DISTRIBUTION OF FINGERPRINTS PATTERNS AMONG A COHORT OF POPULATION IN OUAGADOUGOU, BURKINA FASO

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ABSTRACT: Based on their strictly individual and immutable characters, fingerprints are indispensable tool for person's identification. In forensic science, digital pattern families constitute the first level of comparison between an incriminated digital trace and a suspect fingerprint. Until now in the literature, there was no data on the distribution of fingerprints families in Burkina Faso. So, the present study was a descriptive study whose purpose was to provide information on fingerprint patterns distribution in 1500 citizens in Burkina Faso. The results showed that Loops were the most represented with 75.44 % followed by Whorls (17.31%) and Arches (7.23%). These results corroborate with what was previously established and showed that Loops are actually the most predominant fingerprints forms. The Pattern index intensity was higher in males (5.62) than in females (5.53). But Furuhata's Index was higher in females (29.83) than in males (19.72). The same trend was obtained with Dankmeijer's Index which was higher in females (48.26) than in males (30.19). The present study will have to be deepened by subsequent studies to enrich the scientific literature with more data on fingerprints in Burkina Faso.

Keywords: Fingerprints, patterns, loops, whorls, arches, identification, pattern indices.

Introduction

Dermatoglyphic plays an important part in personal identification. This science is in perpetual development and has three fundamental principles which make it very reliable. Dermatoglyphic patterns are fastness, individualistic and do not change throughout life [1]. These digital ridges appear from the 17th week of pregnancy and finish their morphogenesis at the 25th week. From this moment, they retain their definitive morphology until the putrefaction of the skin [1]. The importance of fingerprints has been known since the Babylonian period (-2200 to -625), as evidenced by the thousands of tablets found in ancient Mesopotamia, now in Iraqi territory [2].

Fingerprints are impressions of papillary drawings on a surface. There are two types of fingerprints: inked fingerprints and fingerprints found on a crime scene. During the crime scenes investigations, most of the fingerprints found are partial and are not visible to the naked eye. They are thus qualified as latent traces. These latent fingerprints result from a deposit of sweat, amino acids and fat present on the surface of the fingers [3-5]. Many techniques are then used to reveal them and collect them for fingerprint identification purposes. These techniques are based on chemical, physical or physicochemical principles that highlight interactions with the aqueous, protein or fat components of the fingerprint [6].

Fingerprints are grouped within three great families: the Loops, the Arches and the Whorls. In forensic identification, the knowledge of fingerprint pattern frequencies has little value. The general form of the digital drawings is only the first level of comparison in the process of identification by fingerprints. Other minute details are taken into account for a formal identification. Many publications on fingerprints have also been done in many countries [7-10]. These publications have shown the distribution of the three fingerprints patterns families in some populations. But in Burkina Faso, a West African country, there are particularly no such publications because fingerprint data is personal, confidential and unpublished information. So, no data on fingerprints exists in the scientific literature. The present study is therefore a first of its kind and aims to provide useful information on the distribution of fingerprints families in a cohort of citizens in Burkina Faso.

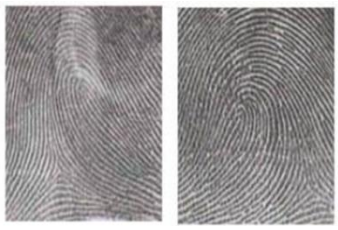
Material and method

This study was carried out in the Department of Forensic Laboratories of Ouagadougou, Burkina Faso, from January 2017 to December 2017 \on

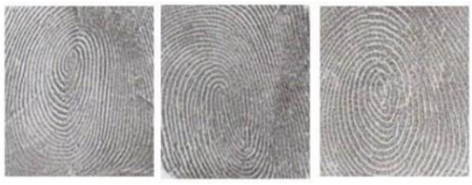
1500 subjects including 750 males and 750 females. The inclusion criteria in this study were that the candidates must not have any physical deformity on the ten fingers, and gave informed consent. Only digital drawings with no deformation are kept for this study. Prior approval of Institutional Ethical Committee was obtained for this study.

For each subject, after washing and cleaning their hands to remove dirt and dust, fingerprints were taken using the inking technique. The ten fingers were alternately rolled at the level of the third phalanx in specific ink spread on a glass plate. The digital drawings of the fingers were then printed on a ten-print card. Each inked finger was affixed to the corresponding box on the card. The fingerprints thus obtained were collected and analyzed according to their general form. For the family of Arches, we have distinguished plain Arches and tent-shaped arches (Figure 1).

(a) Arches



(b) Loops



(c) Whorls

Figure 1: The three fingerprint families.

Fingerprints patterns indices were calculated to better assess the distribution of fingerprints families among our cohort. Pattern Intensity Index (PII) was calculated by (2 x % Whorls + % loops) /2 [11,12]. Furuhata's Index (FI) was calculated as the frequency of Whorls divided by the frequency of Loops multiplied by 100. Dankmeijer's Index (DI) was determined according to the following formula: (% Arches/ % Whorls) x 100 [13].

Collected data was captured and analyzed with IBM SPSS statistic 20 software. Chi square test was performed and differences were significant if p value <0.05.

Results

The subjects were between 18 and 73 years old with a mean age of 32.89 ± 0.3 years and all of them had usable fingerprints for the purposes of the present study.

All the digital patterns form was found in all digits with different frequencies. Our results (Table 1) have shown a high frequency of Loops (75.44%) followed by the Whorls (17.31%) and the Arches (6.8%). The highest percentage of Loops was found on the little fingers and in majority on the left little finger (89.47%). The frequency of tented Arches was globally extremely weak (0.43%) and no such patterns were found on the thumb, the forefinger and the major of the right hand (Table 2).

According to gender, the percentage of Loops patterns was 40.3% in males and 34.66% in females. However, more Whorls were observed in females (10.34%) than in males (7.35%). The Arches represented 2.04% in males and 4.99% in females. There was no significant difference regarding the distribution by gender of fingerprint patterns on each finger ($p < 0.05$), except on the left little finger, where there was a significant difference between males and females (Table 3). Pattern Index Intensity in our study population was globally 11. In males, the Pattern index intensity was higher (5.62) than in females (5.53). But Furuhata's Index was higher in females (29.83) than in males (19.72). The same result was obtained with Dankmeijer's Index which was higher in females (48.26) than in males (30.19).

Discussion

During an investigation on a crime scene, forensic technicians will look for traces and clues to identify the culprit. For that, it is advisable to find the fingerprints or the papillary traces left on the place of the crime and on the various objects. Dactyloscopy is therefore an indispensable tool for the identification of individuals [14,15].

Table 1: Distribution of digital drawings on each type of finger of each hand, with both hands and on all ten fingers.

Fingers		Frequencies	Plain Arches	%	Tented arches	%	Arches	%	Loops	%	Whorls	%
Thumb	left	1500	157	10.47	4	**0.27**	161	10.73	1021	68.07	318	21.2
	right	1500	173	11.53	0	**0**	173	11.53	882	58.8	445	29.67
	left+right	3000	330	11	4	0.13	334	11.33	1903	63.43	763	25.43
Forefinger	left	1500	147	9.8	7	0.47	154	10.27	995	66.33	351	23.4
	right	1500	149	9.93	0	0	149	9.33	973	64.87	375	25
	left+right	3000	296	9.87	7	0.23	303	10.1	1968	65.6	726	24.2
Major	left	1500	102	6.8	15	1	117	7.8	1193	79.53	190	12.67
	right	1500	137	9.13	0	0	137	9.13	1149	76.6	214	14.27
	left+right	3000	239	7.97	15	0.5	254	8.47	2342	78.07	404	26.93
Ring finger	left	1500	42	2.8	14	0.93	56	3.73	1267	84.47	177	11.8
	right	1500	59	3.93	8	0.53	67	4.47	1195	79.67	238	15.87
	left+right	3000	101	3.37	22	0.73	123	4.1	2462	82.07	415	13.83
Little finger	left	1500	24	1.6	4	0.27	28	1.87	1342	89.47	130	8.67
	right	1500	30	2	12	0.8	42	2.8	1299	86.6	159	10.6
	left+right	3000	54	1.8	16	0.53	70	2.33	2641	**88.03**	289	9.63
All fingers	left	7500	472	6.29	44	0.59	516	6.88	5818	77.57	1166	15.55
	right	7500	548	7.31	20	0.27	568	37.87	5498	73.31	1431	19.8
	left+right	15000	1020	6.8	64	**0.43**	1084	**7.23**	11316	**75.44**	2597	**17.31**

Table 2: Distribution of fingerprints pattern according to gender.

Fingers	Fingerprints patterns	Gender and frequencies					
		Male	n	Frequencies (%)	Female	n	Frequencies (%)
Thumb	Plain Arches	63	3000	2.1	267	3000	8.9
	Tented arches	2	3000	0.7	2	3000	0.7
	Arches•	65	3000	2.17	269	3000	8.97
	Loops	1163	3000	**38.76**	740	3000	**24.67**
	Whorls	272	3000	9.06	491	3000	16.37
Forefinger	Plain Arches	85	3000	2.83	211	3000	7.03
	Tented arches	7	3000	0.23	0	3000	0
	Arches•	92	3000	3.07	211	3000	7.03
	Loops	1066	3000	**35.53**	905	3000	**30.17**
	Whorls	342	3000	11.4	384	3000	12.8
Major	Plain Arches	86	3000	2.87	153	3000	5.1
	Tented arches	4	3000	0.13	11	3000	0.37
	Arches•	90	3000	3	164	3000	5.47
	Loops	1215	3000	40.5	1127	3000	**37.57**
	Whorls	195	3000	6.5	209	3000	6.97
Ring finger	Plain Arches	53	3000	1.77	48	3000	1.6
	Tented arches	17	3000	0.57	5	3000	0.17
	Arches•	70	3000	2.33	53	3000	1.77
	Loops	1289	3000	42.97	1173	3000	39.1
	Whorls	241	3000	8.03	274	3000	9.13
Little finger	Plain Arches	24	3000	0.8	48	3000	1.6
	Tented arches	21	3000	0.7	5	3000	0.17
	Arches•	45	3000	1.5	53	3000	1.77
	Loops	1312	3000	43.73	1254	3000	41.8
	Whorls	143	3000	4.77	193	3000	6.43
All digits	Plain Arches	311	15000	2.07	727	15000	4.85
	Tented arches	49	15000	0.33	21	15000	0.51
	Arches•	360	15000	2.4	748	15000	4.99
	Loops	6045	15000	**40.3**	5199	15000	**34.66**
	Whorls	1193	15000	7.95	1551	15000	10.34

Table 3: Pearson chi square values.

	Left Thumb	Left Forefinger	Left Major	Left Ring finger	Left Little finger	Right Thumb	Right Forefinger	Right Major	Right Ring finger	Right Little finger
Pearson chi square	<0.001	<0.001	0.006	<0.001	**0.619•**	<0.001	<0.001	0.001	<0.001	<0.001

•p>0.05: the difference was not significant

Based on the strictly individual and immutable characters of digital patterns, this science is nowadays unavoidable in crime scene investigations [16,17]. We found a high percentage of Loops followed by Whorls and Arches, respectively. Our results corroborate with the trend observed in most studies [7-10]. Indeed, in these studies, it was established a strong predominance of Loops, an intermediate prevalence of Whorls and a low frequency of Arches.

It has been shown that in the Negroid populations, the frequencies of Loops were between 50% and 60%, those of Whorls about 30% and the prevalence of Arches fluctuated between 6% and 7% [13]. But in our study, Loops frequency was 75.44% and the percentage of Whorls was 17.31%. We found that Arches represented 6.8% in our study and this value was comparable with the literature data [18]. The percentage of Loops found in this study was highest than that was established in the literature. But our results were in accordance with the fact that Loops are the most common fingerprints forms except in the populations from China where Whorls are predominant. However, the percentages of the family of Loops vary according to the type of studied population. For example, Loops accounted for 47% of Maharati population in India, 57% in a Malaysian population and 56% in a Nigerian cohort, respectively.

According to gender, the percentage of Loops was higher among males than females (40.3% vs. 30.66%). Arches were found in 2.4% of males and 4.99% of females (Figure 2). With regard to Whorls, they are also observed mainly in females than in males. These results corroborated with that was established in Ameen's study [19].

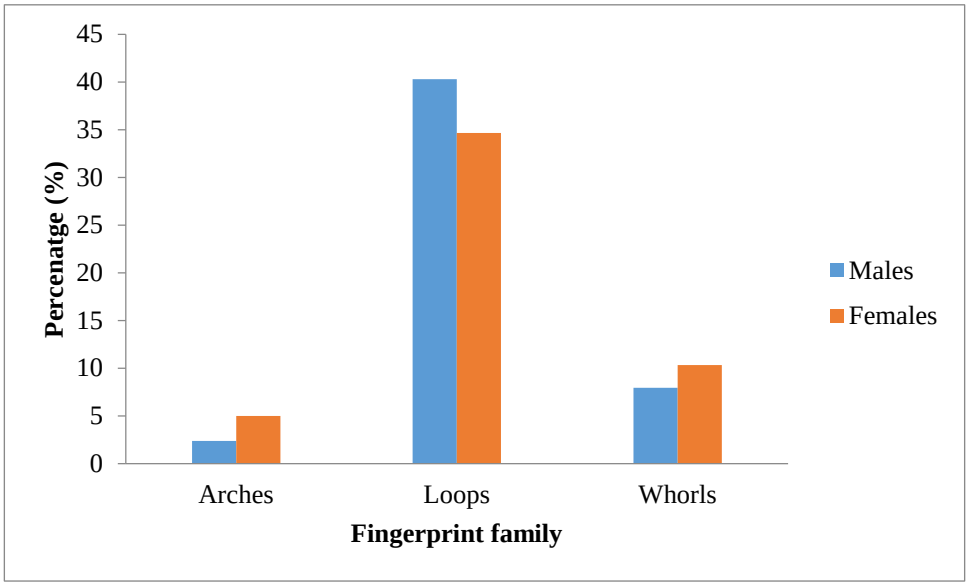


Figure 2: Distribution of fingerprints families according to gender.

As previously announced in our study, for the family of Arches, we distinguished the plain Arches and the Tented Arches forms (Figure 1). The plain Arches have the distinction to flow rather easily through the pattern with no significant changes but Tented Arches do make significant changes and do not have the same facilities like the plain Arches [20]. The percentage of plain Arches found in our study (1.8%) was highest than that found in Marathi population (1.46%) by Hansy et al.[9]. In general, previous studies have reported that the Arch pattern frequency was high in African [21] compared to Indian [22], Thai (3.2%) [23], and New Zealand (0.8%) [24] populations.

The Pattern Index Intensity (PII) found in our study population was 11. This result was comparable to that of a study made in 1963 on the geographical distribution of fingerprint Pattern Index Intensity [25]. However in our study, according to gender, PII was higher in males (5.62) than in females (5.53). This trend was found in a Sri Lankan study. But in another study in a New Zealand cohort, PII was higher in females than in males.

We found a higher Furuhata's index in female than in male. This result didn't corroborate either with that of the Sri Lankan study cited above, or with that of another study conducted in Bengal. Dankmeijer's index was also higher in females than in males in the present study. This was also observed in an Indian study. In general, the fingerprint patterns indices varied according to the studies and the types of populations studied.

Conclusion

The Loops were the predominant fingerprint patterns and represented 40.3% in males and 34.6 % in females. However in females, Whorls and Arches were the most encountered and represent respectively 10.34% and 4.99% against 7.95 % and 2.4% in males. The rate of the tented Arches was overall low. The present study will have to be deepened by subsequent studies to enrich the scientific literature with more data on fingerprints in Burkina Faso.

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