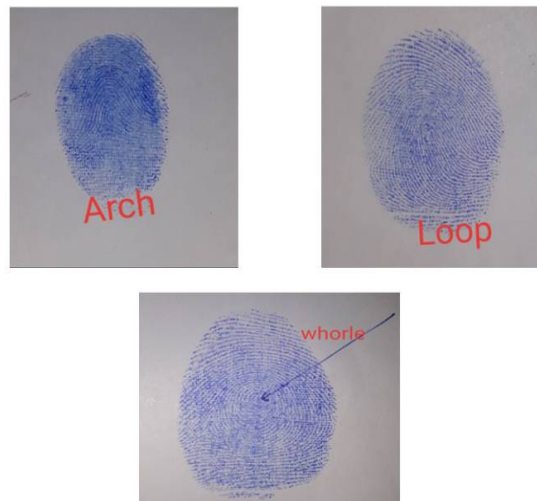


Fig. 1: Pattern of the fingerprints.

### 2.2 Statistical analyses

The chi-square test was applied to examine the relationship between the fingerprints and blood groups for both right and left hands.  $p$ -values < 0.05 were considered to be statistically significant. All computations were done by using SPSS version 19 for Windows.

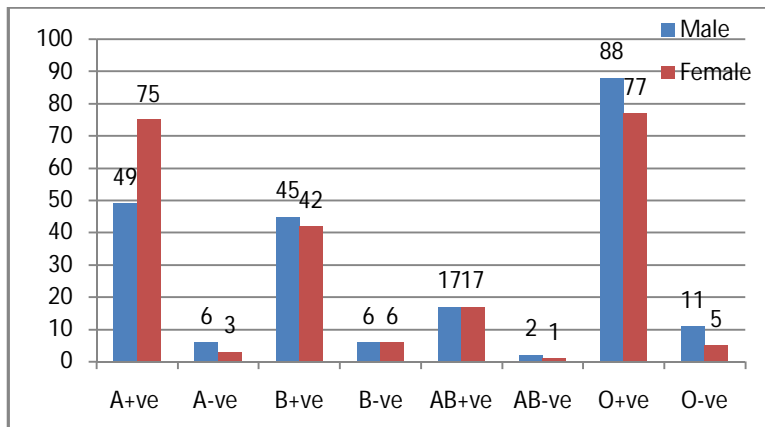
## 3. Results and Discussion

This study reveals the relation between the distribution of dermatoglyphic (Dactylography, fingerprint), blood group and gender. A total of 450 subjects were chosen randomly from Koya University within several faculties. Among 450 subjects 224 were male and 226 were female, and most of the subjects belong to O blood group, i.e., Rh-positive 165 (36.66%) and Rh-negative 16 (3.55%) followed by blood group A-positive 124 (27.55%), A-negative 9 (2%) and B-positive 87 (19.33%), B-negative 12 (2.66%) and AB-positive 34 (7.55%), AB-negative 3 (0.66%). The bigger part of the topics, i.e., 410 (91.1%) were Rh-positive and few, i.e., 40 (8.8%) were Rh-negative.

The incidence of blood type O was highest, followed by blood groups A, B and AB respectively, in each sex (Table 1 and Table 2). Similar results were recorded by Bharadwaj and Ewoldt (2015); Rastogi and Pillai (2010). On the other hand, Mehta and Mehta (2011) and Desai *et al.*, (2013) discovered the dominance of blood type B followed by O and A.

**Table 1: Distribution of cases based on the sex and blood groups.**

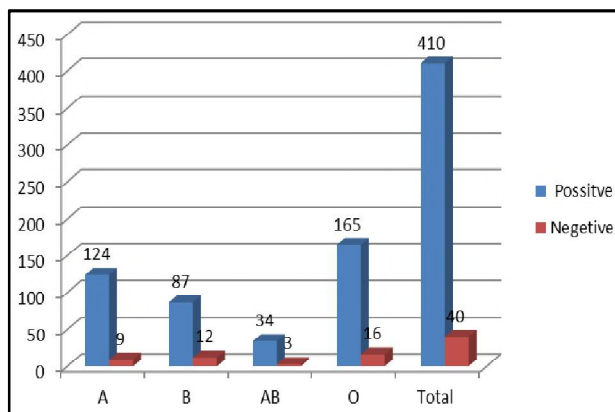
Sex	Blood groups								Total
	A		B		AB		O		
	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative	
Male	49 (10.88%)	6 (1.33%)	45 (10%)	6 (1.33%)	17 (3.77%)	2 (0.44%)	88 (19.55%)	11 (2.44%)	224 (49.74%)
Female	75 (16.65%)	3 (0.66%)	42 (9.33%)	6 (1.33%)	17 (3.77%)	1 (0.22%)	77 (17.11%)	5 (1.110%)	226 (50.18%)
<b>Total</b>	<b>124 (27.55%)</b>	<b>9 (2%)</b>	<b>87 (19.33%)</b>	<b>12 (2.66%)</b>	<b>34 (7.55%)</b>	<b>3 (0.66%)</b>	<b>165 (36.66%)</b>	<b>16 (3.55%)</b>	<b>(100%)</b>



**Fig. 2: Distribution of cases based on the sex and blood groups.**

**Table 2: Distribution of subjects according to Rh blood groups.**

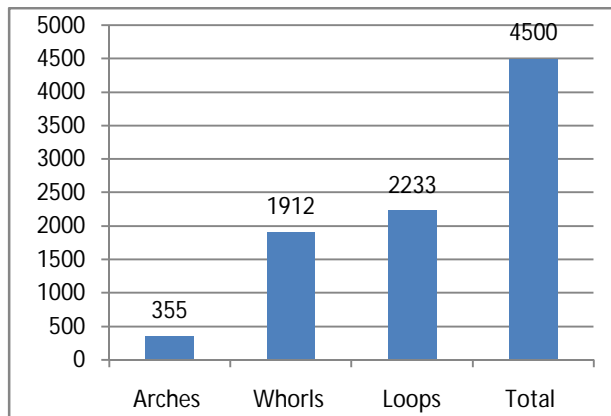
Blood groups	Rh blood groups	
	Rh-positive	Rh-negative
A	124 (27.55%)	9 (2%)
B	87 (19.33%)	12 (2.66%)
AB	34 (7.55%)	3 (0.66%)
O	165 (36.66%)	16 (3.55%)
<b>Total</b>	<b>410 (91.1%)</b>	<b>40 (8.8%)</b>



**Fig. 3: Distribution of subjects according to Rh blood groups.**

**Table 3: General distributions of primary fingerprint patterns in all fingers of both hands for both sexes.**

Types of fingerprints	Total	Percentage
Arches	355	7.88%
Whorls	1912	42.48%
Loops	2233	49.62%
<b>Total</b>	<b>4500</b>	<b>100%</b>



**Fig. 4: General distributions of primary fingerprint patterns in all fingers of both hands for both sexes.**

Mehta and Mehta (2011) and Desai *et al.*, (2013) observed the highest incidence of B blood group followed by O, A and AB. Khalid and Qureshi (2006) observed highest incidence of B blood group in Pakistani and Ghasemi *et al.*, (2010) in Iran. In Turkey, Jaff and O'Briain (1987) observed higher incidence of A blood group (46%) than O blood group (32%), while in Europeans, they observed higher incidence of O blood group (43%) followed by A (40%), B (12%) and AB (7%) blood groups.

The universal distribution of the fingerprint patterns was of the order in individual with blood group A, B, AB and O, i.e., higher frequency of loops, whorls are moderate and arches are low. The identical finding was seen in Rh-positive and Rh-negative people (Kshirsagar *et al.*, 2003). The present study is an associate approach to further classifies fingerprint

patterns. These patterns fall into three general categories known as arches, loops, and whorls. Arches are the best patterns and additionally the rarest (Bhavana, 2013).

Table-4 shows the distribution of the fingerprint patterns among ABO blood groups of all the fingers. Additional numbers of the loops were found in blood group O-positive, i.e. 811 (18.02%) followed by A-positive, i.e. 610 (13.55%) among the Rh-positive people. However, the incidence of whorls is found to be predominant within the blood group O people in Rh-negative. Whorls in Rh-positive people were completely different from each B and O blood groups; are 390 (8.66%) and 740 (16.44%) respectively. Normally, fewer Arches were found in all the blood groups. Least numbers of arches were seen within the people AB blood group.

For blood groups A-positive and A-negative the chi-square statistic is 666.6778. The *p*-value is < 0.00001. The result is significant at *p* < 0.05. For blood group B-positive and B-negative, the chi-square statistic is 9.8585. The *p*-value is 0.007232. The result is significant at *p* < 0.05. On the other hand, blood group AB positive and AB negative the chi-square statistic is 12.5404. The *p*-value is 0.001892. The result is significant at *p* < 0.05. But statistically O-positive and O-negative blood group showed chi-square statistic

is 1.8873. The *p*-value is 0.3892. The result is not significant at *p* < 0.05 (Table 4).

In Table 5 the thumb, middle and little fingers of A, B and O blood group showed a high frequency of loops, i.e. in blood group A total loops are 655 (49.24%), blood group B total loops are 499 (50.4%) and blood group AB total loops are 196 (52.97%) and for Blood group O total loops are 911 (50.33%). Whorls were more in ring fingers; in blood group A 143 (10.75%), blood group B 109 (11.01%), blood group AB 39 (10.49%) and blood group O 211 (11.65%). Frequency of arches were least (less than -5%) in the majority of cases, but index and middle fingers of blood group A, B and O individuals showed comparatively high frequency. The statistical results for blood group A showed chi-square statistic is 128.8014. The *p*-value is < 0.00001. The result is significant at *p* < 0.05. Similar statistical results are observed for individual fingers of blood groups A and B people. The *p*-value is < 0.00001. The result is significant at *p* < 0.05. However, individual fingers of blood groups AB and O showed the different statistical analysis. For blood group AB chi-square statistic is 34.5. The *p*-value is 0.000091. The result is significant at *p* < 0.05. For blood group O chi-square statistic is 150.3832. The *p*-value is < 0.00001. The result is significant at *p* < 0.05.

Table 4: Distribution of pattern of fingerprints among subjects of A, B, O and Rh blood groups (n = 4500) for both sexes.

Type of Fingerprint	Blood group A		Blood group B		Blood group AB		Blood group O	
	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative
Arches	142 (3.15%)	9 (0.2%)	50 (1.11%)	15 (0.33%)	25 (0.5%)	1 (0.02%)	99 (2.2%)	14 (0.31%)
Whorls	488 (10.84%)	32 (0.71%)	390 (8.66%)	42 (0.93%)	146 (3.24%)	4 (0.08%)	740 (16.44%)	70 (1.55%)
Loops	610 (13.55%)	49 (10.08%)	430 (9.55%)	63 (1.4%)	169 (3.75%)	25 (0.5%)	811 (18.02%)	76 (1.68%)
Total	1240 (27.55%)	90 (2%)	870 (19.33%)	120 (2.66%)	340 (7.55%)	30 (0.6%)	1650 (36.66%)	160 (3.55%)
Statistics	The chi-square statistic is 666.6778. The <i>p</i> -value is < 0.00001. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 9.8585. The <i>p</i> -value is 0.007232. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 12.5404. The <i>p</i> -value is 0.001892. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 1.8873. The <i>p</i> -value is 0.3892. The result is not significant at <i>p</i> < 0.05.	

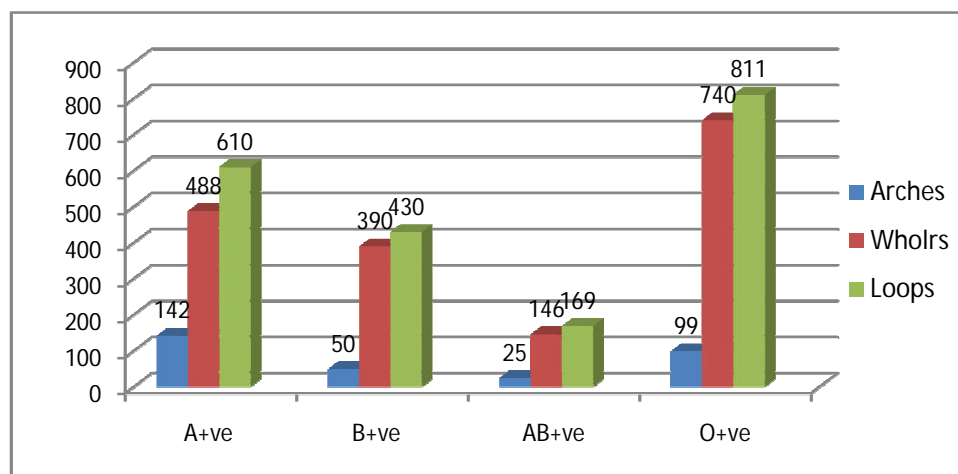


Fig. 5a: Distribution of pattern of fingerprints among subjects of A, B, O and Rh blood groups for both sexes (N = 4100).

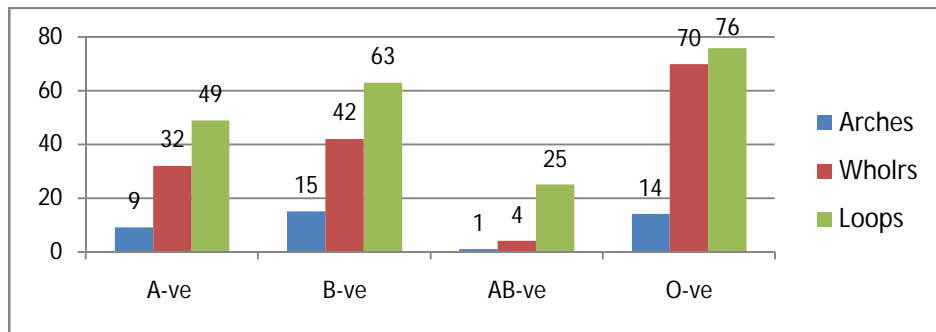


Fig. 5b: Distribution of pattern of fingerprints among subjects of A, B, O negative blood groups both sexes (n = 400).

Table 5: Distribution of pattern of fingerprints in different fingers of both hands of subjects (n = 450x2) for both sexes.

Individual fingers	Blood groups											
	A (n = 133x2)			B (n = 99x2)			AB (n = 37x2)			O (n = 181x2)		
	Arches	Whorls	Loops	Arches	Whorls	Loops	Arches	Whorls	Loops	Arches	Whorls	Loops
Thumb	15 (1.12%)	139 (10.45%)	113 (8.49%)	7 (0.7%)	98 (9.89%)	94 (9.49%)	2 (05%)	35 (9.450%)	38 (10.27%)	6 (033%)	189 (10.44%)	178 (9.83%)
Index	57 (4.28%)	107 (8.045%)	100 (7.51%)	21 (2.12%)	90 (9.09%)	78 (7.87%)	10 (2.70%)	33 (8.91%)	30 (8.1%)	39 (2.15%)	184 (10.16%)	148 (8.17%)
Middle	38 (2.85%)	70 (5.26%)	147 (11.05%)	14 (1.41%)	80 (8.28%)	107 (10.8%)	9 (2.43%)	20 (5.40%)	45 (12.16%)	34 (1.87%)	100 (55.52%)	200 (11.04%)
Ring	19 (1.42%)	143 (10.75%)	109 (8.19%)	7 (0.7%)	109 (11.01%)	83 (8.38%)	5 (1.35%)	39 (10.49%)	30 (8.1%)	9 (0.49%)	211 (11.65%)	137 (7.56%)
Little	22 (1.65%)	65 (4.88%)	186 (13.98%)	0 (0%)	65 (6.56%)	137 (13.83%)	0 (0%)	21 (5.67%)	53 (14.32%)	9 (0.49%)	118 (6.51%)	248 (13.70%)
Total	151 (11.35%)	524 (39.39%)	655 (49.24%)	49 (4.94%)	442 (44.64%)	499 (50.4%)	26 (7.02%)	148 (40%)	196 (52.97%)	97 (5.35%)	802 (44.30%)	911 (50.33%)
Statistics	The chi-square statistic is 128.8014. The p-value is < 0.00001. The result is significant at p < 0.05.			The chi-square statistic is 60.8. The p-value is < 0.00001. The result is significant at p < 0.05.			The chi-square statistic is 34.5. The p-value is 0.000091. The result is significant at p < 0.05.			The chi-square statistic is 150.3832. The p-value is < 0.00001. The result is significant at p < 0.05.		

Primary distribution pattern in individual fingers had a high frequency of loops in thumb and tiny finger, whereas ring fingers had additional whorls. Middle and index fingers showed a higher incidence of arches in subjects of blood groups A, B and O. Individuals of blood group AB had a high frequency of whorls within the thumb, index and ring fingers whereas middle and little fingers showed the number of loops.

However, the study done by Verma *et al.*, (2015) has shown that in the thumb, index, middle and little fingers of A and B blood group individuals have high frequency of loops. Whorls were more in ring fingers of all blood groups. AB blood group individuals also had more whorls in their thumbs, whereas; their index, middle and little fingers have shown more loops. Individuals of O blood group conjointly given more whorls in their thumbs and index fingers, whereas; their middle and little fingers have additional loops. Frequencies of arches were least within the majority of cases, but the index, middle and ring fingers of people A and O blood group and index of people B blood group showed relatively high frequency.

Table 6 shows the distribution of primary patterns of fingerprints in all digits of both hands of male among ABO blood group and Rh factor. In group A-positive

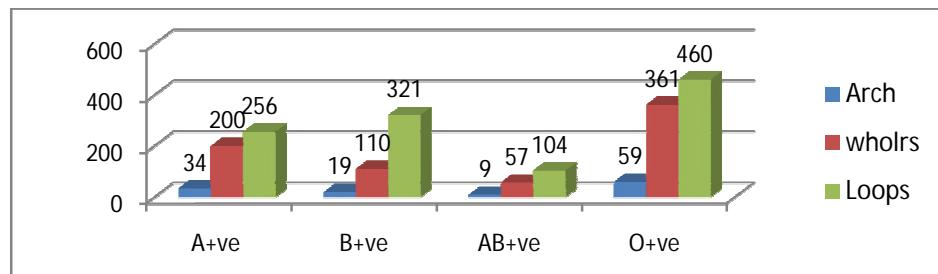
arch type of fingerprints is 34 (1.51%), whorl type is 200 (8.92%), loop type is 256 (10.08%) and in A-negative the Arch type of fingerprint is 9 (0.4%), Whorl type is 14 (0.65%) and loop type is 37 (1.65%).

In group B-positive the arch type of fingerprints is 19 (0.84%), whorl type is 110 (4.91%) and loop type is 321 (14.33%), but this percentage differs in group B-negative the arch type of fingerprints is very rare 7 (0.31%), whorl type is 22 (2.54%) and loop type is 31 (1.38%). In blood group AB the arch is rarest types of fingerprint, especially in AB-negative is only 1 (0.04%) and whorls are exactly the same (Table 6).

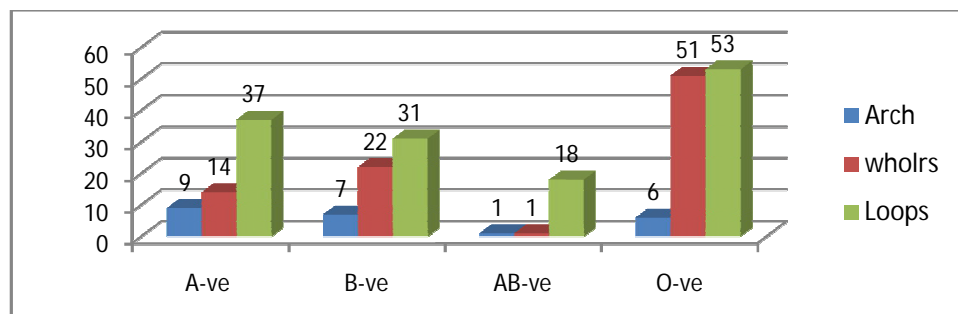
Statistically, there is a difference between all four types of blood groups. Blood groups A, B and AB are significant, but O is not significant. For blood group A chi-square statistic is 9.533. The p-value is 0.00851. The result is significant at p < 0.05, for blood group B chi-square statistic is 11.7774. The p-value is 0.002771. The result is significant at p < 0.05. For blood group AB chi-square statistic is 7.0896. The p-value is 0.028875. The result is significant at p < 0.05 and for blood group O chi-square statistic value is 1.2187. The p-value is 0.543707. The result is not significant at p < 0.05 (Table 6).

**Table 6: Distribution of primary patterns of fingerprints in all digits of both hands of male among ABO blood group and Rh factor.**

Types of fingerprint patterns	Blood group A		Blood group B		Blood group AB		Blood group O	
	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative
Arches	34 (1.51%)	9 (0.4%)	19 (0.84%)	7 (0.31%)	9 (0.4%)	1 (0.04%)	59 (2.63%)	6 (0.26%)
Whorls	200 (8.92%)	14 (0.65%)	110 (4.91%)	22 (2.54%)	57 (2.54%)	1 (0.04%)	361 (16.07%)	51 (2.27%)
Loops	256 (10.08%)	37 (1.65%)	321 (14.33%)	31 (1.38%)	104 (4.64%)	18 (0.8%)	460 (20.53%)	53 (2.36%)
<b>Total</b>	490 (21.871%)	60 (2.67%)	450 (20.08%)	60 (2.67%)	170 (7.58%)	20 (0.89%)	880 (39.28%)	110 (3.91%)
<b>Statistics</b>	The chi-square statistic is 9.533. The <i>p</i> -value is 0.00851. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 11.7774. The <i>p</i> -value is 0.002771. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 7.0896. The <i>p</i> -value is 0.028875. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 1.2187. The <i>p</i> -value is 0.543707. The result is not significant at <i>p</i> < 0.05.	



**Fig. 6a: Distribution of primary patterns of fingerprints in all digits of both hands of male among ABO positive blood group (n = 1990).**



**Fig. 6b: Distribution of primary patterns of fingerprints in all digits of both hands of male among ABO negative blood group (n = 250).**

In our study of fingerprints in both hands of female among ABO blood and Rh factor, for A-positive blood group arch type of fingerprints is rarest type followed by loops and whorls. Fingerprint patterns of male and female are statistically different based on the results for blood group A and O. For blood group A chi-square statistic is 2.1492. The *p*-value is 0.341431. The result is not significant at *p* < 0.05, but in male is significant. For blood group B chi-square statistic is 8.4757. The *p*-

value is 0.014439. The result is significant at *p* < 0.05. For B type chi-square statistic is 8.4757. The *p*-value is 0.014439. The result is significant at *p* < 0.05. But for AB chi-square statistic is 0.9886. The *p*-value is 0.609999. The result is significant at *p* < 0.05. O blood group is statistically different from males, in female chi-square statistic is 6.0355. The *p*-value is 0.048912. The result is significant at *p* < 0.05 but for male is not significant (Table 7).

**Table 7: Distribution of primary patterns of fingerprints in all digits of both hands of female among ABO blood group and Rh factor.**

Types of fingerprint patterns	Blood group A		Blood group B		Blood group AB		Blood group O	
	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative	Rh-positive	Rh-negative
Arches	88 (3.89%)	0 (0%)	22 (0.97%)	9 (0.39%)	11 (0.48%)	0 (0%)	34 (1.5%)	6 (0.26%)
Whorls	390 (17.34%)	18 (0.79%)	143 (6.32%)	20 (0.88%)	55 (2.43%)	2 (0.08%)	362 (16.01%)	20 (0.88%)
Loops	272 (12.03%)	12 (0.53%)	255 (11.28%)	31 (51.66%)	104 (4.6%)	8 (0.35%)	374 (16.54%)	24 (1.06%)
<b>total</b>	750 (33.18%)	30 (1.32%)	420 (18.58%)	60 (2.65%)	170 (7.52%)	10 (0.44%)	770 (34.07%)	50 (2.21%)
<b>Statistics</b>	The chi-square statistic is 2.1492. The <i>p</i> -value is 0.341431. The result is not significant at <i>p</i> < 0.05.		The chi-square statistic is 8.4757. The <i>p</i> -value is 0.014439. The result is significant at <i>p</i> < 0.05.		The chi-square statistic is 0.9886. The <i>p</i> -value is 0.609999. The result is not significant at <i>p</i> < 0.05.		The chi-square statistic is 6.0355. The <i>p</i> -value is 0.048912. The result is significant at <i>p</i> < 0.05.	

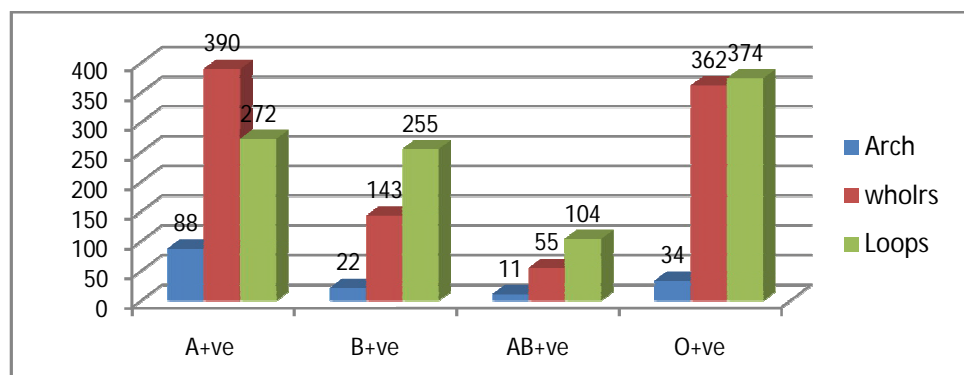


Fig. 7a: Distribution of primary patterns of fingerprints in all digits of both hands of female among ABO positive blood group (n = 2110).

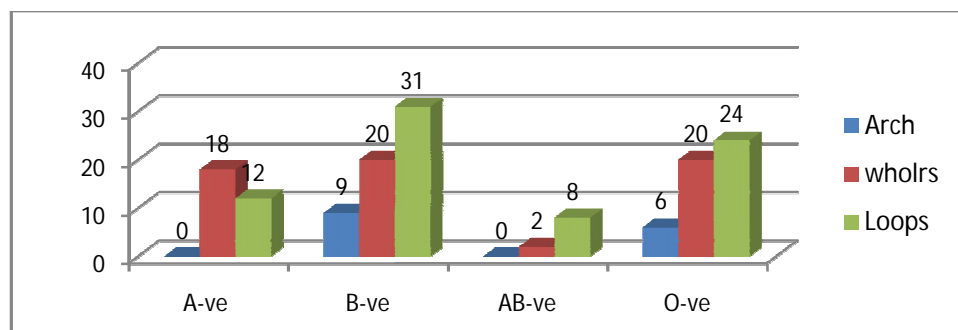


Fig. 7b: Distribution of primary patterns of fingerprints in all digits of both hands of female among ABO negative blood group (n = 150).

#### 4. Conclusions and Recommendation

Conclusively, there was an association between the distribution of fingerprint patterns and some types of blood groups (A, B and AB) as well as in each finger (thumb, index, middle, ring and little) among students in University of Koya thus it is possible to predict blood group of a person based on fingerprint pattern.

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