

## SOLE PATTERNS IN SOME ETHNIC GROUPS

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### Abstract

Populational dermatoglyphic study was conducted in order to gain and compare data between different ethnic groups.

The aims of the study were to analyze and compare individual dermatoglyphic features in healthy examinees of Macedonian, Albanian and Roma ethnic origin.

Some dermatoglyphic parameters were read on the right and left sole prints obtained from healthy individuals of Macedonian, Albanian and Roma ethnic origin. In each group sole prints were obtained from 100 males and 100 females. Sole prints were taken using Cummins and Midlo's ink method. Dermatoglyphics was classified and comparison was made with the results obtained by other authors.

We found that the most present patterns in both sexes were in the hallucal, first interdigital and distal thenar area on the sole.

The second more common pattern was found in the third interdigital area, with higher frequency in males than in females, and the smallest frequency was found in Roma females. The next pattern was in the second interdigital configurational area on the sole, and again with higher pattern presence in males than in females.

Distal loops were the most abundant pattern, followed by concentric whorls, and the rest of the patterns were found in lower percentage in all groups and both sexes.

The results obtained for the present triradii were:  $d, c > b, a > pm > p > e > p', p''$  in males and  $d > c > a, b > pm > p > e > p' > p''$  in females.

The results obtained in this study along with data on other dermatoglyphic features elaborated by other authors can serve as the basis for the dermatoglyphic status in the healthy population of Macedonian, Albanian and Roma ethnic origin. They can also serve in further medico-biological investigation for theoretical and scientific purposes.

**Keywords:** dermatoglyphics, sole prints, ethnic groups

### Introduction

Classification of the patterns of the sole area is one of the tasks of dermatoglyphic analysis. During the past few decades the use of dermatoglyphics in anthropology has increased. Methodological approaches became more sophisticated and dermatoglyphics researches have been summarized in excellent reviews and papers.

We have the chance to look at some of the insights dermatoglyphics have provided into population variation [1].

One of the most neglected aspects of dermatoglyphics research has been the studies of the plantar surface. Relatively few scientists, compared to the palmar literature, have examined toes and soles.

The lack of data for the sole patterns in healthy population led us to undertake this study in order to provide basic frequencies of a random population sample's sole pattern distribution and whether the information obtained from the sole studies provide additional useful anthropological data [2].

The classification of dermatoglyphics on the human sole reported in 1969 by Penrose and Loesch offered new possibilities for comprehensive analysis of sole and toes patterns. From simple looking at prints of the sole it is obvious that the interpretation of patterns is more difficult compared to those analyzed on the hands.

They are most often extralimital, situated on the extreme fibular or tibial borders of the soles; they vary greatly in their size and appearance and are not limited to one particular configurational area. The toes are short with limited movements [3].

The paper describes classification of the patterns on the configurational areas of the sole and describes some differences among people from few ethnic groups.

### **Material and method**

In this paper we present the statistical analysis of plantar pattern frequencies on the sole prints in 200 Macedonians (100 males and 100 females), 200 Albanians (100 males and 100 females), and 200 Roma (100 males and 100 females).

All prints were taken by Cummins and Midlo's ink method.

The prints were taken from healthy examinees of Macedonian, Albanian and Roma nationality who live in Shutka settlement and students at the Ss. Cyril and Methodius University in Skopje.

Types of patterns present on the sole were formulated as: whorls, which were divided as three types-concentric (Wc), elliptical (We) and spiral (Ws). Loops, according to their orientation, can be positioned in three directions - tibial loop (Lt), fibular loop (Lf), distal loop (Ld), proximal loop (Lp) and finally arches. We also detected some accidental patterns in the first configurational area of the sole.

Triradii are the center in which the line from three different regions meet and the angle between them is higher than 90 degrees. Triradii are divided as basic (a, b, c, d, e, p, pm) and additional ones with the apostrophe (p', p''). Arches are patterns without triradii; whorls have two and loops are patterns with one present triradii.

Configurational areas on the sole are:

Hal/Thd-Idp1: hallucal (distal thenar and first interdigital);

Idp2: second interdigital configurational area;

Idp3: third interdigital configurational area;

Idp4: fourth interdigital configurational area;

Thp: thenar proximal, Hyd: hypothenar distal and Hyp: hypothenar proximal;

Cal: calcar.

Statistical analysis for the qualitative parameters was done. The significant difference was with the error lower than 0.05 (p).

### **Results**

The results of the study are shown in tables. The frequencies for the present patterns on the sole areas were: the most present patterns in all groups and both sexes were found in the Hal/Thd-Idp1 distal loops (Ld); concentric whorls (Wc) were the next ones, then arches and tibial loops (Lt) with the lowest frequency in all groups and for both sexes. Distal loops (Ld) were more abundant in the Idp3, concentric whorls (Wc) in Macedonian males were present in higher percentage compared to the other groups and proximal loops (Lp) in the Idp3 sole area, both in males and females. Proximal loops (Lp) were found in the highest percentage in the Idp3; in female they had slightly lower values than in male examinees.

In the Idp4, distal loops (Ld) were the most present pattern, with the highest values in Albania males.

In the hypothenar distal (Hyd), tibial loops (Lt) were found in Roma females in the lowest percentage. Accidentals (Wacc) were present in small numbers in the Hal/Thd-Idp1 area in male examinees.

**Table 1.** Distribution of sole patterns in Macedonian males

Patterns	Hal/Thd-Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	17%	32%	1%	1%	15%	14%	0%	0%	0%	0%	0%	0%
W-e	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
W-s	8%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
L-t	6%	3%	0%	0%	0%	0%	0%	0%	18%	20%	0%	0%
L-d	49%	50%	1%	0%	41%	40%	8%	9%	0%	0%	0%	0%
L-p	0%	0%	24%	27%	3%	8%	2%	0%	0%	0%	0%	0%
A	11%	9%	0%	0%	0%	0%	0%	0%	4%	4%	0%	0%
Wacc	4%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>96%</b>	<b>100%</b>	<b>26%</b>	<b>28%</b>	<b>59%</b>	<b>62%</b>	<b>10%</b>	<b>9%</b>	<b>22%</b>	<b>24%</b>	<b>0%</b>	<b>1%</b>

**Table 2.** Distribution of sole patterns in Albanian males

Patterns	Hal/Thd-Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	25%	30%	3%	1%	5%	6%	2%	0%	0%	0%	0%	0%
W-e	2%	1%	1%	2%	2%	1%	0%	0%	0%	0%	0%	0%
W-s	3%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%
L-t	2%	1%	0%	0%	0%	0%	0%	0%	14%	13%	4%	4%
L-d	57%	51%	1%	0%	43%	37%	23%	17%	0%	0%	0%	0%
L-p	0%	0%	26%	30%	8%	10%	3%	3%	0%	0%	0%	0%
A	6%	5%	0%	0%	0%	0%	0%	0%	4%	5%	1%	0%
Wacc	3%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>98%</b>	<b>99%</b>	<b>31%</b>	<b>33%</b>	<b>58%</b>	<b>54%</b>	<b>28%</b>	<b>20%</b>	<b>19%</b>	<b>19%</b>	<b>5%</b>	<b>4%</b>

**Table 3.** Distribution of sole patterns in Roma males

Pattern s	Hal/Thd- Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	18%	21%	1%	1%	5%	6%	0%	0%	0%	0%	0%	0%
W-e	0%	0%	0%	0%	6%	7%	0%	0%	0%	0%	0%	0%
W-s	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-t	13%	7%	0%	0%	0%	0%	0%	0%	19%	20%	0%	0%
L-d	60%	58%	2%	1%	34%	28%	11%	9%	0%	0%	0%	0%
L-p	0%	0%	33%	32%	7%	13%	3%	4%	0%	0%	0%	0%
A	5%	9%	0%	0%	0%	0%	0%	0%	6%	3%	0%	0%
Wacc	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>99%</b>	<b>99%</b>	<b>36%</b>	<b>34%</b>	<b>52%</b>	<b>54%</b>	<b>14%</b>	<b>13%</b>	<b>25%</b>	<b>23%</b>	<b>0%</b>	<b>0%</b>

**Table 4.** Distribution of sole patterns in Macedonian females

Pattern s	Hal/Thd- Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	23%	28%	0%	1%	2%	1%	1%	1%	0%	0%	0%	0%
W-e	4%	4%	1%	1%	4%	3%	0%	0%	0%	0%	0%	0%
W-s	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-t	6%	6%	0%	0%	0%	0%	0%	0%	10%	12%	0%	0%
L-d	54%	52%	2%	2%	22%	15%	10%	8%	0%	0%	1%	1%
L-p	0%	0%	28%	26%	20%	18%	5%	4%	0%	0%	0%	0%
A	4%	6%	0%	0%	0%	0%	0%	0%	4%	3%	1%	0%
Wacc	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>93%</b>	<b>97%</b>	<b>31%</b>	<b>30%</b>	<b>48%</b>	<b>37%</b>	<b>16%</b>	<b>13%</b>	<b>14%</b>	<b>15%</b>	<b>2%</b>	<b>1%</b>

**Table 5.** Distribution of sole patterns in Albanian females

Patterns	Hal/Thd-Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	19%	17%	0%	1%	7%	3%	1%	0%	0%	0%	0%	0%
W-e	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
W-s	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-t	10%	6%	0%	0%	0%	0%	0%	0%	7%	6%	2%	2%
L-d	59%	57%	4%	3%	25%	29%	2%	5%	0%	0%	0%	0%
L-p	0%	0%	18%	22%	12%	10%	4%	2%	0%	0%	0%	0%
A	8%	11%	0%	0%	0%	0%	0%	0%	3%	2%	0%	0%
Wacc	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>99%</b>	<b>96%</b>	<b>22%</b>	<b>26%</b>	<b>45%</b>	<b>42%</b>	<b>7%</b>	<b>7%</b>	<b>10%</b>	<b>8%</b>	<b>2%</b>	<b>2%</b>

**Table 6.** Distribution of sole patterns in Roma females

Patterns	Hal/Thd-Idp1		Idp2		Idp3		Idp4		Hy-d		Cal	
	right	left	right	left	right	left	right	left	right	left	right	left
W-c	24%	29%	1%	0%	2%	3%	0%	0%	0%	0%	0%	0%
W-e	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
W-s	1%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-f	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
L-t	5%	8%	0%	0%	0%	0%	0%	0%	1%	1%	2%	3%
L-d	55%	43%	0%	0%	16%	19%	5%	5%	0%	0%	0%	0%
L-p	0%	0%	23%	21%	10%	4%	2%	1%	0%	0%	0%	0%
A	9%	11%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%
Wacc	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
<b>Total</b>	<b>94%</b>	<b>95%</b>	<b>24%</b>	<b>24%</b>	<b>28%</b>	<b>26%</b>	<b>7%</b>	<b>6%</b>	<b>2%</b>	<b>2%</b>	<b>2%</b>	<b>3%</b>

Statistically significant differences for the present patterns of the configurational areas of the sole were found: in the Hal/Thd-Idp1 for the Lt patterns; they were more present in Roma males.

In females, Wc in Roma were with statistically significant difference compared to Albanian female examinees.

Statistically significant differences for the other areas on the sole were found: in female examinees the Ld and Lp in the Idp 3 had higher values in Macedonians than in Albanians and in the Ld in Idp4 higher values in Macedonian females.

In the Idp2 statistically significant differences for Ld and in Idp3 for Lp also higher in Albanians compared to Roma females. In male examinees, a statistical difference was found in the Idp 4; Ld was found in higher percentage in Albanians compared to Macedonians as well as in Roma examinees. In Idp3 there were more Ld patterns in Macedonian than in Roma males.

**Table 7.** Triradii on the sole in both sexes

Triradii male	Macedonians		Albanians		Roma	
	right	left	right	left	right	left
a	82%	94%	89%	95%	87%	93%
b	87%	84%	98%	91%	97%	98%
c	100%	100%	100%	100%	93%	95%
d	100%	100%	100%	100%	100%	100%
e	42%	41%	44%	45%	41%	42%
p	73%	69%	63%	56%	59%	59%
p'	7%	10%	12%	12%	13%	10%
p''	11%	6%	13%	15%	10%	9%
pm	82%	84%	86%	86%	79%	78%
Triradii female	Macedonians		Albanians		Roma	
	right	left	right	left	right	left
a	90%	94%	89%	90%	75%	90%
b	95%	93%	92%	87%	91%	89%
c	99%	99%	99%	99%	100%	100%
d	100%	100%	100%	100%	100%	100%
e	39%	38%	32%	32%	47%	47%
p	46%	46%	48%	47%	49%	49%
p'	7%	8%	6%	12%	7%	7%
p''	1%	0%	2%	0%	1%	2%
pm	82%	82%	78%	79%	80%	81%

For the present basic and additional triradii the results are shown in Table 7, for males and for females with the following formulas:  $d, c > b, a > pm > p > e > p', p''$  in males and  $d > c > a, b > pm > p > e > p' > p''$  formula in females.

Statistically significant differences for the present basic and additional triradii were found: among males, for the b triradii, higher values in Roma, as for the p and a triradii we found higher values in Macedonians.

In female examinees a significant difference was found for the a triradii higher values in Macedonian females and for e triradii higher values in Roma females.

### Discussion

The results have shown dermatoglyphic qualitative plantar characteristics in different ethnic groups; therefore, they represent data for their presence in healthy population.

The findings of Loesch and Skrinjaric in their examination of a population group of 219 children of Croatian and 63 of Polish origin showed more fibular loops than in Roma people; the triradii were not specific and different enough to mark the chosen nationality.

The precise definition of the plantar loops gives us possibility for further examination and exploring their biological and genetic significance according to two authors [3].

Plantar prints of 500 people from Egypt were examined by Hassan and Sayed. Their results are consistent with our findings for the patterns of the sole regions and toes. On the sole configurational areas distal loops prevailed [4].

In healthy examinees of a tribe in Malwala, there were fibular loops on the four digits, but not on the fifth one. Arches were with 100% presence on the fifth digit as in our study. PII was higher than in our study [5].

Siemens GJ. study included 310 Jews and 124 non-Jews whites. Jews showed higher PII with more dermatoglyphic patterns present; there were whorls in the third interdigital region different from our study. Distal loops and whorls in the second interdigital space were the same as in our study although Roma people were with a smaller percentage.

In Jews hallucal and hypothenar region, there were whorls, tibial loops, and additional triradii were more abundant. Jews showed more ridges in transverse direction compared to Roma and non-Jews whites [6].

Buchwald and Grubska examined 20 traits of the fingers, 22 traits of the palm and 8 traits of the sole, on both sides of the body of 1652 males and 1628 females. Numbers of asymmetrical variants of the traits within the whole complex of 25 pairs of traits were determined individually. The greatest dimorphism was demonstrated by the asymmetry of the patterns in the IV area of the sole in contrast to our study.

The proposed index of dermatoglyphic asymmetry (IA) may be used for comparative purposes in population, clinical and genetic research [7].

In the Gasiowski A. study a comparison of the distribution of sole dermatoglyphics in the rural populations of different regions of Poland was made and the results are similar to ours. A comparison of the occurrence of dermatoglyphics in the population of the Lublin region and that of their occurrence in the populations of Suwałki, Ostrołęka and Giełbo areas revealed statistically significant differences between particular patterns.

According to the author, the differences were the result from ethnic isolation and isolation of the communities caused by geographical barriers [8].

## **Conclusion**

The results obtained in this study have demonstrated that the analyzed sole patterns can be considered as a good set of sole features to be used in finding of biological relationships between some different ethnic groups, with further possible use in clinical and genetic studies.

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