

Fingerprint Angles and Patterns in the Population of Najaf Province

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Abstract

The values of fingerprint angles were studied in 57 females and 44 males from Najaf province in the middle of Iraq. Some results of this sample were compared with the results of Southern provinces sample from Iraqi population.

The results revealed that the mean of maximum fingerprint angle (MFA) and also the mean of absolute fingerprint angle (AFA) between samples in the studied provinces did not differ significantly. However, the unilateral analysis revealed only one significant difference in L5 of the male samples ($t=2.89$, $P<0.01$), while the bilateral analysis revealed two significant differences, which occurred in R1 and R3 of the right hand.

As for the comparison between sexes of the sample in Najaf province, the unilateral analysis revealed a significant difference in L5, but there wasn't a significant difference in (MFA). The bilateral analysis of Southern provinces sample showed significant differences in R1 and R3 as well as in (AFA).

The frequency distribution for (MFA) and (AFA) reveals that the males of Najaf sample have a narrow range in these two variables in comparison with the males of Southern provinces sample, whilst the female sample of Najaf province has a narrow range for (AFA) values only. Latter, a positive relationship was found between Pattern Intensity Index (PII), percentage of whorls and the AFA values.

This study shed the light on the importance of digital fingerprint angle values when analyzed at the level of separate fingers in detecting genetic variation between samples and sexes, but not at the level of summation the values of all fingers together.

Introduction

The interest in dermatoglyphic studies is extended due to its importance in detecting the genetic variation between populations. The development of dermal ridges is under genetic control, and this control is not affected by environmental factors, except at the earlier period of embryo life (1). In addition, these markers give an importance to detect the mating pattern between the members in population groups through studying the variation of the character (2 and 3). The population samples in general consist of a number of persons selected randomly from population groups or society representing the mean of character in that society, and there is no relationship between members of both sexes (4).

There is a little information about Iraqi population, especially in dermal ridge characters, but in general these studies revealed some differences in these characters, which refer to a genetic variation in population of these regions (5, 6 and 7).

This study aims to detect the differences in dermal ridges of Najaf province population in comparison with Southern province populations in Iraq. These differences reflect at the same time the genetic variation between populations who lived together in these geographical areas.

Materials and Methods

Samples:Digital fingerprint angles were studied in 57 females and 44 males from Najaf province in the middle of Iraq. Some results of this sample compared with some other quantitative analyses results taken from Southern provinces sample of Iraq, in a previous study done by Hussein (8).

Another quantitative and qualitative analyses have been done on Southern provinces sample, and these analyses were never used in that previous study. The samples collected randomly from Najaf province which consisted of healthy females and males. Ink method was used in collecting digital fingerprint angles. Two kinds of analyses performed; quantitative and qualitative (8).

Measurement of fingerprint angles:In this method, fingerprints' angles were classified topologically, and this classification depended on the slope of any curve at any point equal to the slope of the tangent line for this curve at the same point (9).

In this method, numbers of main patterns were classified into six types. This new method of studying the fingerprint angles is called (Abdullah-Mohaissin Method), according to the names of researchers who suggested this method (10).

The values of the calculated angles were recorded beside the angle patterns directly. So, the whorls have two values, one for radial direction and the other for ulnar. But, the radial loop patterns have one value in ulnar direction, and the contrast for the ulnar loop patterns. Whilst, the plain arches pattern have a zero value, because of the absence of delta.

Fingerprint angles analysis (Quantitative analysis)

a. **Unilateral analysis:** In this analysis, the highest values of the whorl pattern were added to the loop values. This variable is called the Maximum Fingerprint Angle (MFA).

b. **Bilateral analysis:**

The two values of whorls pattern (one value in each side) are added to the loops values. This variable is called Absolute Fingerprint Angles (AFA).

Fingerprint angle analysis (Qualitative analysis): The qualitative analysis deals with classification of digital fingerprints to main patterns. In addition, the pattern intensity index (PII) were done according to Cummins and Midlo method (11).

Results and Discussion

Quantitative analysis

The variation between population groups in fingerprint values:

Table (1) illustrates the comparison between digital fingerprint angles for both sexes of Najaf province and Southern province samples.

The mean of fingerprint angles in Najaf province females is lower than that of Southern province females in both analyses (unilateral and bilateral). A contrast picture is found in unilateral analysis of Najaf province males, but in the bilateral analysis the mean of fingerprint angles in Southern provinces males is higher as compared with Najaf province male sample, but the difference did not attain any significant level when t-test was applied.

Comparison between sexes in fingerprint values: The comparison between sexes revealed that the mean of fingerprint angles in males is

higher than females in both samples and analyses. However, these results did not reveal a significant difference, except the difference in fingerprint angles mean of bilateral analysis in males as compared with the females of Southern provinces sample ($t=2.351$, $P<0.05$).

It seems that the females have a variation higher than that of males in both samples and analyses. This refers to a decrease in the percentage of inbreeding between parents of these females in comparison with the males parents. Whilst, the lower standard deviation refers to an increase in inbreeding rates between the population groups (2, 12 and 13). However, in a previous study on dermal ridges of Kut province population in the middle of Iraq revealed that males have a higher variation from females' (14).

The MFA and AFA values in each digit of Najaf province and Southern province females in both analyses are illustrated in tables (2 and 3), respectively. These analyses revealed that the mean of fingerprint angles values in Southern provinces sample is higher as compared with those of Najaf province, for instance, R1, L1, R4, L4, R5 and R5. The contrast was found in R2, L2, R3 and L3 in both analyses, except the L2 in bilateral analysis. These results did not reveal a significant difference when a t-test was used.

The MFA and AFA values in each digit of Najaf province and Southern province males in both analyses were illustrated in tables (4 and 5), respectively. The results revealed that the mean of fingerprint angle values in Najaf province is higher compared with that in the Southern provinces for R1, L1, R2, L3, R4, L4, R5, and L5 in unilateral analysis. But these differences did not attain a significant level, except for the L5 ($t=2.890$, $P<0.01$).

In the bilateral analysis the mean of fingerprint values in Southern provinces males is higher compared with Najaf province for all digits in both hands. But these differences did not attain a significant level, except for R1 ($t=2.249$, $P<0.05$) and R3 ($t=2.514$, $P<0.02$). Significant differences between sexes in each sample for both analyses were found. There is a significant difference in unilateral analysis of Najaf province sample which occurred in L5 ($t=2.323$, $P<0.05$). In addition, there are two significant differences in bilateral analysis of Southern provinces sample, the first occurred in R1 ($t=2.784$, $P<0.01$) and the second in R3 ($t=3.269$, $P<0.01$).

The results in this study agreed with the study that was presented by (5), especially for the differences between sexes in

dermal ridge character. These differences were also mentioned by (15).

Frequency distribution: The frequency distribution for MFA in Najaf females sample ranging from 428°-1225° and their percentage having MFA less than 1000° is 26.31% (fig. 1). Whilst, the frequency distribution for Southern provinces females sample ranging from 200°-1200° and their percentage having less than 1000° is 30.00%. The frequency distribution for AFA in Najaf province sample (fig. 2) ranging from 428°-1949° and the percentage of females having AFA less than 1000° is 7.01%, whilst the AFA for Southern provinces females ranged from 200°-2100° and their percentage having AFA less than 1000° is 20%.

The frequency distribution for MFA in Najaf males sample (fig. 1) ranged from 673°-1162° and their percentage having MFA less than 1000° is 6.82%, in comparison with 500°-1300° and 11.67%, respectively for the Southern provinces males sample. The frequency distribution for AFA in Najaf province sample (fig. 2) ranged from 673°-1937° and their percentage having AFA less than 1000° is 4.54%, in comparison with 500°-2300° and 5.00%, respectively for Southern provinces' males sample.

Qualitative analysis

Table (6) illustrates fingerprint pattern frequencies with Pattern Intensity Index (PII) in both sexes of the two samples. The Najaf female sample has a percentage of radial and ulnar loops higher as compared with Southern females. Whilst the contrast was found in the other patterns (arches and whorls), however these differences did not attain a significant level, and the comparison was made on overall fingerprint pattern when Chi-square (X^2) test was used.

The PII values in Southern provinces females sample is higher than that for Najaf province females, and the reason for these results depends on the first sample that has more values of whorls patterns, but in general, the PII for population groups ranging between 9.8-15.5 (16). Whilst, the Najaf males sample have percentage of arches, radial loops and ulnar loops higher in comparison with Southern males sample, and the contrast is found for whorl pattern. These differences revealed a significant level when Chi-square (X^2) was made ($X^2=41.97$, d.f. =3, $P<0.01$). Moreover, the comparison was made

between the overall digital pattern number. The PII values in Southern males sample was higher in comparison with the Najaf males sample, and the reason of these results depends on the higher values of whorls pattern in this sample.

The increase in the percentage of whorls pattern in Southern provinces in comparison with Najaf province agreed with that of Roberts and Abdullah (5). They found an increase in whorls pattern from the North of Iraq towards the South and South-East regions was supported. But, in the comparison between sexes in each sample using the numbers of all digital patterns, we found in the present study a significant difference only between sexes of Najaf province ($X^2=13.86$, d.f. =3, $P<0.01$).

The relationships between PII, whorls pattern and fingerprints' angles values

Fig. (3) illustrates the arches, whorl frequencies and the mean of AFA in both samples and sexes. This figure shows a positive relationship between the increasing of whorl percentage and increasing the AFA mean values in both sexes and samples. This refers to the fact that the mean of the angle values depends on the number of whorls, whilst the percentage of arches did not affect the AFA elevation. The results of this study agreed with that presented by the first author, Hussein, (8) in fingerprints' angles in healthy and diseased samples in the population of Iraq.

This study recommends to do comparisons between tribal samples that have a higher level of inbreeding with that of unrelated normal population groups in order to support the results in this study, especially in the males sample. This study with the other studies in this field suggests to use the variation in dermal ridge values and their angles as a morphological probe used to detect the genetic variation and mating pattern between population groups.

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Table (1): Comparison between Fingerprints' Angles values in Najaf province and Southern province samples

Sample	N	Maximum Fingerprint's Angles (MFA)		Absolute Fingerprint's Angles (AFA)		
		Mean ± S.E	S.D	Mean ± S.E	S.D	
NP	F	57	1025.4 ± 17.54	132.43	1295.9 ± 40.38	304.86
	M	44	1073.5 ± 11.98	79.47	1387.2 ± 40.82	270.74
SP*	F	60	1029.9 ± 19.64	152.10	1336.7 ± 74.67	369.24
	M	60	1061.1 ± 11.18	86.61	1554.3 ± 44.88 ⁺	347.63

N= Number of persons, F= Females, M= Males, S.E= Standard error, S.D+ Standard deviation, NP= Najaf province, SP= Southern provinces, += Significant differences between sexes, *= from Hussein, 1994

Table (2): Comparison between Fingerprints' angles values in each digit for Najaf province and Southern province females (Unilateral analysis)

Digit	Hand	Najaf province (N=57)		Southern provinces (N=60) ⁺	
		Mean ± S.E	S.D	Mean ± S.E	S.D
1	R	109.4 ± 3.01	22.73	112.1 ± 1.06	8.20
	L	107.5 ± 1.57	11.88	110.1 ± 2.29	17.75
2	R	101.0 ± 3.42	25.84	96.6 ± 4.38	33.89
	L	98.1 ± 4.26	32.18	94.6 ± 4.64	35.95
3	R	105.8 ± 3.55	26.77	98.2 ± 4.41	34.16
	L	98.6 ± 4.29	32.38	94.2 ± 4.64	35.91
4	R	101.8 ± 3.52	26.60	104.5 ± 2.83	21.90
	L	101.8 ± 2.94	22.21	107.0 ± 2.29	17.72
5	R	100.8 ± 3.96	29.90	108.5 ± 2.37	18.35
	L	100.7 ± 3.48 ⁺	26.25	104.2 ± 2.78	21.53

N= Number of persons, R= Right, L= left, S.E= Standard error, S.D= Standard deviation, += Significant differences between sexes, *= from Hussein, 1994

Table (3): Comparison between Fingerprints' angles values in each digit for Najaf province and Southern province females (Bilateral analysis)

Digit	Hand	Najaf province (N=57)		Southern provinces (N=60)*	
		Mean ± S.E	S.D	Mean ± S.E	S.D
1	R	142.9 ± 7.10	53.59	159.0 ± 6.59 ⁺	51.04
	L	140.1 ± 6.92	52.24	154.6 ± 7.08	54.85
2	R	138.6 ± 7.70	58.13	134.1 ± 8.58	66.44
	L	132.9 ± 7.94	59.95	133.5 ± 8.84	68.47
3	R	124.1 ± 6.18	46.65	114.9 ± 6.85 ⁺	53.05
	L	115.9 ± 7.05	53.24	114.6 ± 7.47	57.83
4	R	142.8 ± 7.56	57.10	149.2 ± 7.35	56.91
	L	132.5 ± 6.91	52.16	142.9 ± 6.42	49.75
5	R	113.6 ± 5.98	45.12	115.4 ± 3.62	38.02
	L	112.4 ± 5.42	40.90	118.6 ± 5.22	40.40

N= Number of persons, R= Right, L= left, S.E= Standard error, S.D= Standard deviation, += Significant differences between sexes, *= from Hussein, 1994

Table (4): Comparison between Fingerprints' angles values in each digit for Najaf province and Southern province males (Unilateral analysis)

Digit	Hand	Najaf province (N=44)		Southern provinces (N=60)*	
		Mean ± S.E	S.D	Mean ± S.E	S.D
1	R	113.1 ± 1.71	11.37	112.3 ± 1.09	8.47
	L	111.8 ± 1.27	8.41	109.6 ± 2.16	16.74
2	R	106.8 ± 3.78	25.07	103.3 ± 2.71	20.95
	L	90.7 ± 5.66	37.57	102.9 ± 2.77	21.46
3	R	105.6 ± 3.83	25.41	107.6 ± 2.14	16.57
	L	105.2 ± 3.88	25.75	103.8 ± 2.18	16.87
4	R	110.8 ± 1.51	10.04	109.0 ± 1.19	9.24
	L	108.8 ± 1.30	8.63	103.6 ± 1.35	10.49
5	R	108.4 ± 1.47	9.76	107.2 ± 1.03	8.01
	L	112.3 ± 1.53 ^x	10.15	101.7 ± 2.13	16.48

N= Number of persons, R= Right, L= left, S.E= Standard error, S.D= Standard deviation, x= Significant differences between samples, *= from Hussein, 1994

Table (5): Comparison between Fingerprints' angles values in each digit for Najaf province and Southern province males (Bilateral analysis)

Digit	Hand	Najaf province (N=44)		Southern provinces (N=60)*	
		Mean ± S.E	S.D	Mean ± S.E	S.D
1	R	161.6 ± 8.37 ^x	55.51	193.2 ± 5.68	43.99
	L	150.7 ± 7.88	52.25	168.8 ± 7.40	57.28
2	R	152.8 ± 8.50	56.35	158.6 ± 7.43	56.79
	L	125.6 ± 10.33	68.53	154.6 ± 7.49	58.02
3	R	124.6 ± 7.01 ^x	46.48	158.4 ± 6.43	49.80
	L	127.4 ± 7.60	50.42	140.1 ± 7.06	54.72
4	R	152.5 ± 6.71	44.53	158.9 ± 6.05	46.90
	L	149.3 ± 6.52	43.22	161.9 ± 6.16	47.74
5	R	115.9 ± 4.07	27.01	129.9 ± 5.22	40.46
	L	126.8 ± 4.78	31.68	130.0 ± 5.73	44.38

N= Number of persons, R= Right, L= left, S.E= Standard error, S.D= Standard deviation, x= Significant differences between samples, *= from Hussein, 1994

Table (6): Fingerprint's pattern frequencies and PII values in Najaf province and Southern provinces for both sexes

Sample	N	A		RL		UL		W		PII	
		n	%	n	%	n	%	n	%		
NP	F ⁺	57	30	5.26	30	5.26	339	59.48	171	30.00	12.47
	M ⁺	44	12	2.73	42	9.55	233	52.95	153	34.77	13.21
SP	F ⁺	60	33	5.50	24	4.00	348	58.00	195	32.50	12.70
	M	60	8	1.33	22	3.67	252	42.00	318	53.00	15.17

N= Number of persons, F= Females, M= Males, n= number of patterns, A= Arches, RL= Radial loops, UL= Ulnar loops, W= Whorls, PII= Pattern Intensity Index, NP= Najaf province, SP= Southern provinces, *= Significant differences between samples for the same sex, += Significant differences between sexes for the same sample

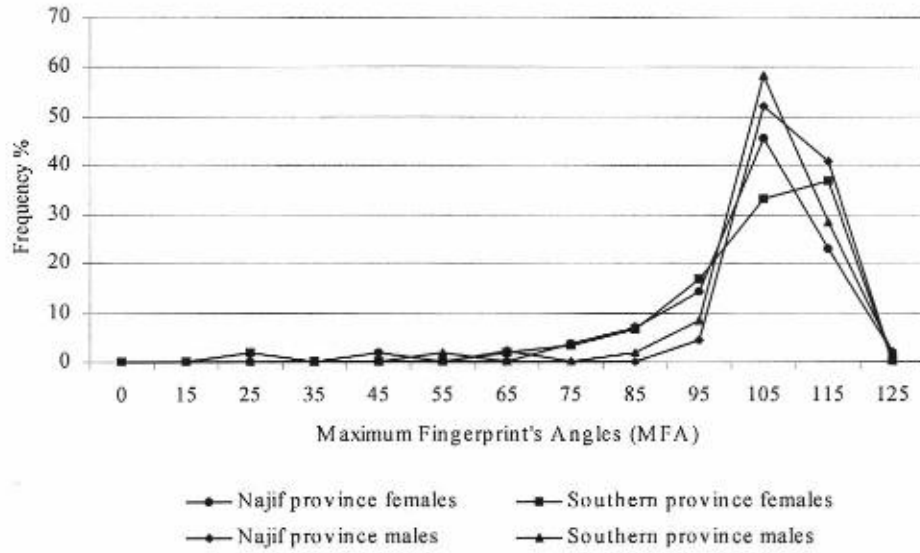


Fig.(1) Distribution of Maximum Fingerprints' Angles (MFA) in Najaf and Southern provinces

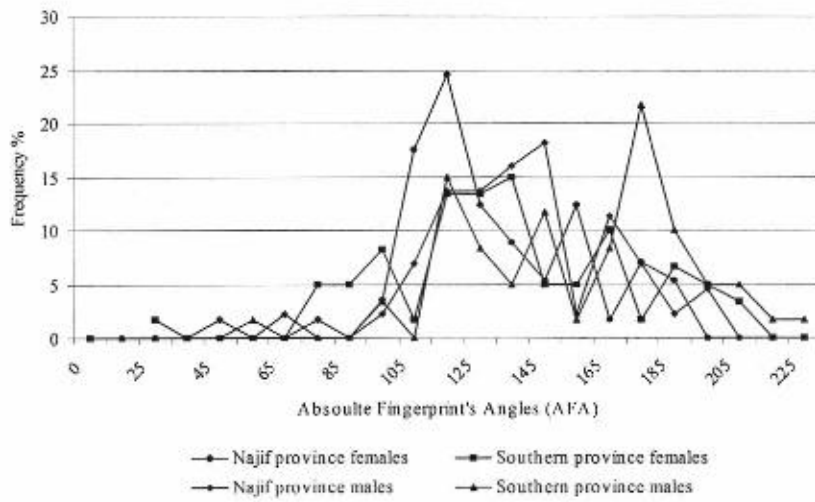


Fig.(2) Distribution of Absolute Fingerprints' Angles (AFA) in Najaf and Southern provinces

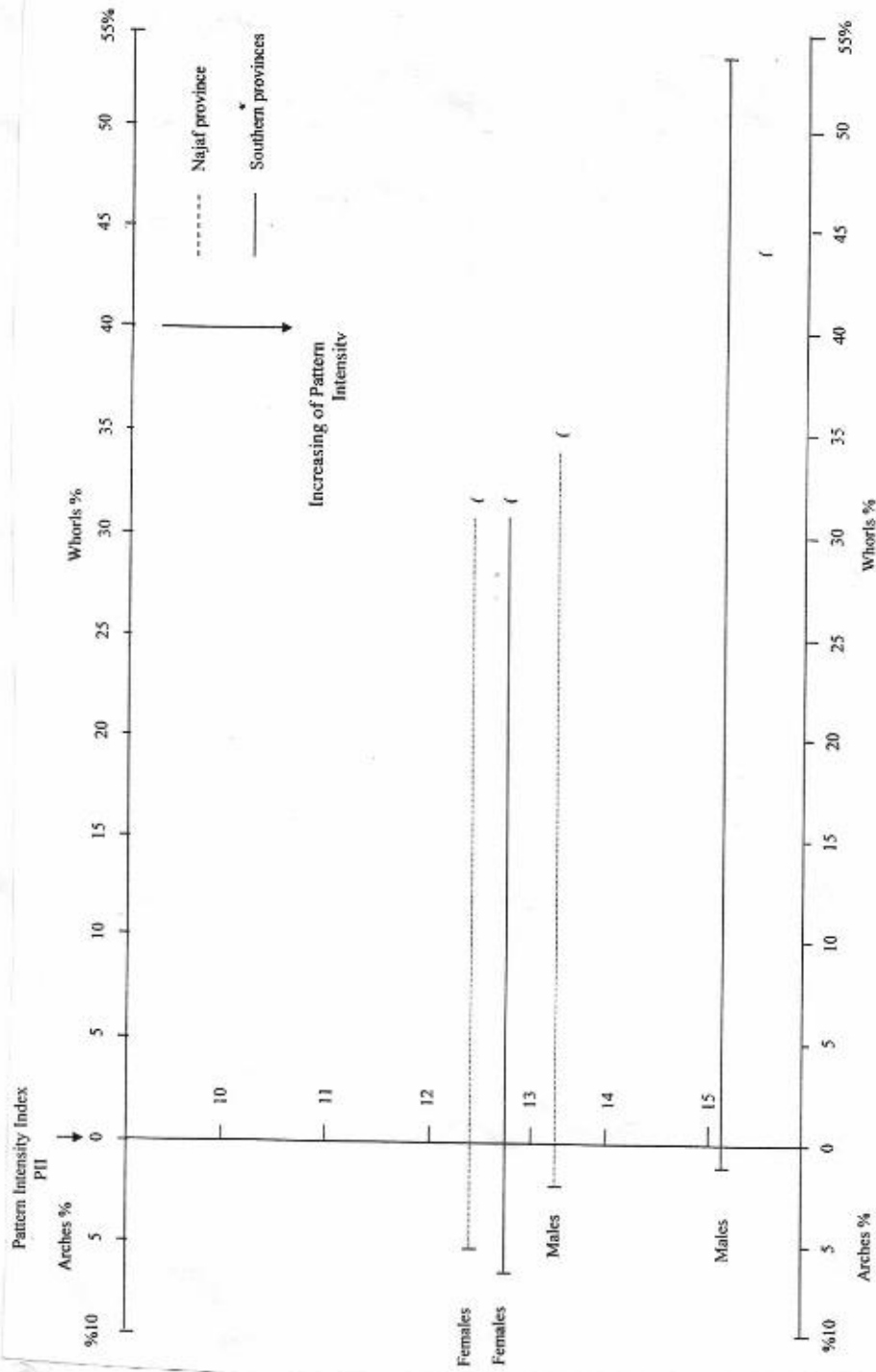


Fig.(3) The frequencies of arches and whorls in Najaf and Southern provinces and their relationship with the mean of fingerprints' angles in bilateral analysis (AFA)

زوايا بصمات الأصابع وأنماطها في سكان محافظة النجف

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الخلاصة

تم دراسة قيم زوايا بصمات الأصابع في عينة من سكان محافظة النجف مكونة من 57 أنثى و 44 ذكراً. أن بعض نتائج هذه العينة قد تم مقارنتها مع نتائج عينة مماثلة من سكان المحافظات الجنوبية. كشفت النتائج أن متوسط زوايا بصمة الإصبع الكبرى Maximum Fingerprint's Angle (MFA) وأيضاً متوسط قيم زاوية الإصبع المطلقة Absolute Fingerprint's Angles (AFA) في العينتين المدروستين للمحافظات لم تختلف بصورة معنوية، ولكن كشف التحليل الأحادي وجود اختلاف معنوي واحد في الخنصر الأيسر لعينة الذكور ($t=2.89; P<0.01$). بينما كشف التحليل الثنائي وجود اختلافين معنويين والتي حدثت في الإبهام الأيمن والوسطى اليمنى.

أما بصدد المقارنة بين الجنسين فلقد أظهرت عينة النجف في التحليل الأحادي وجود اختلاف معنوي في الخنصر الأيسر، ولكن لم يظهر اختلاف معنوي في (MFA). لقد أظهر التحليل الثنائي لعينة محافظات الجنوب اختلاف معنوي في الإبهام الأيمن والوسطى اليمنى وكذلك في المتغاير (AFA).

أن التوزيع التكراري لـ (MFA) و (AFA) أشار إلى أن ذكور عينة النجف تمتلك مدى ضيق في هذين المتغايرين مقارنة مع ذكور عينة محافظات الجنوب، بينما أظهرت إناث عينة محافظة النجف فقط مدى ضيق في قيم المتغاير (AFA). من جهة أخرى لقد وجدت علاقة موجبة بين مؤشر كثافة النمط والنسبة المئوية للمستديرات وكذلك قيم (AFA).