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The Quantitative Dermatoglyphic Traits in Three Population Groups of Albanians from Kosovo

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ABSTRACT The quantitative dermatoglyphic traits from three population groups of Albanians from Kosovo have been analyzed. The first group consists of the population from the Dukagjini valley (106 males and 106 females), the second group encompasses the people living in the Kosovo plain (103 males and 110 females), and the third group lives in the valley of the South Morava River (108 males and 108 females). From the results of the present study, we can conclude that the examined Albanian population from Kosovo is very homogeneous, and there are only few differences found on fingers. More differences are found on the palmar dermatoglyphs, and they are more pronounced in males than in females. From these results, we can conclude that there has been some gene flow through migration routes in the males from the Kosovo plain as a result of employment, but also in the females from the South Morava valley as a result of marital migration. High pollution of the Sitnica River and the surroundings could also have environmental influence on the dermatoglyphic patterns of the Kosovo plain.

INTRODUCTION

Kosovo is located between the Mediterranean Sea and the mountain ranges of the Dinaric Alps of South-east Europe, on the Balkan Peninsula. This area has been inhabited by Dardani, who were an Illyrian tribe, from about 4th century BC (Durham 1923). Albanian population from Kosovo is probably an ethnic outcropping from this ancient Balkan people. The biological structure of this population has been influenced by socio-cultural and geographical characteristics of the area. In this region, Illyrian tribes battled with the Greeks, Thracians, before succumbing to Roman rule. Eastern and Western powers, secular and religious, made wars for centuries. The Illyrians gradually disappeared as a distinct people from the Balkans, replaced, by Slavic colonization, and Ottoman occupation in the Middle Ages, when most of them became Muslims. A forbidding mountain homeland and resilient tribal society enabled the Albanians to survive into modern times with their identity and their Indo-European language intact.

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Dermatoglyphs are cutaneous ridges on fingers, palms and soles, formed in the course of early intrauterine life, from the 7th to the 21st week (Cummins and Midlo 1961). During this period (and only then) genetic and environmental factors have a chance to greatly influence their formation (Loesch 1979; Hauser 1987). Therefore, dermatoglyphs are used as easily accessible in the study of genetically or environmentally influenced diseases. On the other hand, dermatoglyphics are polygenetic traits selectively neutral and adequate for studies of population structure (Blangero 1988).

Population studies carried out in South-east Europe have shown that isolation could be presented by differences in dermatoglyphic patterns, e.g. in the island populations of Hvar (Rudan 1975), Korcula (Milicic 1990a) or Pag (Milicic 1990b; Milicic 2000) in Croatia and in the mountain populations from the Selška valley in Slovenia (Milicic and Vidovic 2005).

Only few studies have been carried out so far to investigate the effects of environmental pollutants on dermatoglyphic patterns. Environmental pollutants may have an effect on dermal patterns of the newborn if the mothers is exposed to them during the first half of pregnancy (Ahuja and Plato 2000).

The present study was aimed to investigate the degree of homogeneity or heterogeneity of the quantitative dermatoglyphic variables of the

digito-palmar complex present in three mutually isolated subpopulations living in Kosovo. This analysis will possibly aid in the interpretation of migrational patterns and (micro)evolutionary processes occurring in the sub-populations living in this specific Balkan region.

MATERIALS AND METHODS

Population

In this paper we have carried out the analysis of dermatoglyphic pattern of the digito-palmar complex in the Albanian population groups from three distinct geographic regions in Kosovo. The first group is constituted by the population from Rrafshi and Dukagjini, a long valley in the western part of Kosovo (Fig. 1). The average altitude is 450 m above sea level. Its principal rivers are the White Drin and the Erenik. It is bordered by the mountains of Mokra gora (2156 m), Prokletije (Đeravica 2656 m) and the Albanian Alps. This valley has the characteristic influence of the Mediterranean climate. The analyzed population consists of inhabitants from the cities of Pec, Decani, Đakovica and Prizren.

Fig.1. Geographic map of Kosovo with examined regions
Source: Adopted from TEAM welt-atlas.de

The second population is formed from the people living on the Kosovo plain along the Sitnica River from the cities of Mitrovica, Prishtina, Lipljan and the northern part of Uroševac. The Sitnica flows generally to the north, as the main river in the Kosovo plain, on the western slopes of the •egovac and Cicavica (1091 m) and the Kopaonik mountain (Pancic peak 2017 m in Serbia border), in the east. The climate is continental, with hot summers and cold and snowy winters. The Sitnica leaves the coal basin as the most polluted river in Kosovo, especially notorious for its highly toxic phenol spills, which pollute not only the Sitnica, but also the Ibar and the West Morava rivers (Popovac et al. 1981; 1982; Rozhaja and Jablanovic 1983; Murphy et al. 1990; Wasserman et al. 1998).

The third population group is formed of inhabitants from the cities of Kamenica, Gnjilane, Vitina and a part of Uroševac surroundings. This population lives in a valley formed by the South (or Binacka) Morava River, which consists of a series of gorges and depressions while the Gnjilane depression - Konculj - is in Kosovo. On the south it is surrounded by Šar Mountain (Kara Nikola 2408 m and Ljuboten 2499 m on the Macedonian border). The surroundings have been almost completely deforested, which causes one of the most severe cases of excessive erosion in the Balkans.

The population from the Dukagjini valley is very isolated. The population from the Kosovo plain is also isolated from the others by mountains, but there is the influence of the main road and the railway road connecting Pristine, the capital of Kosovo, with two neighboring capital cities, Beograd (Serbia) and Skopje (Macedonia). The third population that lives in the valley formed by South Morava often marries people of Albanian nationality living in the plain of Preševo and Bujanovc along the river in south Serbia. The Anamorava dialect has its common specific characteristics due to the Turkish influence on this part of Kosovo. In all, three populations live in large families (more than 10 members).

Sample

The dermatoglyphic prints were collected and analyzed on 652 persons in total (326 males and 326 females). The investigations were carried out in the sub-population groups of three regions in Kosovo Dukagjini valley (107 males and 110 females), the Kosovo plain (108 males and 108 females), and the South (or Binacka) Morava valley (108 males and 108 females). About 100 prints were taken from each group of students, who were not closely related, who came from the three examined regions from both sexes. The students were studying at the Medical Faculty, University of Pristine and all of them had signed informed consent. The prints which were not complete were excluded.

METHODS

The prints of the dermatoglyphs of the digito-palmar complex were taken and analyzed according to the method of Cummins and Midlo (1961). The quantitative properties were analyzed by summing the number of papillary ridges on the apical pads of all ten fingers (FRC), by the sum for counts of all ten fingers total ridge count (TRC), by the ridge counts between the palmar triradii a, b, c and d (a-b rc, b-c rc and c-d rc), while the atd angle was measured in degrees on the right and left palm.

The initial analyses based on quantitative dermatoglyphic traits applied the descriptive statistics for the samples from all three groups. The estimate of heterogeneity between individual population groups was carried out by univariate (ANOVA) analysis of variance. A discriminant analysis was performed on quantitative variables, and a scatter plot was presented using function I and function II. All statistical analyses were performed by means of program package Statistica, Release 8.

RESULTS AND DISCUSSION

Table 1 and table 2 present the descriptive statistics of 18 dermatoglyphic variables on fingers and palms for three groups from different parts of Kosovo in males and females. In table 1, the dermatoglyphics of males from the Dukagjini valley (N = 106), the Kosovo plain (N = 103 males), and the South Morava valley (N = 108 males) show some differences. The ridge count on the first and second finger in the population from the Kosovo plain differs from the other two populations. The results of One-way ANOVA in males are presented on table 3, and confirm the above findings, since the statistically significant differences were found among the populations

from the Dukagjini valley and the Kosovo plain in males for the first finger right (FRR1, F = 10.059; p< 0.002), for the second finger right (FRR2, F = 3.913; p< 0.049) and left (FRL2, F = 5.144; p< 0.024). The population from the Kosovo plain also significantly differs from the population from the South Morava valley for the second right (FRR2, F = 4.278; p< 0.040) and left finger (FRL2, F = 4.008; p< 0.047). There are more differences found on palm areas. The population from the Dukagjini valley differs statistically from the one from the Kosovo plain for all palmar variables on the left hand (a-b rcL, F = 40.066; p< 0.001), (b-c rcL, F = 37.704; p< 0.001) (c-d rcL, F = 11.551; p< 0.001) and for the atd angle right (atd R, F = 55.874; p< 0.001). The population from the Kosovo plain is also significantly different from the population from the South Morava valley in terms of palmar variables on the left hand (a-b rcL, F = 24.834; p< 0.001) (b-c rcL, F = 18.155; p< 0.001) (c-d rcL, F =

Table 1: Descriptive statistics (means and standard deviations) in males

	Dukagjini valley N = 106		*Kosovo plain N = 103*		*South Morava valley N = 108*	
	X	*SD*	*X*	*SD*	*X*	*SD*
Right Hand						
FRR1	16.61	4.30	14.48	5.17	15.83	5.00
FRR2	9.38	6.13	7.81	5.48	9.31	5.05
FRR3	9.58	5.22	8.95	5.23	9.53	4.55
FRR4	12.43	5.24	11.52	5.49	12.54	5.10
FRR5	10.41	4.33	10.32	4.42	10.45	3.91
a-b rcR	34.08	6.70	35.27	5.89	36.83	5.92
b-c rcR	23.68	6.10	22.24	5.36	23.13	5.17
c-d rcR	29.69	5.20	29.63	6.03	29.80	5.91
atd R	45.07	7.62	36.65	8.58	45.25	7.19
Left Hand						
FRL1	14.30	5.40	13.17	5.03	13.56	5.08
FRL2	8.25	6.10	6.49	5.46	7.99	5.46
FRL3	9.45	5.32	8.80	5.48	9.09	4.98
FRL4	12.46	5.19	11.39	5.28	12.01	5.34
FRL5	10.59	4.63	10.16	4.75	10.28	4.26
a-b rcL	34.11	6.28	40.01	7.37	35.36	6.15
b-c rcL	22.08	5.31	27.75	8.00	23.69	5.67
c-d rcL	28.58	5.99	25.77	6.28	31.23	6.17
atd L	44.63	8.06	43.84	5.27	45.30	7.69

Table 2: Descriptive statistics (means and standard deviations) in females

	Dukagjini valley N = 106		*Kosovo plain N = 103*		*South Morava valley N = 108*	
	X	*SD*	*X*	*SD*	*X*	*SD*
Right Hand						
FRR1	14.92	5.48	14.08	5.90	12.64	4.93
FRR2	9.58	6.25	10.51	5.99	8.64	5.32
FRR3	9.40	4.53	9.55	4.30	8.69	4.70
FRR4	11.86	5.13	13.75	5.27	11.87	5.29
FRR5	9.95	4.77	10.41	4.18	9.15	4.48
a-b rcR	34.86	5.73	34.53	5.89	34.22	5.66
b-c rcR	23.36	5.27	23.56	5.75	23.67	7.08
c-d rcR	30.76	6.51	31.37	7.41	27.78	7.14
atd R	44.24	5.57	43.16	7.95	43.72	10.55
Left Hand						
FRL1	12.68	5.47	11.83	5.17	11.99	4.64
FRL2	8.49	6.12	9.56	6.12	8.07	6.08
FRL3	9.33	5.87	10.44	5.24	8.47	5.07
FRL4	11.88	5.63	12.34	5.32	11.03	5.32
FRL5	9.68	4.87	10.25	4.22	9.48	5.93
a-b rcL	34.69	5.77	32.06	7.52	32.94	5.77
b-c rcL	22.56	5.23	24.66	7.08	23.08	7.50
c-d rcL	29.18	6.57	33.65	9.46	28.14	6.99
atd L	45.07	6.62	45.62	6.99	46.99	8.71

40.672; p< 0.001), and for the atd angle on the right hand (atd R, F = 62.509; p< 0.001). The populations from the Kosovo plain and the South Morava valley differ in a-b ridge counts right (a-b rcR, F = 10.714; p< 0.001), and b-c (b-c rcL, F = 5.484; p< 0.020) and c-d ridge counts left (c-d rcL, F = 9.716; p< 0.002).

Descriptive statistics of dermatoglyphic variables in females is presented on table 2. The populations from the Dukagjini valley (N = 106), the Kosovo plain (N = 110), and the South Morava valley (N = 108) show some differences. More differences are found in the South Morava valley. These differences are confirmed by One-way ANOVA which was presented on table 4. The statistically significant values were found among the populations from the Dukagjini valley and the Kosovo plain in females for the fourth finger

Table 3: One-way ANOVA between the compared male groups

	Dukagjini valley Kosovo plain		*Dukagjini valley South Morava valley*		*Kosovo plain South Morava valley*	
	F	*p<*	*F*	*p<*	*F*	*p<*
Right Hand						
FRR1	10.059	0.002	1.311	0.254	3.708	0.056
FRR2	3.913	0.049	0.013	0.909	4.278	0.040
FRR3	0.808	0.370	0.011	0.916	0.731	0.393
FRR4	1.626	0.204	0.010	0.921	1.932	0.166
FRR5	0.028	0.868	0.003	0.953	0.054	0.816
a-b rcR	2.093	0.149	10.714	0.001	3.683	0.056
b-c rcR	3.592	0.059	0.642	0.424	1.499	0.222
c-d rcR	0.001	0.995	0.050	0.823	0.040	0.841
atd R	55.874	0.001	0.057	0.812	62.509	0.001
Left Hand						
FRL1	2.319	0.129	1.005	0.317	0.299	0.585
FRL2	5.144	0.024	0.153	0.696	4.008	0.047
FRL3	0.882	0.349	0.329	0.567	0.170	0.681
FRL4	2.279	0.133	0.425	0.515	0.722	0.397
FRL5	0.450	0.503	0.264	0.608	0.039	0.844
a-b rcL	40.066	0.001	2.488	0.116	24.834	0.001
b-c rcL	37.704	0.001	5.484	0.020	18.155	0.001
c-d rcL	11.551	0.001	9.716	0.002	40.672	0.001
atd L	0.674	0.413	0.413	0.521	2.569	0.110

Table 4: One way ANOVA between the compared female groups

	Dukagjini valley Kosovo plain		*Dukagjini valley South Morava valley*		*Kosovo plain South Morava valley*	
	F	*p<*	*F*	*p<*	*F*	*p<*
Right Hand						
FRR1	1.155	0.284	10.213	0.002	3.832	0.052
FRR2	1.257	0.263	1.396	0.239	5.935	0.016
FRR3	0.062	0.804	1.236	0.267	1.944	0.165
FRR4	7.176	0.008	0.001	0.987	6.943	0.009
FRR5	0.583	0.446	1.620	0.205	4.690	0.031
a-b rcR	0.175	0.676	0.668	0.415	0.152	0.697
b-c rcR	0.075	0.785	0.130	0.719	0.014	0.906
c-d rcR	0.410	0.523	10.219	0.002	13.293	0.001
atd R	1.310	0.254	0.197	0.657	0.195	0.659
Left Hand						
FRL1	1.356	0.246	0.987	0.322	0.054	0.817
FRL2	1.660	0.199	0.249	0.618	3.250	0.073
FRL3	2.136	0.145	1.309	0.254	7.900	0.005
FRL4	0.379	0.539	1.287	0.258	3.296	0.071
FRL5	0.835	0.362	0.071	0.790	1.204	0.274
a-b rcL	8.234	0.005	4.888	0.028	0.939	0.334
b-c rcL	6.150	0.014	0.354	0.553	2.560	0.111
c-d rcL	16.199	0.001	1.258	0.263	23.928	0.001
atd L	0.355	0.552	3.304	0.071	1.650	0.200

right (FRR4, F = 7.176; p< 0.008). The population from the Dukagjini valley also significantly differs from the population from the South Morava valley for the first finger right (FRR1, F = 10.213; p< 0.002) and the population from the Kosovo plain differs from those from the South Morava valley for the second (FRR2, F = 5.953; p< 0.016) and fifth finger of the right hand (FRR5, F = 13.293; p< 0.001). There are more differences found in palm areas. The population from the Dukagjini valley differs significantly from the Kosovo plain in all palmar variables on the left hand: a-b ridge count (a-b rcL, F = 8.234; p< 0.005), b-c ridge count (b-c rcL, F = 6.150; p< 0.014) and c-d ridge count (c-d rcL, F = 16.199; p< 0.001). The population from the Dukagjini valley differs significantly from the population from the South Morava valley in palmar variables on the c-d ridge count of the right (c-d rcR, F = 10.219; p< 0.002) and left (a-b rcL, F = 4.888; p< 0.028) hand.

The population from the Kosovo plain is also statistically different from the population from the South Morava valley for the c-d ridge count of both hands (c-d rcR, F = 13.293; p< 0.001; c-d rcL, F = 23.928; p< 0.001).

The results of discriminant analysis for all groups in males and females for the first two discriminant functions are presented on table 5.

Table 5: The results of discriminant analysis for all groups in males and females

Populations	*Function I*	*Function II*
Dukagjini valley M	0.172	0.635
Kosovo plain M	-1.525	-0.212
South Morava valley M	0.207	0.157
Dukagjini valley F	0.302	-0.091
Kosovo plain F	0.619	-0.727
South Morava valley F	0.150	0.259

The total finger ridge counts (TRC) represents the sum of the ridge counts of all ten fingers, where only the larger count is used on those digits with whorls (Cummins and Midlo 1961). The TRC is higher in males than in females in population groups. The highest TRC is observed in XO individuals and lower if the number of chromosome X were multiplied (Schaumann and Alter 1976; Holt 1968). The total finger ridge counts for three population groups are presented on table 6. In males, the differences exist between the population from the Dukagjini valley (TRC = 113.47) and the population from the Kosovo plain (TRC = 103.09). In females, the difference among the population from the Kosovo plain (TRC = 112.73) and the population from the South Morava valley (TRC = 100.04) was not statistically significant. Unusual is the differnence between males (TRC= 103.09) and females (TRC = 112.73) from the Kosovo plain.

In Figure 2, the first two discriminant functions are presented. Differences found in males and females of the population from the Kosovo plain could be explained by both genetic and environmental influences. The dermatoglyphic traits are polygenetically determined and the environmental influences could only be reflected on the b-c ridge count in males. A genetic influence was found on fingers mostly in the difference in second finger in males, and in palmar variables. Arrieta et al. (1992) found that in palmar variables in males, the genetic influence is stronger for a-b and c-d ridge counts. Although the quantitative dermatoglyphics are changing more slowly than the qualitative ones, they were also sensitive to the events which took place during the microevolution of the contemporary populations, and as it was expected from the literature which shows that males are more influenced by environmental factors than females. These studies suggest that for successful reproduction, the female phenotype is more canalized and shows greater among-group variations than within-group (Hall and MacNair 1972; Relethford et al. 1980), and that females represent the ancestral population to a higher degree than males (Roberts et al. 1976; Arrieta et al. 1991). According to this, we found more differences in fingers and mostly in c-d ridge counts between the examined groups in males.

The obtained results confirmed the assumption of a high degree of isolation of the population from the Dukagjini valley in comparison with the other two parts. The forces of random genetic

Table 6: The total finger ridge count for all groups in males and females

	Males		*Females*	
	Mean TRC	*SD*	*MeanTRC*	*SD*
Dukagjini valley	113.47	39.76	107.75	43.84
Kosovo plain	103.09	40.60	112.73	40.73
South Morava valley	110.58	36.10	100.04	39.54

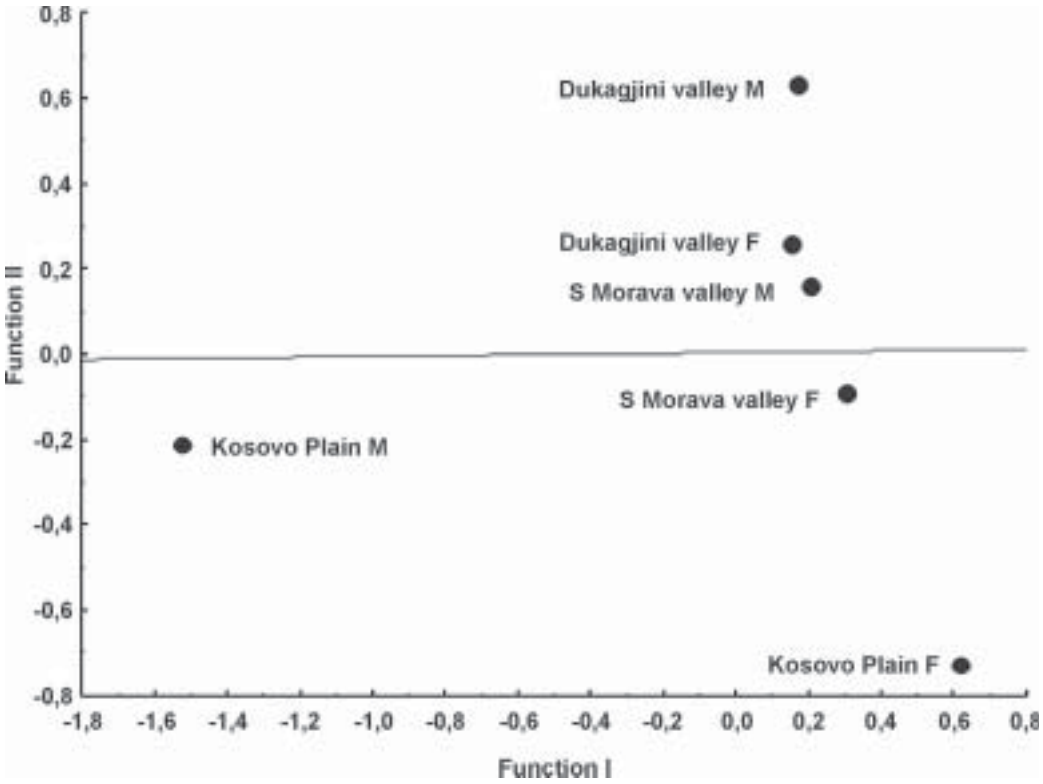

Fig. 2. The first two discriminant functions are presented for all population groups

drift and local gene flow adequately describe the observed (micro) geographic variations. The population from the Kosovo plain is also isolated from the others, but the influence of the main road and the railway road connecting Pristine, the capital of Kosovo, with two neighboring capital cities, Beograd (Serbia) and Skopje (Macedonia), could offer more opportunities for employment migration as well as for gene flow. The total finger ridge counts for the male population from the Kosovo plain (TRC = 103.09) is unexpectedly less than in other male populations and also from the females of the same population (TRC = 112.73). This difference could be explained with the postulates by Froehlich and Giles (1981) who claimed that dermatoglyphs are conservative with respect to the plastic environmental influences and to the stochastic processes of evolution. Both in theory and in practice, dermatoglypics offer numerous advantages for the biological reconstruction of human history.

The males are less canalized than females against negative environmental effects, especially during prenatal period (Stinson 1985). Environmental pollutants may have an effect on dermal patterns of the newborn if the mothers are exposed to them during the first half of pregnancy (Ahuja and Plato 2000).

The differences found in b-c ridge count between all three groups of males could be the result of the environmental influence. This could be explained by coal industry and pollution of the Sitnica River and a negative environmental influence to the examined populations. The differences found for the females of the population in the valley formed by the South Morava could be explained by their migration and marriage opportunities to people of Albanian nationality living in the plain of Preševo and Bujanovc along the river in south Serbia.

CONCLUSION

From the results of the present study, we can conclude that the studied Albanian population

from Kosovo is very homogeneous, but there are some influences on the gene flow through migration routes in males from the Kosovo plain as a result of employment, but also in the females from the South Morava valley as a result of marital migration. High pollution of the Sitnica River and its surroundings could also have an environmental influence on dermatoglyphic patterns.

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