PRINT: ISSN 0972-0073 ONLINE: ISSN 2456-6802
Anthropologist 14(2): 185-191 (2012)
DOI: 10.31901/24566802.2012/14.02.12

Diversity of Finger Patterns in Iranian Populations

M. Sharif Kamali and Alireza Hassanzadeh

Anthropology Research Centre, Iranian Cultural, Handicrafts and Tourism Organization (ICHTO), Tehran, Iran
E-mail: mohammad.sharif.kamali@googlemail.com
allica.hassanzadehi350@googlemail.com

KEYWORDS Dermatoglyphics, Finger Patterns, Distance analysis, Dendrograms, Iran

ABSTRACT Six Iranian populations have been analyzed for finger patterns, utilizing bilateral prints of 720 individuals. Bimanual and sex differences were frequently insignificant and non-significant. Interpopulational variation showed significant hetererogeneity among the populations studied. Distance analysis and constructed dendrograms, based on these six populations and other thirteen Iranian populations, provided separation between the populations for finger patterns, and the dendrograms were only in agreement with the ethnohistoric records of the populations studied for combined sexes but not for males or females. Therefore, finger patterns are good measures of population distance and the relationships of populations one to another.

INTRODUCTION

Anthropological dermatoglyphics has attracted many scholars in anthropology and population genetics for the past 70 years. The results are mainly descriptive dermatoglyphics of single populations. Of course, there are also studies in different populations and populations comparisons. A bibliography of dermatoglyphics can be found in Mavalwala (1977) and a comprehensive review of anthropological dermatoglyphics has been compiled by Meier (1980). Plato et al. (1975) and Plato (1976) also showed variations of different dermatoglyphic features in major human ethnic groups and finally, Meier (1991) has discussed in detail, the application of dermatoglyphics to anthropologic populations.

However, the results of dermatoglyphic studies in human populations showed that populations vary in their dermatoglyphic features but little is known about the relationships of these variations with the past histories and ethnic relationships of the populations studied. It seems that some dermatoglyphic features are better than others as measures of population distances (Kamali et al. 1991).

Among several aspects of qualitative dermatoglyphics, terminations of the C- and D-lines have been used to show the existence of significant variations among between populations (Plato 1976). Plato et al. (1975) and Plato (1976) in reviewing the worldwide distribution of qualitative dermatoglyphics, have shown that the C- and D- lines terminations are different among the main human ethnic groups and each of them has its own range of variation for these features. Hoff et al. (1981) found that the C-line terminations show better results in interpopulational comparisons affinities compared to than the D-line terminations among the native American populations. Balgir (1984) in studying C- and D-lines terminations of the Sikligars of Chandigarh India, found their common population origin with Rajputs and Hindu Gujjars. Jose Martin (1991) studied palmar C-line polymorphism in Spain and Sanna and Floris (1995) in studying Sardinian linguistic groups, showed that the terminations of main lines terminations could be used as an indicator of relationships among linguistic groups.

The aim of the present study is 1) to study six Iranian populations for finger patterns, 2) to report bimanual and sex differences of these traits and, 3) to find out that whether or not the finger patterns are is a good measures for understanding of population distances.

ETHNOGRAPHIC BACKGROUND

Iran has been settled by many diverse peoples during the past 25 centuries, and all of these peoples have in varying degree contributed to the Iranian gene pool (Field 1939; Ghirshman 1978; Kamali and Mavalwala 1990). However, most of the Iranian populations are of Indo-European origin and there are African origin populations in the south, East Asian origin in the north-east and Dravidian mixture in the south-east (Baluchistan).

The samples of this study were drawn from the six following populations. Care has been taken to select the populations which are mostly endogamous, have non-assortative matings and if there was any kind of suspected admixture, the samples were omitted.

Abyaneh is a population of Indo-European origins living in Abyaneh village in Province of Esfahan in central west of Iran. The village is located at the margins of desert on the mountainous area with the history of about 1500 years. They are Indo-Europeans with the stable population of 250. Abyaneh is losing population year by year because of migration. Many persons immigrate to bigger cities to work and often to marry. The people who live permanently in the village, are endogamous.

Bandar Gaz population lives in Bandar Gaz, Southeast Caspian Sea coastal area. It seems that these peoples are Indo-Europeans but might have some admixture with Turkmans who live nearby. Actually they belong to the Mazandarani populations who seems to have originated from old Iranians (Indo-Europeans). The samples were collected from non-relatives of and Bandar Gaz origin peoples.

Amlash Gilaks are also of Indo-European origins. The natives of Gilan Province are called Gilaks. Actually we have samples of three Gilak populations. One sample from urban area (Rasht), the others from village and town and the third one from mountainous areas. Even though these three populations have more or less same origins, their gene pools have changed through the time. The Rasht Gilaks who live in a big city, star-ted to change earlier and the Masouleh who live in a village in the mountainous area, have the least changes. However, we collected data from the people who have Gilak origins and omitted the mixed ones.

Konar Sandal population live in Kerman Province, South Iran. Actually the population has been formed from the Baluch immigrants who were living in the area as agricultural workers who bought the lands after Iranian Land Reform of 1961 and formed the current population. The size of population is nearly 1000. Many males have migrated to the big cities for work. Therefore, the sex ratio is below 100. However, the population is endogamous with the features of Baluchi and Dravidian admixture.

The ethnographic records of the other thirteen Iranian populations who were compared with the present study have been already described (Kamali and Mavalwala 1990; Kamali et al. 1990, 1991).

MATERIALS AND METHODS

Inked bilateral palm prints of 720 individuals representing six populations of Iran were collected and analyzed for finger patterns.

The names of the populations and the sizes of the samples are given in Table 1, and the geographic locations of the populations are shown in Figure 1.

Finger patterns are classified as whorl, ulnar loop, radial loop, tented arch and arch (Cummins and Midlo 1961).

Interpopulational variation has been examined by analysis of variance for categorical data (CATANOVA), distance analysis and the construction of dendrograms. CATANOVA is an analysis of variance for a one-way table when the response variable is categorical. Test statistics of CATANOVA follow a Chi-square distribution. To determine whether the populations studied showed significant differences, the categorical variance component analysis was computed after Light and Margolin (1971). Distance analysis was calculated for phenotypic frequencies of the finger patterns using Sanghvi's G2 (Sanghvi 1953: Balakrishnan and Sanghvi 1968) with the formula:

Table 1: Iranian populations studied and their sample sizes

Populations	*Abbreviations used*	*Sample sizes*	
		Males	*Females*
Abyaneh	AH	52	34
Bandar Gaz	BG	83	60
Gilak Amlash	GA	67	46
Gilak Rasht	GR	79	53
Konar Sandal	KS	45	49
Masouleh	MA	78	73
Total		405	315
Other Iranians:			
Arabs	AB	81	102
Armenians	AR	132	140
Assyrians	AS	111	125
Azaris	AZ	208	124
Baluchis	BA	134	97
Guklan Turkmans	GT	91	100
Kurds	KU	120	81
Lors	LO	91	70
South Iranians	SI	184	159
Taleshes	TA	82	133
Teke Turkmans	TT	154	80
Yomut Turkmans	YT	146	96
Zoroastrians	ZO	162	155

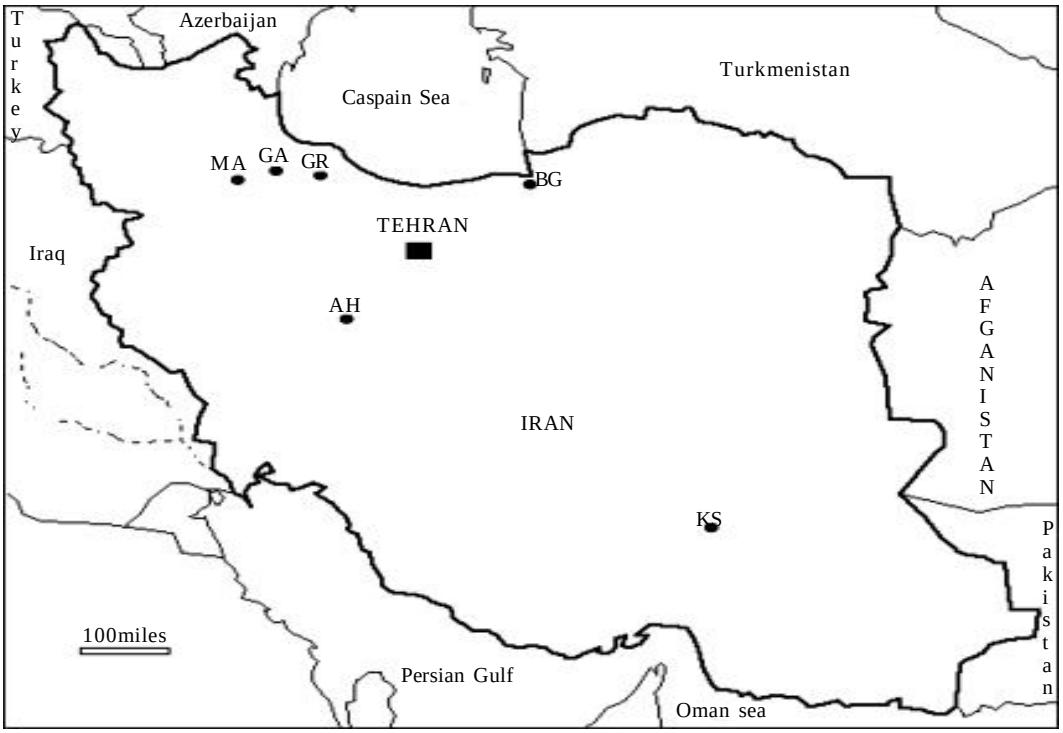

Fig. 1. Geographic locations of the populations studied. The abbreviations used for the populations are as in Table 1

Where P1j and P2j are the phenotypic frequencies of a given finger pattern in the compared populations 1 and 2 and sj is the number of considered modal type. The extraction of square root is not obligatory. Its purpose is to reduce the scale.

For testing interpopulational affinities with these distance matrices, we constructed dendrograms for cluster analysis using single linkage clustering technique, using MVSP software.

$$G^2 = \frac{1}{sj}\sqrt{\sum_{j=1}^{sj}\frac{(P1j-P2j)^2}{(P1j-P2j)/2}}\ x100$$

RESULTS

The percent frequencies of finger patterns of both palms combined and right and left palms separately for each of the six populations are given in Table 2 for both males and females. It is evident that ulnar loops shows the highest frequencies in both the hands of males for four populations on the left, right and combined sexes with the range of 48.8% (Amlash Gilaks: GA) to 55.8% (Massouleh: MA) for combined fingers.

Among females, ulnar loops show the highest frequencies among five out of six populations studied for both the hands with the range of 48.8% (Amlash Gilaks: GA) to 57.4 (Masouleh: MA) for combined hands. Whorls show the highest frequencies among right haqnds of Abyaneh (AH).

Tented arches show the lowest frequencies for all of the populations studied with the range of 1.8% (Konar Sandal: KS) to 7.5% (Amlash Gilaks: GA) for males and from 0.5% (Abyaneh: AH) to 10.8% (Masouleh: MA) for females.

As is evident in Table 2, even though bimanual differences exist for the finger patterns among the populations studied, the observed differences achieve statistical significance among three male and three female populations studied (Table 3).

Large differences exist in the frequency of finger patterns among males and females (Table 2). These differences are significant among four out of the six populations studied (Table 4). Amlash Gilaks and Konar Sandal populations do not show significant sex differences.

Table 2: Frequencies of finger patterns among 6 populations of Iran1

Populations		*PA*			*TA*			*LR*			*LU*			*W*		
		L	*R*	*L+R*	*L*	*R*	*L+R*	*L*	*R*	*L+R*	*L*	*R*	*L+R*	*L*	*R*	*L+R*
AH	M	5.4	5.4	5.4	0.0	0.0	0.0	3.1	3.5	3.3	56.9	46.5	51.7	34.6	44.6	39.6
	F	1.1	0.0	0.5	1.1	0.0	0.5	2.4	4.1	3.2	57.1	41.8	49.4	38.8	54.1	46.5
BG	M	6.3	4.6	5.5	1.9	3.1	2.5	2.7	4.3	3.5	48.9	40.5	44.7	40.2	47.5	43.9
	F	6.0	5.0	5.5	2.0	3.3	2.7	2.7	1.3	2.0	55.0	51.3	53.2	34.3	38.7	36.5
GA	M	8.4	6.6	7.5	2.4	3.0	2.7	1.8	2.4	2.1	51.0	46.6	48.8	36.4	41.2	38.8
	F	7.4	6.5	7.0	2.6	3.0	2.8	3.0	1.3	2.2	52.2	56.5	54.4	34.8	32.6	33.7
GR	M	3.3	6.1	4.7	1.5	0.8	1.2	4.3	4.3	4.3	58.5	48.6	53.6	31.6	40.3	36.0
	F	9.4	5.3	7.4	1.1	1.1	1.1	3.0	1.5	2.3	43.8	46.0	44.9	42.6	46.0	44.3
KS	M	4.4	0.4	1.8	0.0	0.9	0.5	3.1	4.9	4.0	52.0	43.6	47.8	40.9	51.1	46.0
	F	6.1	9.0	7.6	0.4	0.4	0.4	2.4	1.6	2.0	60.8	50.6	55.7	30.2	38.6	34.3
MA	M	6.2	5.9	6.0	0.8	1.8	1.3	4.4	4.1	4.2	62.1	49.5	55.8	26.7	38.7	32.7
	F	12.6	9.0	10.8	1.4	0.0	0.7	3.6	3.8	3.7	60.0	57.8	57.4	22.5	32.3	27.4

1- Abbreviations used: M, males; F, females; L, left; R, right; LU ulnar loop; LR, radial loop: PA, plain arch; TA, tented arch; W, whorl. Abbreviations used for populations are given in table 1.

Table 3: Chi-square values for bimanual variation among the six populations of Iran

Populations	*Sex*	χ^2 *values*	*df*
AH	M	6.05	3
	F	18.67***	4
BG	M	5.66	4
	F	4.68	4
GA	M	2.90	4
	F	2.36	4
GR	M	11.94*	4
	F	4.93	4
KS	M	20.89***	4
	F	10.10*	4
MA	M	15.83**	4
	F	17.80***	3

* P<0.01 ** P<0.05 *** P < 0.01
Abbreviations used for populations are given in table 1

Interpopulational differences in frequency distributions of finger patterns were subjected

Table 4: Chi-square values for sex variation among the six populations of Iran

Populations	χ^2 *values*	*df*
AH	12.80*	4
BG	13.94**	4
GA	3.58	4
GR	14.00**	3
KS	1.98	4
MA	17.32**	4

* P < 0.05 ** P < 0.01
Abbreviations used for populations are given in Table 1

to categorical variance component analysis (CATANOVA) before computing distance analysis. The results are given in Table 5 for males, females and both sexes combined. The values of G^2 for other Iranian populations are given elsewhere (Kamali et al. 1990, 1991).

Based on the G^2 values three dendrograms for males, females and both sexes combined wereconstructed using MVSP software. The results are presented in Figures 2a,b,c.

Table 5: Analysis of variance for categorical traits (CATANOVA) for finger patterns among six Iranian populations

Population	*Test statistics*[1]	*df*
Males	1601.46*	20
Females	1213.30*	20
Males and females combined	2870.25*	20

[1] Test statistics used is the CATANOVA statistics as proposed by Sing (1993), which follows a distribution with degrees of freedom as indicated.
*P < 0.001

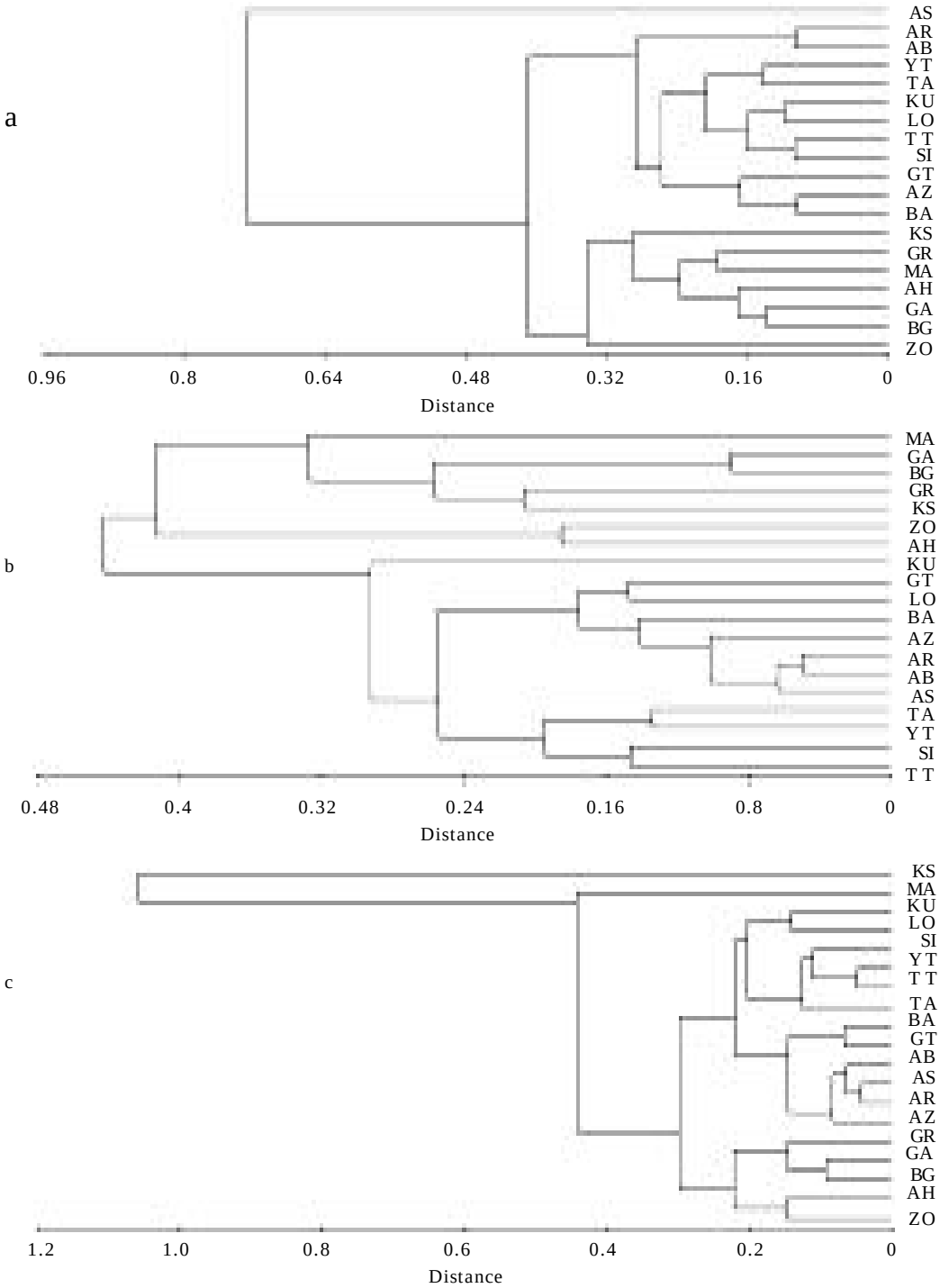

Fig. 2. Dendograms of nineteen Iranian populations based on finger patterns for males (a), females (b) and combined sexes (c). The abbreviations used for the populations are as in Table 1

Table 6: G^2 values for finger patterns among six Iranian populations for males (above diagonal) and females (below diagonal)

Population	*Populations*					
	AH	*BG*	*GA*	*GR*	*KS*	*MA*
AH	-	0.49	052	0.40	0.49	0.45
BG	0.76	-	0.30	0.42	0.52	0.51
GA	0.88	0.16	-	0.43	0.71	0.43
GR	0.72	0.44	0.50	-	0.50	0.17
KS	0.75	0.38	0.39	0.47	-	0.66
MA	1.10	0.62	0.50	0.72	0.39	-

Table 7: G^2 values for finger patterns among six Iranian populations for males and females

Population	*Populations*					
	AH	*BG*	*GA*	*GR*	*KS*	*MA*
AH	-	0.48	0.61	0.39	0.22	0.68
BG		-	0.22	0.22	0.37	0.88
GA			-	0.36	0.40	0.42
GR				-	0.21	0.44
KS					-	0.49
MA						-

DISCUSSION

Variations in the finger patterns among the Iranian populations are generally in agreement with the results of earlier studies (Plato 1970, 1976; Plato et al. 1975; Garruto et al. 1979; Pollitzer and Plato 1979; Kamali et al. 1990, 1991; Balgir 1984; Jose Martin 1991; Sanna and Floris 1995).

Bimanual and sex differences in various dermatoglyphic features, have already been reported (Cummins and Midlo 1961; Holt 1988; Meier 1980; Kamali et al. 1990, 1991) and the populations studied are no exception.

Interpopulational variation for finger patterns showed significant differences among the populations studied. The dendrograms constructed from the G^2 distances for C-line (Fig. 2 a), shows two clusters and one population separated from others for males. In the first cluster, there are seven populations. These populations have Indo-European origins except Konar Sandal (KS) who has admixture with Dravidians. In the second cluster, there are eleven populations. Here, East Asian origin populations (Turkmans: GT,YT and TT) clustered with Semitic and Indo-European origin populations which was not expected. Finally, the Assyrians are separated from all other populations.

Figure 2 b shows two clusters for females. The first cluster contains twelve populations in which Kurds (KU) separated from other eleven populations. The other populations are divided into two sub-clusters with Indo-European, East Asian and Semitic origin populations which was not expected based on their ethno-histories whereas other cluster contains eight populations of Indo-European origins which their relationships were expected based on their ethnohistories.

While males and females combined (Fig. 2 c), there are two clusters with one population (Konar Sandal: KS) separated from others. The first cluster contains five populations. Here, Zoroastrians (ZO) paired with Abyaneh (AH) which is expected based on their Indo-European origins and being isolated from past. The other three populations that is, Bandar Gaz (BG), Amlash Gilaks (GA) and Rasht Gilaks (GR) which are clustered, have Indo-European origins and live nearby each other in the same geographical area. Therefore, the first cluster fits with the ethnohistories and affinities exist between populations. The second cluster contains twelve populations, which is divided into two sub-clusters. The first sub-cluster contains six populations. Being Guklan Turkmans (GT) in this subcluster was not expected but the other populations especially pairing of Armenians (AR) and Assyrians (AS) who have intermarriages, fit well with their ethnohistoric backgrounds. The second sub-cluster has six populations in which pairing of Yomut and Teke Turkmans (YT and TT) and, Kurds and Lors (KU and LO), were expected but not in the same sub-cluster. Masouleh (MA) is separated from other populations which is expected because they live in mountainous area as an isolate from the past. Finally, Konar Sandal (KS) who have admixture with Dravidians, are separated from the others with most maximum distance.

Therefore, finger patterns seems to be a good measure for comprehending of population distances based on their ethno-historic relationship. based on combined sexes. It should be emphasized here that populations of Iran during the past 25 centuries, had admixed with the other populations such as Greeks, Arabs and Orientals. Here the role of gene flow and thus migration, during the history and intermarriage, is obvious. Therefore, if the results are not completely expected, it happened because of gene flow between the Iranian populations and invaders who had different origins.

This study of finger patterns in six Iranian populations and comparison with the other thirteen Iranian populations, shows the following:

1- Even though finger patterns show bimanual variation, this variation is frequently non-significant.
2- Sex differences for finger patterns are also frequently non-significant.
3- There exists significant inter-population variation for finger patterns.
4- Whereas interpopulation differences for finger patterns show significant variations among the populations studied and compared, the constructed dendrograms from G^2 values show a good fit with the known ethnohistoric backgrounds for combined sexes but not for males and females.
5- Therefore, finger patterns are good measures of population distance and the relationships of populations.

ACKNOWLEDGEMENTS

Present study was partly funded by Anthropology Research Centre, Tehran, Iran. The data analysis was done at Anthropology Research Centre, Tehran, Iran. We acknowledge the helps of M Marzban and Bahman Rahimi in data collection and analysis.

REFERENCES

Balakrishnan V, Sanghvi LD 1968. Distance between populations on the basis of attribute data. *Biometrika*, 24: 859- 865.

Balgir RS 1984. Polymorphism of palmar C- and D-line terminations among the Sikligars of Chandigarh. *Am J Phys Anthropol.* 65: 199- 200.

Cummins H, Midlo C 1961. *Finger Prints, Palms and Soles: An Introduction to Dermatoglyphics.* New York: Dover.

Field H 1939. Contributions to the Anthropology of Iran. Chicago: Anthropological Series. *Field Museum of Natural History*, Vol. 29, Nos. 1 and 2.

Ghirshman R 1978 *Iran.* New York: Penguin.

Garruta RM, Plato CC, Hoff CJ, Newman MT, Gajdusek DC, Baker PT 1979. Characterization and distribution of dermatoglyphic features in Eskimo and North, Central and South American Indian populations. In: W Wertelecki, CC Plato (Eds.): *Dermatoglyphics-Fifty Years Later.* New York: Alan R. Liss, Inc., pp. 277-334.

Hoff C, Plato CC, Garruto RM, Dutt J 1981. Dermatoglyphic assessment of the genetic relat-ionship of native American populations. *Am J Phys Anthropol,* 55: 455-461.

Jose Martin M 1991. Palmar C-line polymorphism in Spain. In: B Mohan Reddy, SB Roy, BN Sarkar (Eds.): *Dermatoglyphics Today.* Calcutta: Indian Institute of Biosocial Research and Development, pp. 245-255.

Kamali M Sharif, Mavalwala J 1990. Diversity of palmar pattern ridge counts in Iranian populations. *Am J Phys Anthropol,* 81: 363-373.

Kamali M Sharif, Mavalwala J, Bhanu BV 1990. Diversity of C-line terminations in Iranian populations. *Am J Phys Anthropol,* 81: 527-533.

Kamali M Sharif, Mavalwala J, Khaneqah A Askari, Bhanu BV 1991. Qualitative dermatoglyphic traits as measures of population distance. *Am J Phys Anthropol,* 85: 429-450.

Light, RJ, Margolin BH 1971. An analysis of variance for categorical data. *J Am Statist Assoc,* 66: 534-544.

Mavalwala J 1977. *Dermatoglyphics. An International Bibliography.* The Hague: Mouton.

Meier RJ 1981. Applications of dermatoglyphics to anthropologic populations. *Birth Defects: Original Article Series,* Vol. 27, No. 2, pp. 253-265. New York: Wiley-Liss.

Meier RJ 1980. Anthropological dermatoglyphics: A review. *Yrbk Phys Anthropol,* 23: 147-178.

Plato, CC 1976. Dermatoglyphics: A review. (In Greek). *Materia Medica Greca* (Suppl. III)4: 246-257.

Plato CC. 1970 Polymorphism of the C line of palmar dermatoglyphics with a new classification of the C line terminations. *Am J Phys Anthropol,* 55:455-461.

Plato CC, Brown P, Gajdusek DC 1972. Dermatoglyphics of Micronesians from the outer islands of Yap. *Z Morphol Anthropol,* 64: 29-44.

Plato CC, Cereghino JJ, Steinberg FS 1975. The dermatoglyphics of American Caucasians. *Am J Phys Anthropol,* 42: 195-210.

Pollitzer WS, Plato CC 1979. Anthropology and dermatoglyphics. In: W Wertelecki, CC Plato (Eds.): *Dermatoglyphics-Fifty Years Later.* New York: Alan R. Liss. Inc. pp. 211-224.

Sanghvi LD 1953 Comparison of genetic and morphological methods for a study of biological differences. *Am J Phys Anthropol,* 11: 385-404.

Sanna E, Floris G 1995 Polymorphism of palmar main line terminations as an indicator of relationships among Sardinian linguistic groups of males. *Hum Biol,* 67: 265-282.