

## Comparative Analysis of Dermatoglyphic Traits in Albanian and Roma Populations in Kosovo

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### Abstract

We examined dermatoglyphics of children in three Albanian and one Roma population sample (collected from 641 individuals from the Albanian populations and 226 individuals from the Roma population of both sexes). We compared Albanian and Roma populations based on four finger (whorl, radial and ulnar loop, and arch) and thirteen palmar traits (pattern frequencies in the Thenar/I interdigital area, II, III, and IV interdigital area, Hypothenar and axial »t« triradius position). The differences between the populations were more evident for palmar traits. In our study the Albanian and the Roma populations showed the best separation when finger and palmar traits are separately analyzed. As expected, the Albanian and the Roma populations separated in statistical analyses of most traits; the main reason for this is the different origins of two ethnic groups. The observed difference also indicates a low level of admixture between the Albanians and the Roma despite them living beside one another for several centuries.

### Introduction

Dermatoglyphics are individual-specific and highly heritable traits. They play a very important role in anthropology and human biology research for study of population variation, personal identification, twin study, association with diseases even today; see, for example, Arrieta et al., 2003; Temaj et al., 2009; Temaj et al., 2010; Temaj et al., 2011; Temaj et al., 2012. Dermatoglyphics have been used extensively to characterize human populations and most studies have focused on dermatoglyphic variables within and between various populations across the world (Arrieta et al., 2003; Crawford and Duggirala, 1992; Demarchi et al., 1997; Petranović et al., 2020; Reddy et al., 2001; Temaj, 2021; Weisensee and Siváková, 2003), or

between sexes (Esteban and Moral, 1993; Kusuma et al., 2002). Dermatoglyphics and fingerprints are formed during early intrauterine life, between the 7<sup>th</sup> and 21<sup>st</sup> week of gestation (Holt & Penrose, 1968) and are fully formed at about seven months of fetal development (Maltoni et al., 2003; Sharma et al., 2008). In the present study, we investigated several qualitative dermatoglyphic traits in a representative sample of the Albanian and the Roma population living together in Kosovo to determine whether the studied populations differ in these traits. In order to analyze the differences between these populations we compared the obtained data with those found in other studied populations. There is solid evidence for this assumption since many Punjabis today can understand some of the Roma language, depending upon the dialect. Roma have been

emigrating out of India for thousands of years. Major migratory events, however, have been established. One such movement was in 1308 when the Lohar caste was defeated defending their ancestral city in Rajasthan; the Lohars, the blacksmith caste of India, have been documented to have arrived in Eastern Europe around 1320. This is an important date in the history of the Kosovar Roma, since it is believed that they draw their origins from the Lohars (Nagy and Pap, 2004). Considerable cultural and socioeconomic differences exist between Albanians and the Roma. Their level of education is generally low, and their living conditions are unfavorable. The Roma population is small compared to the rest of Kosovo population. They are distributed and not concentrated just in one region. From the last census conducted in 2020, Kosovo has 1.800.000 inhabitants, of which the share of Roma is 1%. From our knowledge, this is the first work that compared Albanians and the Roma population. In this paper we present the results of a study conducted in Albanian and Gypsy populations in Kosovo (Census 2011. <http://esk.rks-gov.net/rekos2011/?cid=2,1>, 2011).

## Material and methods

The prints were collected by the widely used traditional ink method proposed by Cummins and Midlo in 1961. Four traits from the fingers and thirteen traits from the palm were taken into consideration, and each trait was measured in both hands. We collected Albanian samples from three sampling sites and one Roma population sample from one micro region. We analyzed the finger and palm prints of 641 children in the Albanian population samples from three regions: Kosovo plain, Dukagjini valley and South Morava (Fig. 1), and 226 children in the Roma (120 females, and 106 male) population sample throughout the territory of Kosovo (age range 8-18 years). The dermatoglyphic prints were collected and analyzed on 652 persons in total (326 males and males). The comparison has made between 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) (Temaj et al., 2010), with Roma population. The data for males and females were treated separately.



Figure 1. Geographic map of Kosovo with examined regions.

We analyzed the following qualitative digito-palmar dermatoglyphic traits: frequency patterns on the fingers (whorl, ulnar loop, radial loop, arch, and accidental whorl), pattern frequency in individual parts of the palm (Thenar/I interdigital area, II, III, and IV interdigital area and Hypothenar), MLI (main line index), and the axial »t« triradius position. Comparisons were performed using Chi-square ( $\chi^2$ ) test (statistical significance  $p < 0.05$ ).

## Results

The different pattern types are broadly classified, and four principal patterns – namely whorls, ulnar loop, radial loop and arch are outlined. Among both sexes in the Albanian and the Roma populations ulnar loop was the most predominant pattern type followed by whorls, arch and radial loop. The results of the chi-square test for digital dermatoglyphic traits, patterns in the individual parts of the palm and the axial »t« triradius positions between Roma and the three Albanian populations are shown in Table 1. Statistically significant difference was found between Roma females and females from all three Albanian populations for radial loop ( $p < 0.05$ ), while among males that difference was significant only between Roma and South Morava Albanian population ( $\chi^2 = 3.9$ ,  $p < 0.05$ ). The differences between Roma and Dukagjini valley

Table 1. Digits: results of the chi-square test for dermatoglyphic traits (arch, ulnar loop, radial loop, whorl, atd angle, I/th, II, III, IV and HY) of both sexes in the Albanian population from three different regions of Kosovo and the roma population from Kosovo (chi-square values that have reached the threshold of statistical significance are printed in bold letters).

Females	Arch	Ulnar loop	Radial loop	Whorl	t	t'	t''	I/Th	II	III	IV	HY
<b>Statistical significance</b> between Albanian population from Kosovo plain and Roma population			$\chi^2=14$ . 1 **				$\chi^2=3$ . .9*					
<b>Statistical significance</b> between Albanian population from Dukagjini valley and Roma population			$\chi^2=11$ . 2 **	$\chi^2=19$ . 1 **		$\chi^2=3$ . .3*						
<b>Statistical significance</b> between Albanian population from South Morava and Roma population	$\chi^2=3$ . 23*											$\chi^2=4$ . .4*
Males	Arch	Ulnar loop	Radial loop	Whorl	t	t'	t''	I/Th	II	III	IV	HY
<b>Statistical significance</b> between Albanian population from Kosovo plain and Roma population		$\chi^2=80.37$ **					$\chi^2=1$ . 2.7**	$\chi^2=3$ . .97*	$\chi^2=3$ . .85*			
<b>Statistical significance</b> between Albanian population from Dukagjini valley and Roma population	$\chi^2=22$ . .8*			$\chi^2=5.7$ . 2*			$\chi^2=1$ . 2.2**					
<b>Statistical significance</b> between Albanian population from South Morava and Roma population			$\chi^2=3.9$ . .									

Albanian population were statistically significant in both sexes ( $p < 0.05$ ). For the other principal patterns, chi-square test showed a statistical significance for arch between female Roma and South Morava Albanian population ( $\chi^2=3.23$ ,  $p < 0.05$ ), and male Roma and Dukagjini valley Albanian population ( $\chi^2=22.8$ ,  $p < 0.01$ ). The only significant difference for ulnar loop was shown between the male Roma and the Albanian male population from Kosovo plain ( $\chi^2=80.3$ ,  $p < 0.01$ ).

For the axial »t« triradius position, a difference was found in position t' only between female Roma and Kosovo plain females ( $\chi^2=3.34$ ,  $p < 0.05$ ). The differences were statistically significant between both sexes of Roma and Kosovo plain Albanian population for the t'' position ( $p < 0.05$ ); while only males differed for the t'' position when Roma were compared to Dukagjini valley Albanian population ( $\chi^2=12.2$ ,  $p < 0.05$ ). Frequencies of patterns in palm areas significantly differed between the Roma and South Morava females, but only for hypothenar ( $\chi^2= 4.43$ ,  $p < 0.05$ ). Male Roma, on the other hand, differed only from the Albanian males from the Kosovo plain in palm area patterns I/Th ( $\chi^2=3.97$ ,  $p < 0.05$ ) and II ( $\chi^2=3.85$ ,  $p < 0.05$ ).

The relative frequencies of main line index (MLI) for both hands for the female sex are presented in Table 2. Chi-square for line A indicates a significant difference ( $p < 0.05$ ) between Albanian female population from Kosovo plain and Roma females; between Albanian females from both Dukagjini valley and South Morava plain and Roma females for positions 4 and 5''. A significant difference ( $p < 0.05$ ) was found for line B between females from Kosovo plain and Roma for positions 5'', 6 and 9; between females from Dukagjini valley and Roma females for positions 5', 5'', 6, 7, and 9; between females from South Morava plain and Roma females for positions 5, 5' and 9. A significant difference ( $p < 0.05$ ) was found for line C between Kosovo plain and Roma females for positions 7, 8 and 10; between Albanian females from Dukagjini valley and Roma females for positions 6, 7, 8, 10 and 11; between South Morava plain and Roma females for positions 6, 8 and 10. A significant difference ( $p < 0.05$ ) was found for line D between females from Kosovo plain and Roma for positions 9, 10 and 11; between females from Dukagjini valley and Roma females for positions 7, 9, 11 and 12; between females from South Morava plain and Roma females for positions 9, 11 and 13'. A significant difference ( $p < 0.05$ ) was found for line T between

Table 2. PALMS: Results of the Chi-square test for main line index between both sexes of the Albanian population from three different regions of Kosovo and the Roma population from Kosovo (Chi-square values that have reached the threshold of statistical significance are printed in bold letters).

Main line index	Position	Female			Male		
		Kosovo Plain/Roma population	Dukagjini valley / Roma population	South Morava plain/ Roma population	Kosovo Plain/Roma population	Dukagjini valley / Roma population	South Morava plain/Roma population
A	4	$\chi^2=30.4^{**}$	$\chi^2=11.90^{**}$	$\chi^2=34.50^{**}$	$\chi^2=3.30^*$	$\chi^2=9.90^*$	
	5'				$\chi^2=3.80^*$		
	5''	$\chi^2=66.7^{**}$	$\chi^2=33.10^{**}$	$\chi^2=62.10^{**}$	$\chi^2=16.90^{**}$	$\chi^2=18.40^{**}$	
B	5'		$\chi^2=4.20^*$	$\chi^2=4.40^*$	$\chi^2=4.30^*$		
	5''	$\chi^2=5.2^*$	$\chi^2=25.30^{**}$	$\chi^2=10.50^*$	$\chi^2=34.20^{**}$	$\chi^2=22.80^{**}$	$\chi^2=39.4^{**}$
	6	$\chi^2=17.9^{**}$	$\chi^2=21.10^{**}$		$\chi^2=10.50^*$	$\chi^2=26.50^{**}$	$\chi^2=41.9^{**}$
	7		$\chi^2=4.60^*$				
	8				$\chi^2=4.20^*$		
	9	$\chi^2=9.04^*$	$\chi^2=17.50^{**}$	$\chi^2=12.50^*$			
C	5''						
	6		$\chi^2=8.9^*$	$\chi^2=3.40^*$	$\chi^2=6.40^*$	$\chi^2=6.90^*$	
	7	$\chi^2=9.6^*$			$\chi^2=4.80^*$		$\chi^2=7.70^*$
	8	$\chi^2=57.40^{**}$	$\chi^2=51.8^{**}$	$\chi^2=67.50^{**}$	$\chi^2=13.60^*$	$\chi^2=38.80^{**}$	$\chi^2=26.90^{**}$
	9						
	10	$\chi^2=67.60^{**}$	$\chi^2=36.5^{**}$	$\chi^2=69.90^{**}$		$\chi^2=22.90^{**}$	
D	11				$\chi^2=11.00^*$		
	7						
	8				$\chi^2=9.90^*$	$\chi^2=3.20^*$	
	9	$\chi^2=19.70^{**}$	$\chi^2=7.9^*$	$\chi^2=18.4^*$		$\chi^2=5.20^*$	
	10	$\chi^2=5.40^*$			$\chi^2=4.60^*$		
	11	$\chi^2=18.80^*$		$\chi^2=6.60^*$		$\chi^2=11.80^*$	
T	12						
	13'						
	13''				$\chi^2=9.10^*$		$\chi^2=9.90^*$
	11	$\chi^2=12.10^*$				$\chi^2=7.02^*$	

Kosovo plain and Roma females for positions 11 and 12; between Dukagjini valley and Roma females for positions 11 and 12; between South Morava plain and Roma females for position 10.

The relative frequencies of main line index (MLI) for both hands for the male sex are presented in Table 2. Chi-square for line A indicates a significant difference ( $p<0.05$ ) between Albanian male population from Kosovo plain and Roma males for positions 4, 5' and 5'', and males from Dukagjini valley and Roma males for positions 4 and 5''. Between Albanian male population from South Morava plain and Roma Chi-square doesn't

reveal statistically significant differences for line A for any position. A significant difference ( $p<0.05$ ) was found for line B between males from Kosovo plain and Roma for positions 5', 5'', 6 and 8; between males from Dukagjini valley and Roma males for positions 5'' and 6; between males from South Morava plain and Roma males for positions 5'' and 6. A significant difference ( $p<0.05$ ) was found for line C between males from Kosovo plain and Roma for positions 6, 7 and 8; between males from Dukagjini valley and Roma males for positions 6, 8, 10 and 11; between males from South Morava plain and Roma males for positions 7 and 8. A

significant difference ( $p < 0.05$ ) was found for line D between females from Kosovo plain and Roma males for positions 8 and 10; between males from Dukagjini valley and Roma males for positions 8, 9 and 11; between males from South Morava plain and Roma males for position 13'. A significant difference ( $p < 0.05$ ) was found for line T between males from Kosovo plain and Roma for positions 12 and 13''; between males from Dukagjini valley and Roma males for position 11; between males from South Morava plain and Roma males for positions 12 and 13''.

For comparison between Albanian and Roma population for both sex is made classical MDS calculation which are presented in figure 2.

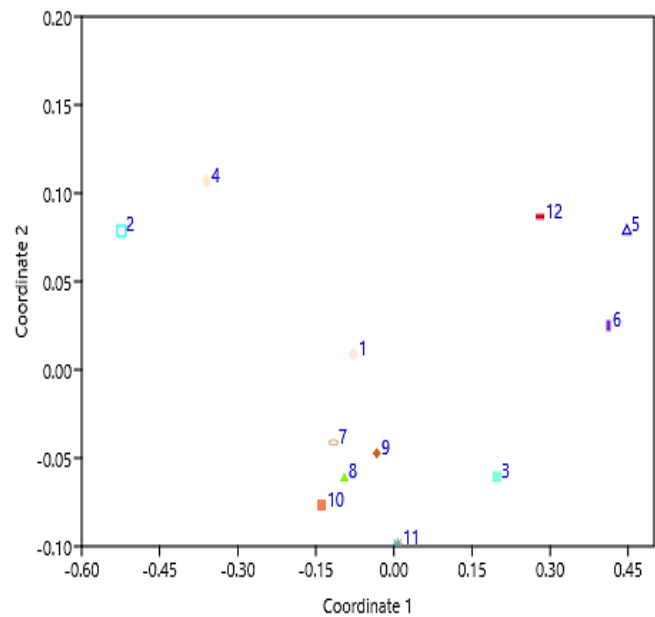
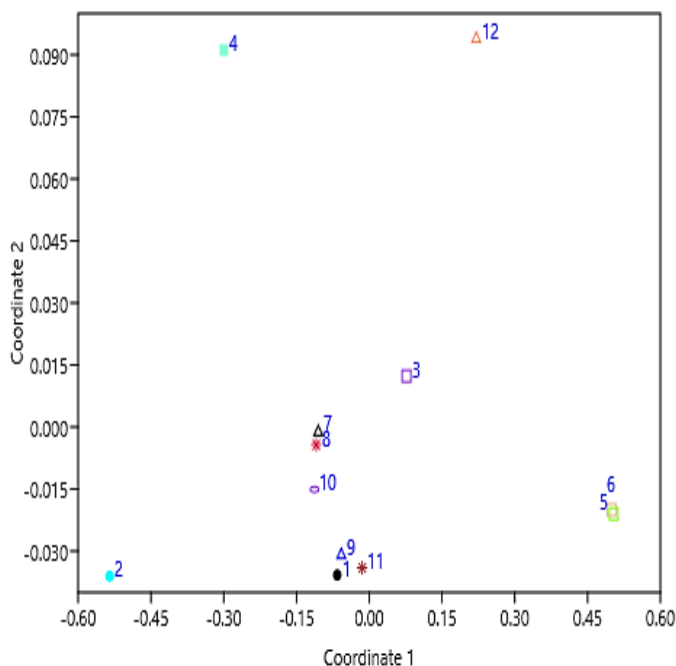


Figure 2 on left and above. An example of classical multidimensional scaling applied for comparison of Albanian from three regions in Kosovo and Roma population. A) Female; B) Male

The quantitative dermatoglyphic traits change more slowly than do the qualitative traits. Statistical comparison showed significant differences between Albanian population from three different regions in Kosovo and the Roma population, which confirms the distinction between Albanian populations and Roma population. According of population studies which are made in Kosovo is shown to have more difference between Bosnian and Albanian population; less differences between Zupa and Gora region from Kosovo (Petranovic et al., 2020). The same results are found during the comparison between Albanian and Turkish inhabitants in Kosovo (Temaj et al., 2009; Temaj et al., 2011).

According to the results from other authors (Jantz and Chopra, 1983; Kamali et al., 1991; Reddy et al., 2001; Reddy et al., 1988; Nagy and Pap, 2004; Temaj et al., 2011) palmar traits are better indicators of distances among populations than finger traits. This result was also supported by our research.

Statistical comparisons show significant differences in higher number of palmar traits. There can be two

## Discussion

The study of the qualitative dermatoglyphic traits in the Albanian populations from Dukagjini valley, Kosovo plain, South Morava plain and the Roma population living in Kosovo was carried out to determine whether differences between those two populations could be found. Albanian and Roma populations lives in the same territory, but they are of a different origin and have different customs, and the marriages connecting the two communities are extremely rare.

reasons why palmar traits are better indicators of the distances among populations than finger traits. First, the evolutionary changes in palmar traits can be slower than those in finger traits; second, it is possible that the dependence of palmar traits on environmental factors during their development is smaller than that of finger traits. The more dermatoglyphic traits depend on environmental factors, the less useful they are in estimating distances (Micle and Kobylansky, 1985).

## Conclusion

In conclusion, the Albanian population from three different regions of Kosovo and the Kosovar Roma population show numerous differences in frequencies of qualitative dermatoglyphic pattern, the most important reason for this being their different origins. This indicates the admixture between Albanian and Roma population in Kosovo. The most responsible factors might be geographical isolation, environmental condition, linguistic and socio-cultural differences. Qualitative traits are not very sensitive to evolutionary forces (Dittmar, 1993; Froehlich and Giles, 1968; Rotthammer et al., 1997), thus these traits reflect the differences between the populations of different origins for long periods of time.

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