FINGERPRINT DISTRIBUTION FEATURES IN THE POPULATION OF ADJARA (GEORGIA)

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ABSTRACT

Our research study interest was to analyze the quantitative specific characteristic of primary fingerprints in the secondary and high school students in the population of Adjara. Data from 210 individuals have been studied. For obtaining the proper image of the fingerprint pattern, classical method was used. For one of the purposes of our study, the data has been processed according to all ten fingers (n = 2100), where the frequency of distribution of each fingerprint was determined. The Loop type fingerprint was revealed in 58.29 ± 1.08% of cases; Whorl type fingerprint was revealed in 32.9±1.03% of studied individuals, while, Arched type was observed in 8.33±0.60% and only 0.48±0.15% shown Composite type of fingerprint. In our research fingerprint distribution model were as follows: Loop > Whorl > Arches > Composite. Based on obtained data on the population of Ajara, we might conclude that a variety of fingerprint patterns are not related to gender.

KEYWORDS

Fingerprint, papillae, rete ridges, Adjara population

1. INTRODUCTION

Individualism of the human being is related to its own biological characteristics. In the modern era, there is a variety of methods for the identification of human being personality [1]. One of the most popular is biometrics, which automatically identifies an individual's (person), based on his/her physiological and/or behavioral characteristics. One biometric characteristic is the fingerprint. The fingerprint method is the ancient and the most common method among other biometric identification methods that have been used for physiological and morphological characteristics of organisms. The fingerprint method globally is used for the identification of criminals [2].

Each fingerprint is composed of specific papillae and rete ridges. Every single person has his/her unique papillary fingerprint pattern that makes characteristic individualism. The ridges of every finger on the right and left hand are unique and developed prenatally. It is formed in a fetus at the 13th week of embryonic development and doesn't alter with growth or age. The genetic component has the great importance in the formation of the fingerprint. However, their formation is also influenced by the non-genetic environment of early pregnancy, which is important for

tissue differentiation and organogenesis [3][4][5]. Fingerprints are extremely individual characteristics; hence it is evidenced by the fact that they are different even in monozygotic twins. Monozygotic twins have similar genetic operation systems but have different fingerprints [6][1][7], suggesting that the latter is a complex trait and is being formed by the interaction of genes and the environment during the early stages of pregnancy. The fingerprint is an evolutionary sign, since it has also been finding out in few primates. An interesting fact is, that there are some skin diseases that alter the phenotypically expressed fingerprint [8].

Dermatoglyphics which are the science about skin epidermal ridge patterns of the fingers and toes have been widely linked with anthropology [9] and population genetics [10][11][12][13][14]. It is very useful for the assessment of population structure. The fingerprint ridge and also the fingertip size are very useful parameters for gender classification [15] [16].

Human being fingerprint is classified into four categories: "Loop", "Whorl", or "Arche", "Composite". The distribution of these categories of the fingerprint is slightly different in different geographic areas. Our study interest was to analyze the quantitative specific characteristic of primary fingerprints in the secondary and high school students in the population of Adjara (Georgia republic).

2. RESEARCH MATERIAL

Data from 210 individuals have been studied and analyzed in our research. Most of the studied individuals (55%) were females (n = 116), the remaining 94 were males, accordingly. In our study, only volunteers have participated. The age ranges of volunteers were between 12-24 years. Data collection was performed with the participation of pupils of "Batumi Future School Ltd" and the students of Batumi Shota Rustaveli State University (BSU). Prior to data collection, volunteers were provided with proper research information in advance. They were informed of the purpose and objectives of the scientific research and substantiated their written consent for participation in the study (involvement of the volunteers below ≤18 have been done with the consent of their parents). Research materials were collected in the time interval from March 10th to May 15th in 2021. The research has been duly approved by the research ethics committee from the Batumi Shota Rustaveli State University (BSU).

Inclusion criteria

For conducting the proper and reliable study we defined some criteria for participation in the current study. The major accent was focused on high and secondary school students, aged 12-14. The most important criteria for participation were undamaged finger relief. The person who belonged to the so-called category of "difficult fingers", could not participate in the current research.

Research methods

The volunteers involved in the study went through the interview phase in the first stage. The interview questionnaire was informative and was included: Name, surname; address; date of birth; contact information; school / faculty / course; assessment category / GPA; blood type ABO / Rh; type of diet and etc. After the interview, the fingerprint pattern was taken. We used the classical method to take the image of the fingerprint pattern as the methodology of our research.
During the research, so-called "pencil technique" have been used to take and determine the specificity of the fingerprints. The following materials: 1. 2B pencil; 2. White sheet of paper A4; 3. Adhesive tape; and 4. magnifying glass were used for research implementatoin, respectively (Figure 1).
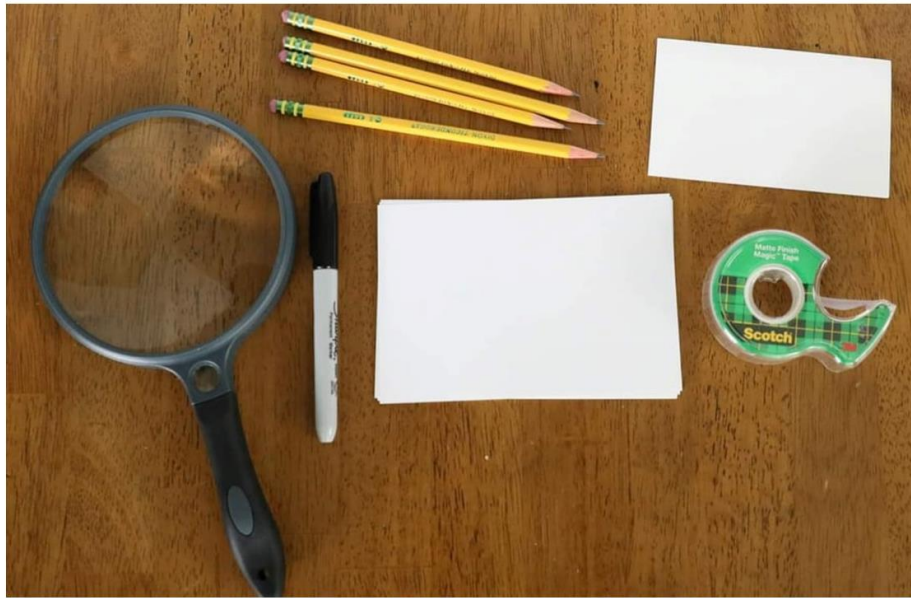
Figure 1. Required materials for Fingerprinting.

The method includes the following steps (Figure 2.):

1. Drawing a square-shaped figure on the paper A4 by 2B pencils. Repeating the process several times to be sure for proper fingerprint taking (1);
2. Convincing in the cleanness of the volunteers' fingers (2);
3. Moving finger several times within the square-shaped figure on the A4 paper (3);
4. After removing the finger (4), carefully sticking the adhesive tape on the finger and fixing it (5);
5. After fixing the fingerprint, applying the adhesive tape on the sheet (6).
6. Repeating the process for all ten fingers.
7. Convincing in the good quality image of fingerprint were obtained. Otherwise several repetition procedures were required until the obtaining desirable results.
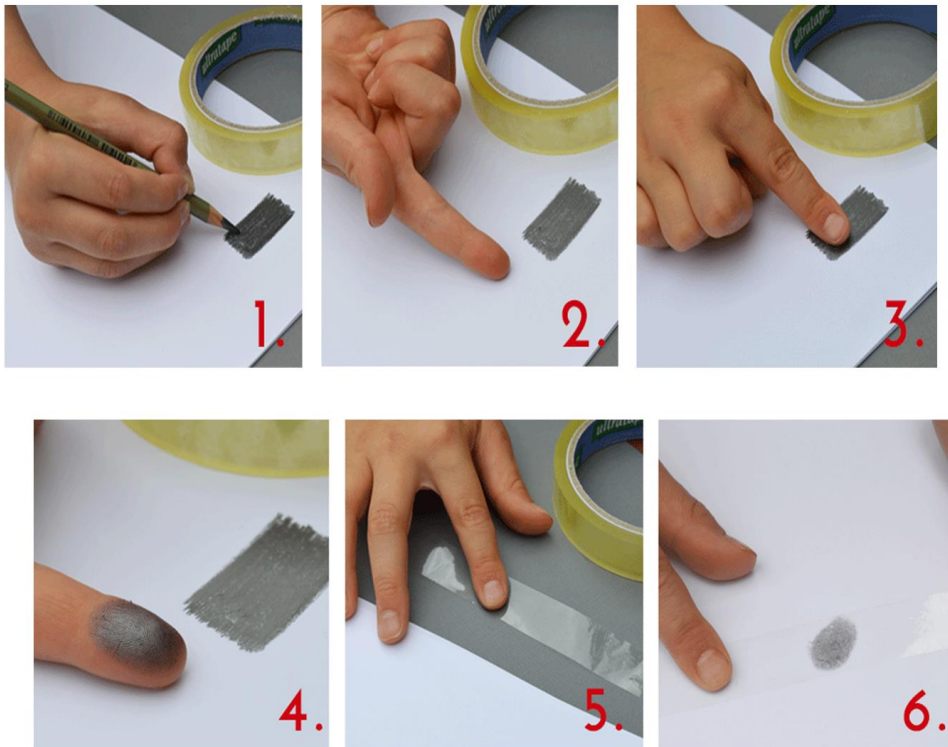
Figure 2. Stages of the fingerprinting method

8. For the last stage, inspecting and studying the fingerprints pattern, using a magnifying glass were conducted. The magnification of the glass was 3X. By observing and inspecting carefully the outlines of each fingerprint, categorization has been done, accordingly (Figure 3).
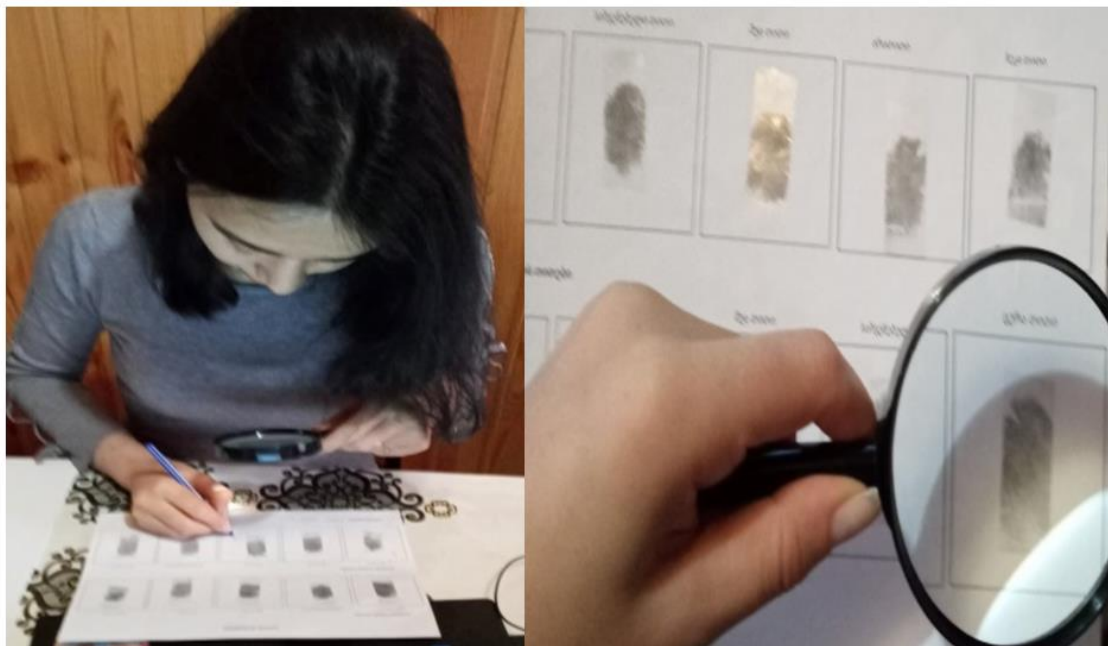

Figure 3.Categorizing the fingerprint by using a magnifying glass

Figure 4. Variety of fingerprint patterns.

3. RESULTS

For one of the purposes of our study, the data has been processed according to all ten fingers (n = 2100), categorized and the frequency of distribution of each fingerprint was determined. In this particular part, the data were analysed regardless the gender: The Loop type fingerprint was revealed in 58.29 ± 1.08% of cases(n=1224); Whorl type fingerprint was revealed in 32.9±1.03%(n=691) of studied individuals,while, Arched type was in 8.33±0.60% (n=175) and only 10 cases shown Composite type of fingerprint, which equals 0.48±0.15% of whole studied cohort (Table 2) (Figure 5). The chi-square statistic is 1723. This statistic means that fingerprint type is not equally distributed in the studied cohort, respectively. The p-value is .0001. The result is significant at p<.05.

Table №1. Peculiarities Features of distribution of fingerprint patterns (according to all ten fingers).

Fingerprint type	$\sum$	%	$\chi2$ (d.f.=3)	CV
Loop	1224	58.29±1.08	1723	7,8
Whorl	691	32.9±1.03		
Arched	175	8.33±0.6		
Composite	10	0.48±0.15		
Total	2100	100		

*The chi-square statistic is 1723. The p-value is .0001. The result is significant at p<.05.
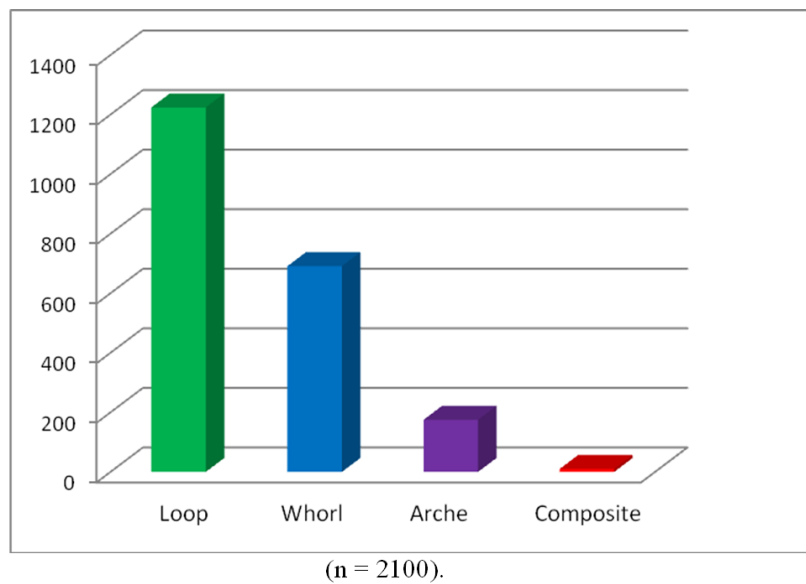
(n = 2100).

Figure 5. Frequency of fingerprint types in the study cohort (n = 2100).

The above-mentioned information has been analyzed by considering the specific characteristics of all ten fingers. As it is well known, the fingerprint patterns of the different fingers of the same individual are not the same, in many cases. Thus, the sample of fingerprint pattern of each finger was considered as a separate sample. Accordingly, the obtained data were analyzed by considering all ten-finger samples of 210 studying individuals as 2100 individual cases (n=2100). A similar approach has been used in the works of some authors[17], although there are different approaches when the authors are focused only on the right hand's thumb's fingerprint patterns [18]. We categorized the fingerprint patterns according to the right thumb as well (Table 2).

Based on the obtained data, 49.52% of the total number of studied individuals (n = 104) has revealed the Loop fingerprint pattern. Slightly lower (45.24%) distribution has revealed the Whorl pattern (n = 95) fingerprint and only 4.29% of studied individuals has shown Arched fingerprint pattern (n=9). The rarest form was the Composite fingerprint pattern similarly to primarily obtained results for all ten fingers. The only two people in the study population has revealed a Composite fingerprint pattern (0.95%) ($\chi2$ =106.7475).

Table №2. Peculiarities Features of distribution of fingerprint patterns (according to the right hand thumb).

Fingerprint type	$\sum$	%	$\chi2$ (d.f.=3)	CV
Loop	104	49.52	106.7475	7,8
Whorl	95	45.24		
Arched	9	4.29		
Composite	2	0.95		
Total	210	100		

* p-value არის<0.00001; p<.05.

We were interested to analyze the prevalence of fingerprint patterns among all ten fingers, as well. We have identified the fingerprint patterns on the thumb, index, middle, ring, and little

fingers' relief for right and left hands. As it is shown from the figure below (Figure 5) for almost all fingers dominantly expresses the Loop fingerprint pattern, except for the right index and the right ring fingers. Most of the cases for both the right as left little fingers had a Loop fingerprint pattern. The left little fingers in 168/210 cases had this specific Loop relief, while for the right little fingers Loop type number was 155/210 (Figure 5). After the Loop fingerprint pattern the Whorl type (47/210 and 36/210) was followed. Very few cases were expressed Arched fingerprint pattern as in right as the left little fingers (8/210 and 6/210). The Composite type is not found for right and left little fingers in our studied individuals.

The right thumb morphological characteristics have been analyzed (Table2). The left thumb has also shown the same prevalence patterns of distribution as before: Loop >Whorl> Arched >Composite (125/210, 71/210, 8/210, 6/210) (Figure 5).

The right thumb morphological characteristics were analyzed above (Table2). The left thumb also showed the following prevalence pattern: Loop > Whorl > Arched > Composite (125/210, 71/210, 8/210, 6/210) (Figure 6).
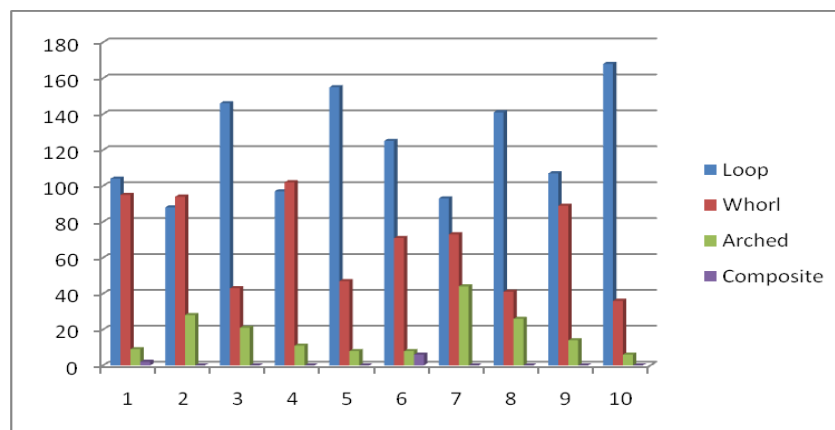

Figure 6. Categories of all ten fingerprints' images.

* Each number in the given picture corresponds to the name of a specific finger, namely: 1-Right thumb, 2-Right index finger, 3-Right middle finger, 4-Right ring finger, 5-Right little finger, 6-Left thumb, 7-left index finger, 8-left middle finger, 9-left ring finger, 10-left little finger.

The Right and left index fingers have shown different prevalence models. For the left index finger this model is Loop >Whorl>Arched (93/210, 73/210, 44/210), but for the right index finger prevalence model slightly changed: Whorl>Loop>Arched (88/210, 94/210, 28/210). The right and left ring fingers have also shown different prevalence characteristics, respectively. For the right ring finger, the high distribution feature had the Whorl fingerprint model (102/210), after was the Loop image (97/210). The Arched type fingerprint pattern had appeared only in 11 cases. The prevalence model of the left ring finger was Loop > Whorl > Arched (107/210, 89/210, 14/210). The composite type is not present for right and left ring finger cases, as well.

The right and left middle finger's fingerprint model is similar (Loop >Whorl> Arched), and also quantitative characteristics of the cases were the same. For the right, the middle finger's quantitative characteristics were 146/210 - Loop, 43/210 - Whorl, 21/210 - Arched, and for the left middle finger 141/210 - Loop, 41/210 - Whorl, 26/210 - Arched. The Composite type was also not presented within the middle finger type (Figure 6).

We tried to analyze the gender characteristic issue in our study. The obtained result was significant at p<.05. As it is shown from the table below (Table 3) the Arched and Composite type of fingerprint is equally distributed in males and females. The prevalence of Loop and Whorl categories of fingerprint patterns in females and males were slightly different from each other. 59.5±2% of the females have a Loop fingerprint image, while this category slightly less (56.8±2.6%) distributed in males. Whorl fingerprint pattern is 1.15 more times distributed in males (35.53±2.4%) than in females (30.8±1.8%). The chi-square statistic equals 10.3366. The p-value is .015911.

We have also categorized fingerprints according to the right-hand thumb (n=210). The right-hand thumb fingerprint pattern has not shown any association with gender. All fingerprint categories had equally the same distribution characteristics (Table 4).

Table 3. Peculiarities Features of distribution of fingerprint patterns in the females and males (according to all ten fingers).

Fingerprint type	Female		Male		χ^2 (d.f.=3)	CV
	$\sum$	%	$\sum$	%		
Loop	690	59.5±2	534	56.8±2.6	10.3366.	7,8
Whorl	357	30.8±1.8	334	35.53±2.4		
Arched	104	8.96±0.7	71	7.55±0.7		
Composite	9	0.8±0.06	1	0.1±0.01		
Total	1160	100	940	100		

*The chi-square statistic is 10.3366. The p-value is .015911. The result is significant at p<.05.

Table № 4. Peculiarities Features of distribution of fingerprint patterns in the females and males (according to the right-hand thumb).

№	Fingerprint type	Female		Male		$\sum$			
		$\sum$	%	$\sum$	%	$\sum$	%	χ^2, (d.f. = 3)	CV
1	Loop	56	48.27	48	51.06	210	100	0.7184	7,8
2	Whorl	52	44.82	43	45.74				
3	Arched	6	5.17	3	3.19				
4	Composite	2	1.7	0	0				
5	Total	116	100	94	100				

*The chi-square statistic is 0.7184. The p-value is .868863. The result is not significant at p < .05.

In this case, the χ^2 is 0.7184, which is less than the critical value (CV) of the criterion of the degree of freedom (d.f. = 3), which is equal to 7.8. In this case, the value of χ2 is not useful for rejecting the null hypothesis (E = 0). Based on this data we can conclude that fingerprint patterns are not related to gender.

According to our study, 48.3 ± 4.63% of females had a Loop fingerprint, 44.8 ± 4.61% had a Whorl finger, 5.2 ± 2.06% had an Arched finger, and the smallest number of composite fingerprint were presented only in 1.7 ± 1.20% of the total cohort, respectively.

We have been analyzed females' and males' fingerprint pattern based on all, right and left fingers (thumb, index, middle, ring and little), as well. In the females the right middle finger fingerprint patterns are distributed as follows: 72.4±4.15% had a Loop fingerprint, 18.1±3.57% had a Whorl model of the fingerprint. The rest of the female cases (9.5±2.72%) had an Arched fingerprint phenotype. The Composite fingerprint pattern was not observed on the right middle finger case in the females, accordingly (Table 5).

Right ring finger relief in the majority of female cases (50,0±4.64%) had a loop pattern 44,0±4.60% case it was detected Whorl model of the fingerprint. The Composite type of fingerprint was not present on this finger in the studied females.

Table №5. Categorize fingerprints according to all ten fingers in the female

	Finger type	Fingerprint pattern in females ($\sum$/%)								Total		χ^2, (d.f. = 27)	CV
		Loop		Whorl		Arched		Composite					
		$\sum$	%	$\sum$	%	$\sum$	%	$\sum$	%	$\sum$	%		
Right hand	Thumb	56	48,3±4.63	52	44,8±4.61	6	5,2±2.06	2	1,7±1.20	116	100	174.69	67.5
	Index	58	50,0±4.64	43	37,1±4.48	15	12,9±3.11	0	-	116	100		
	Middle	84	72,4±4.15	21	18,1±3.57	11	9,5±2.72	0	-	116	100		
	Ring	58	50,0±4.64	51	44,0±4.60	7	6,0±2.20	0	-	116	100		
	Little	88	75,9±3.97	22	19,0±3.64	6	5,2±2.06	0	-	116	100		
Left hand	Thumb	69	59,5±4.55	37	31,9±4.32	4	3,4±1.68	6	5,2±2.06	116	100		
	Index	47	40,5±4.55	39	33,6±4.38	30	25,9±4.06	0	-	116	100		
	Middle	75	64,7±4.43	25	21,6±3.82	15	12,9±3.11	1	0,9±0.9	116	100		
	Ring	58	50,0±4.64	50	43,1±4.59	8	6,9±2.35	0	-	116	100		
	Little	97	83,6±3.43	17	14,7±3.28	2	1,7±1.20	0	-	116	100		

The p-value is .00001. The result is significant at p < .05.

75,9±3.97% of females have revealed Loop fingerprint model on the right little finger. 19,00±3.64% of studied females had Whorl fingerprint specificity. Only 5,2±2.06% of female cases have revealed the Arched phenotype on the right little finger, and the Composite fingerprint model was not absolutely presented for this type of finger in the studied females (Table 5).

According to the study materials, 59.5±4.55% of females revealed the Loop fingerprint model on the left index finger. In 31.9±4.32% of the females fixed Whorl fingerprint phenotype and 3.4±1.68 has shown Arched fingerprint morphological characteristics. The fewer number of the studied females (5.2±2.06%) on the left index finger has presented the Composite fingerprint model. The majority of females cases (40,5±4.55%) had a Loop fingerprint model on the left index finger. 33,6±4.38% had a Whorl fingerprint pattern. The Arched fingerprint phenotype characteristics are showed in 25,9±4.06% cases.

64,7±4.43% of studied females on the left middle finger revealed a Loop fingerprint pattern 21,6±3.82% - Whorl, 12,9±3.11% - Arched. The Composite type fingerprint was distributed only in 0,9±0.9% cases. The studied females 50,0±4.64% on the left ring finger had a Loop fingerprint pattern. 43,1±4.59% had - Whorl, 6 9±2.35% - Arched fingerprint character. The Composite fingerprint pattern was not present on the left ring finger case in the studied females.

The quantitative distribution of the left little finger' fingerprint model was as follows: 83.6±3.43% of the studying females had Loop fingerprint model, 14.7±3.28% of females had The Whorl phenotype, very fewer cases of the studied females have presented the Arched fingerprint model (Table 5). The left little finger's fingerprint pattern was distributed so: quite high in amount with 83,6±3.43% of the studied females have revealed Loop and 14,7±3.28% Whorls fingerprint pattern, while very less distributed was Arched fingerprint pattern (Table 5).

We can summarize, that in the studied female's Loop fingerprint pattern more cases are appeared on the left and right hand's Middle and little finger, Whorl are more frequently presented on the thump and ring finger. The arched fingerprint pattern has more characteristics for the index finger (Table 5).

In this case, a rather high number of $\chi 2$ criteria were observed, indicating a relationship between qualitative variables. In this particular case, the value of $\chi 2$ is quite effective for rejecting the null hypothesis (E = 0). The value of $\chi 2$ is equal to 174.69, which is much higher than the critical value (CV) of the criterion of the degree of freedom (d.f. = 27), which is equal to 67.50.

According to our study, 51.06±4.64% of males had a Loop fingerprint on the right-hand thumb. 45.74±4.62% had a Whorl fingerprint, 3.19±1.63% had the arched model and the Composite fingerprint was absolutely not fixed. The right index finger's fingerprint pattern in the males was so: 31.91±4.32% had a Loop; 54.26±4.62% - Whorl; 13.83±3.2% had an Arched fingerprint. The Composite fingerprint was not observed on the right index finger in the studied males (Table 6). The right middle finger in the males 65,96±4.39% cases revealed Loop, 23,40±3.93% - Whorl; 10,64±2.86% - Arched fingerprint pattern. A composite fingerprint is not observed in these finger cases in the studied male, respectively. 41,49±4.57% of the studied males have shown Loop fingerprint on the right ring finger, 54,26±4.62% - Whorl and 4,26±1.87% - arched pattern. Regarding the fingerprint pattern on the right little finger the quantitative characteristic has shown the following results: 71.28 ± 4.20% of males has revealed the Loop fingerprint pattern on the right little finger, 26.60 ± 4.10% had a Whorl, 2.13 ± 1.34% had an Arched fingerprint pattern, and 0.0% Composite pattern as in the majority of the cases in our studied cohort.

Quantitative differentiation of left-hand fingers was as follows: 59.47±4.55% of males had Loop fingerprint, 35.17±4.46% had Whorl fingerprint, 4.26±1.87% - Arched. The composite fingerprint of the left index finger was not observed in males (Table 6).

According to the left index finger, the data in males were distributed as follows: 48.94±4.64% shown the Loop fingerprints; 36.17±4.46% had the Whorl fingerprint. 14.89±3.30% had an Arched fingerprint. The composite fingerprint category, like the right-hand index finger, was not observed in any male individuals.

70.21±4.24% of the studying males on the left middle finger was revealed the Loop fingerprint, 17.02±3.48% - the Whorl fingerprint, 11.7±2.98% - Arched fingerprint, and 1.06±0.95% of the studying males had the composite fingerprint on the left middle finger. 52.12±4.63% of the studied males had a Loop fingerprint on the left-hand ring finger, 41.49±4.57% had Whorl fingerprint, 6.38±2.26% had Arched model. The composite fingerprint has absolutely not been presented.

Table№6. Categorizing of fingerprints in males according to all ten fingers.

The p-value is .00001. The result is significant at p < .05.

	Finger type	Fingerprint pattern in females (∑/%)								Total			
		Loop		Whorl		Arched		Composite				χ^2, (d.f. = 27)	C V
		∑	%	∑	%	∑	%	∑	%	∑	%		
Right	Thumb	48	51,06±4.64	43	45,74±4.62	3	3,19±1.63	0	-	94	100,0		
	Index	30	31,91±4.32	51	54,26±4.62	13	13,83±3.20	0	-	94	100,0		
	Middle	62	65,96±4.39	22	23,40±3.93	10	10,64±2.86	0	-	94	100,0		
	Ring	39	41,49±4.57	51	54,26±4.62	4	4,26±1.87	0	-	94	100,0		
	Little	67	71,28±4.20	25	26,60±4.10	2	2,13±1.34	0	-	94	100,0	107.56	67,5
Left	Thumb	56	59,57±4.55	34	36,17±4.46	4	4,26±1.87	0	-	94	100,0		
	Index	46	48,94±4.64	34	36,17±4.46	14	14,89±3.30	0	-	94	100,0		
	Middle	66	70,21±4.24	16	17,02±3.48	11	11,70±2.98	1	1,06±0.95	94	100,0		
	Ring	49	52,13±4.63	39	41,49±4.57	6	6,38±2.26	0	-	94	100,0		
	Little	71	75,53±3.99	19	20,21±3.72	4	4,26±1.87	0	-	94	100,0		

77.53±3.99% of the males have shown a Loop fingerprint pattern on the left little finger. 20,21±3.72% - Whorl and 4,26±1.87 – Arched. The composite was not revealed in our cohort, respectively (Table 6).

We may summarize, that in the studied males' Loop fingerprint pattern in the majority of cases have appeared on the left and right hands' Middle and little finger, Whorl are more frequently presented on the thumb, index, and ring fingers. The arched fingerprint pattern has more characterized in the index and middle finger for both hands (Table 6).

4. DISCUSSION

Numerous studies have been conducted to find out which category of the fingerprint is more common in the different cohorts in various populations. Studies conducted by several authors have shown that Loop fingerprint types are spread in the vast majority of the studied populations. Our results coincide to other scientific studies [17] [19] [13], as well. Hansi D. and coauthors have been studied the Indian population fingerprint patterns. The study was conducted on 536 subjects. All the ten fingers were analyzed by the authors. The most common pattern in the above-mentioned study was the Loop fingerprint, especially the Ulnar loop. The 51.3 % of studied samples were carried on this particular phenotype characteristic features. The authors did not find any significant difference between males and females based on the distribution of fingerprint patterns [20], as well.

Iju Shrestha1 and Banshi Krishna Malla were made a study in the population of Duwakot VDC, Bhaktapur. They have studied 196 individuals (age range 18 – 60) in total with all ten fingers' fingerprint distribution patterns and they have been analyzing gender differences at the same time. In our research fingerprint distribution model was like so: Loop >Whorl> Arches >Composite. But the above-mentioned authors researched data showed that the highest frequency of studied samples had Loop fingerprint pattern, whorls and arches equally are distributed. 15.28% of the authors studied samples had a composite pattern [14], but in our study, the composite fingerprint model was revealed in less and only 0.48±0.15 of samples had this phenotype characteristic.

Sudikshya KC and coauthors have studied the Fingerprint Pattern in Nepalese. The authors study 300 Nepalese fingerprint patterns. The authors have shown that the majority of cases within the studied individuals (51.76%) had a Loop fingerprint model. The Whorls fingerprint model was fixed in 42.77% of the studied samples. The Arches fingerprint distribution characteristic had 5.47% of studied samples [13]. The currently mentioned study is slightly similar to our study. The distribution pattern, in this case, is the same as in our study: Loop >Whorl> Arches, But the frequency of each fingerprint pattern is different.

Similar to our study Smriti Ramdas and coauthors made a cross-sectional descriptive study in the students. The study was conducted among 200 dental students. The authors have found out, that Loops were the most common fingerprint pattern among the studied students. 62.5% of studied samples had the Loops fingerprint pattern, 29% of the studied students had whorl phenotype and 8.5% of samples had arch fingerprint pattern [14]. The above-mentioned authors have also studied the correlation of dactyloscopy with blood groups.

5. CONCLUSION

The fingerprint distribution model is Loop > Whorl > Arches > Composite in our study cohort. The dominant fingerprint phenotype pattern in our cohort was Loop, which was revealed in 58.29 ± 1.08% of cases; As for Whorl type fingerprint, was revealed in 32.9±1.03% of studied individuals, while, Arched type was in 8.33±0.60% cases. The fewest cases with 0.48±0.15% of the whole studied cohort revealed the Composite model. Based on our obtained data we can conclude that fingerprint patterns are not related to gender.

For our further study, we are planning to analyze the correlation of fingerprint pattern ABO and Rh blood group and the academic level of the students.

REFERENCE

[1]   X. Tao, X. Chen, X. Yang, and J. Tian, "Fingerprint Recognition with Identical Twin Fingerprints," *PLoS ONE*, vol. 7, no. 4, p. e35704, Apr. 2012, doi: 10.1371/journal.pone.0035704.

[2]   V. I. Syryamkim, D. N. Kuznetsov, and A. S. Kuznetsova, "Biometric identification," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 363, p. 012005, May 2018, doi: 10.1088/1757-899X/363/1/012005.

[3]   M. Kücken and A. C. Newell, "A model for fingerprint formation," *Europhys. Lett. EPL*, vol. 68, no. 1, pp. 141–146, Oct. 2004, doi: 10.1209/epl/i2004-10161-2.

[4]   K. Wertheim, "EMBRYOLOGY AND MORPHOLOGY OF FRICTION RIDGE SKIN," p. 26.

[5]   A. Lh and T. Mg, "Embryogenesis and Applications of Fingerprints- a review," *Int. J. Hum. Anat.*, vol. 1, no. 1, pp. 1–8, Jun. 2017, doi: 10.14302/issn.2577-2279.ijha-17-1539.

[6]   A. K. Jain, S. Prabhakar, and S. Pankanti, "On the similarity of identical twin fingerprints," *Pattern Recognit.*, vol. 35, no. 11, pp. 2653–2663, Nov. 2002, doi: 10.1016/S0031-3203(01)00218-7.

[7]   A. W.-K. Kong, D. Zhang, and G. Lu, "A study of identical twins' palmprints for personal verification," *Pattern Recognit.*, vol. 39, no. 11, pp. 2149–2156, Nov. 2006, doi: 10.1016/j.patcog.2006.04.035.

[8]   "Influence of Skin Diseases on Fingerprint Quality and Recognition | IntechOpen." https://www.intechopen.com/chapters/39012 (accessed Sep. 09, 2021).

[9]   R. J. Meier, "Anthropological dermatoglyphics: A review," *Am. J. Phys. Anthropol.*, vol. 23, no. S1, pp. 147–178, 1980, doi: 10.1002/ajpa.1330230509.

[10]   A. L. Chukwuma, "Gender Prediction from the Primary Fingerprint Pattern: A Study among Medical Students in Ambrose Alli University, Ekpoma," *Biomed. J. Sci. Tech. Res.*, vol. 29, no. 1, Jul. 2020, doi: 10.26717/BJSTR.2020.29.004739.

[11]   H. Cummins and C. Midlo, "Palmar and plantar epidermal ridge configurations (dermatoglyphics) in European-Americans," *Am. J. Phys. Anthropol.*, vol. 9, no. 4, pp. 471–502, Oct. 1926, doi: 10.1002/ajpa.1330090422.

[12]   H. Cummins and C. Midlo, "Palmar and plantar epidermal ridge configurations (dermatoglyphics) in European-Americans," *Am. J. Phys. Anthropol.*, vol. 9, no. 4, pp. 471–502, Oct. 1926, doi: 10.1002/ajpa.1330090422.

[13]   S. Kc, N. Maharjan, N. Adhikari, and P. Shrestha, "Qualitative Analysis of Primary Fingerprint Pattern in Different Blood Group and Gender in Nepalese," *Anat. Res. Int.*, vol. 2018, pp. 1–7, Jan. 2018, doi: 10.1155/2018/2848974.

[14]   S. Ramdas *et al.*, "Correlation and comparison of dactyloscopy and palatoscopy with blood groups among dental students from Western Maharashtra," *Med. J. Dr Patil Vidyapeeth*, vol. 12, no. 2, p. 111, 2019, doi: 10.4103/mjdrdypu.mjdrdypu_65_18.

[15]   P. Gnanasivam and R. Vijayarajan, "Gender classification from fingerprint ridge count and fingertip size using optimal score assignment," *Complex Intell. Syst.*, vol. 5, no. 3, pp. 343–352, Oct. 2019, doi: 10.1007/s40747-019-0099-y.

[16]   M. Verma and S. Agarwal, "Fingerprint Based Male-Female Classification," in *Proceedings of the International Workshop on Computational Intelligence in Security for Information Systems CISIS'08*, vol. 53, E. Corchado, R. Zunino, P. Gastaldo, and Á. Herrero, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2009, pp. 251–257. doi: 10.1007/978-3-540-88181-0_32.

[17] I. Shrestha and B. K. Malla, "Study of Fingerprint Patterns in Population of a Community," *J. Nepal Med. Assoc.*, vol. 57, no. 219, Oct. 2019, doi: 10.31729/jnma.4621.

[18] K. Mandrah and N. K. Kanwal, "A Preliminary Study on Assertion of Hand from Whorl Pattern on Thumb," *J. Med. Toxicol. Clin. Forensic Med.*, 2015, doi: 10.21767/2471-9641.100012.

[19] N. M. Sam, P. Rema, and V. B. Nair, "Study of Fingerprint Patterns in South Indian Population," *J. Indian Acad. Forensic Med.*, vol. 37, no. 4, p. 369, 2015, doi: 10.5958/0974-0848.2015.00096.2.

[20] H. D. Bansal, A. D. Badiye, and N. S. Kapoor, "Distribution of Fingerprint Patterns in an Indian Population," p. 4, 2014.