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Population affinities assessed by dermatoglyphic and hemogenetic variables

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With 3 figures and 2 tables

Summary: 13 dermatoglyphic variables have been studied in eight population samples (five smaller isolated and three larger populations) to identify the possible differences between the larger and the smaller isolated populations. The data and neighbor joining trees for the dermatoglyphic variables show distinct differences between males and females. The isolated population of the Lutheran Mountains is clearly separated from the other populations. Combining the results of dermatoglyphic and 12 hemogenetic variables (only for six populations) the male and female trees are nearly identical. The three isolated populations are clearly separated, whereas the larger ones show smaller distances.

Key words: Dermatoglyphics, hemogenetic variables, genetic distances.

Introduction

Large populations are mostly more homogeneous in their gene pool and exhibit close resemblance (expressed by genetic distance) than smaller populations. The latter are characterized by larger deviations in the frequencies of morphogenetic and hemogenetic markers due to stochastic processes which can alter gene and phenotype frequencies in small and isolated populations (Jantz et al. 1969, Rothhammer et al. 1977, Relethford 1991, Demarchi & Marcellino 1998). In the present paper the relations of some isolated population groups to their regional provenance has been studied, using frequency data of some dermatoglyphic and hemogenetic markers.

We have selected eight groups in the present study for several reasons. First, some data of the finger- and palmprints used in the analysis and collected during a field project in particular countries (Germany, Slovakia, Romania), have not been published as yet. Second, we wanted to analyze the relationships among these dispersed groups that live in various countries, belong at present to different linguistic affiliations, but they are tied (somehow) to each other by historical events. And last, both data sets (dermatoglyphics and blood genetics) are available for the same populations except for Lindenfeld and Şumiţa.

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Background of the populations

Lutheran Mountains (Lutherische Berge, Germany)

This isolated population, living in three neighboring villages in the Lutheran Mountains (E 9°67′ N 48°33′), is a Protestant diaspora amidst an almost exclusively Catholic population. The isolation has endured for 400 years and still exists to some extent (Schmidt & Scheil 1998).

Lindenfeld (Romania)

The highly isolated village Lindenfeld (E 22° 05′ N 45° 36′) was founded by German speaking immigrants from Bohemia (region of Klatovy/Klattau, Czechia) in 1833. Due to an intensive emigration depending on the economic situation, the village became extinct in the second half of the 20th century (Schmidt 1991). The population size was about 200 individuals.

Şumiţa (Romania)

The village Şumiţa (E 22° 13′ N 44°96′) was founded approximately by 50 Czech and 7 German families from Bohemia (region of Beroun) in 1830 (Schmidt & Scheffrahn 1996). Both villages are situated in the Semenic Mountains (Banat, southwestern Romania).

Chmel'nica (Slovakia)

The village Hopgarten (Chmel'nica, E 20°7′ N 49°3′) is situated in the north of Slovakia, near the town of Stará Lubovňa. The village was founded by German immigrants in 1315 or 1354. The settlers of the last period of colonization came from Hannover, Bremen, Prussia and Swabia in the 18th century (Siváková et al. 1995).

Medzev (Slovakia)

The village Unter-Metzenseifen (Medzev, E 20°9′ N 48°7′) has been established in 1359, based on German mining colonizers. The village was highly isolated till the beginning of the 20th century (Siváková & Walter 1996). In 1950 there were 2350 inhabitants. (The present day town Medzev was founded by fusion of Unter- and Ober-Metzenseifen in 1961).

Material and methods

The study includes populations from Germany (Bavaria, 86 males, 88 females, Jantz 2004; Northrhine-Westfalia, 154 males, 157 females, this study; Lutheran Mountains, 28 males, 43 females, Allgaier 1996), Romania (Lindenfeld, 87 males, 80 females, Vulpe 1976; Şumiţa, 128 males, 134 females, this study), Slovakia general (200 males, 200 females, Pospíšil 1970, 1971, Mačurová 2000), Chmel'nica (42 males, 33 females, Siváková et al. 1995); Medzev (50 males, 70 females, this study).

The panel of 13 dermatoglyphic variables used were the finger patterns (arches, tented arches, ulnar loops, radial loops, whorls), total finger ridge count, pattern intensity of fingers, a-b ridge count (right and left), Cummins' index of main lines (right and left), status of main

Table 1. Variability of digito-palmar dermatoglyphs and some indices in male population samples.

	Germany			Romania		Slovakia		
	Bavaria	Northrhine-Westfalia	Lutheran Mountains	Lindenfeld	Şumiţa	Slovakia general	Chmel'nica (Hopgarten)	Medzev (Metzenseifen)
n	86	154	28	87	130	200	42	50
Arches	3.95	2.99	1.43	2.43	3.98	2.17	6.47	7.04
Tented arches	0.93	0.58	0.36	0.49	0.08	0.55	0.48	0.20
Loops ulnar	60.00	59.61	61.07	64.93	48.20	55.42	55.16	46.28
Loops radial	5.58	5.97	3.57	3.88	5.47	5.14	3.12	4.83
Whorls	29.53	30.84	33.57	28.28	42.27	36.73	34.77	41.65
Total finger ridge count	137.71	135.01	130.25	136.16	134.58	151.60	142.14	145.91
Pattern intensity of fingers	12.64	12.79	12.33	12.58	13.05	13.35	12.60	13.44
a-b ridge count								
Right	41.01	39.62	40.29	39.01	39.42	41.48	38.24	37.72
Left	41.46	40.56	42.75	39.58	39.85	41.48	40.90	38.70
Main line index right	10.30	8.91	9.96	9.30	9.20	9.49	9.46	9.76
Main line index left	7.84	7.97	8.97	7.39	7.79	8.42	8.12	8.96
Mainline C, right								
Missing	3.30	5.13	3.57	2.30	3.85	4.50	7.32	–
Rudimental	16.48	8.33	14.29	6.90	10.00	6.50	2.44	4.00
Present	80.22	86.54	82.14	90.80	86.15	89.00	90.24	96.00
Mainline C, left								
Missing	3.30	7.69	3.57	5.75	3.08	12.00	4.88	18.00
Rudimental	30.77	9.62	3.57	16.09	20.00	10.00	2.44	–
Present	65.93	82.69	92.86	78.16	76.92	73.00	92.68	82.00
Hypothenar patterns right	39.56	36.54	76.67	29.89	28.46	42.50	39.02	50.00
Hypothenar patterns left	32.97	32.05	73.33	28.74	28.46	40.00	43.90	48.00
Thenar patterns right	4.40	6.41	17.86	2.30	4.62	13.00	8.53	10.00
Thenar patterns left	9.89	12.82	33.33	13.79	11.54	25.00	18.29	8.00

Table 2. Variability of digito-palmar dermatoglyphs and some indices in female population samples.

	Germany			Romania		Slovakia		
	Bavaria	Northrhine-Westfalia	Lutheran Mountains	Lindenfeld	Şumiţa	Slovakia general	Chmel'nica (Hopgarten)	Medzev (Metzenseifen)
n	88	157	43	80	135	200	33	70
Archs	5.23	4.39	5.12	1.88	6.19	4.76	2.73	7.60
Tented archs	1.14	0.25	1.16	0.38	0.22	0.50	0.61	1.00
Loops ulnar	59.55	60.00	65.58	66.13	55.97	60.20	56.36	54.52
Loops radial	5.11	4.90	4.88	2.38	5.15	3.11	4.55	3.44
Whorls	28.98	30.45	23.26	29.25	32.46	31.42	36.76	33.43
Total finger ridge count	124.53	136.17	122.45	134.29	126.11	129.80	144.56	132.72
Pattern intensity of fingers	12.36	12.62	11.79	12.74	12.63	12.65	13.27	12.48
a-b ridge count								
Right	40.23	38.59	40.29	38.67	39.75	41.80	38.73	37.07
Left	41.48	40.60	42.75	38.35	40.07	42.41	40.06	38.60
Main line index right	9.17	8.98	9.64	8.96	8.81	9.71	10.12	9.63
Main line index left	7.78	7.91	8.79	7.57	7.24	8.29	9.55	9.03
Mainline C, right								
Missing	10.00	3.80	0.00	6.25	3.70	6.00	9.09	10.00
Rudimental	23.33	6.96	4.76	5.00	5.19	2.50	–	–
Present	66.67	89.24	95.24	88.75	91.11	91.50	90.91	90.00
Mainline C, left								
Missing	12.22	10.13	7.14	7.50	5.93	9.00	9.09	11.43
Rudimental	23.33	8.86	4.76	15.00	17.78	8.00	15.15	1.43
Present	64.44	81.01	88.10	77.50	76.30	83.00	75.76	87.14
Hypothenar patterns right	44.44	38.61	60.47	37.50	34.81	38.50	39.39	42.86
Hypothenar patterns left	38.89	36.08	67.44	40.00	26.67	38.00	30.30	44.29
Thenar patterns right	7.78	6.96	24.32	–	5.93	15.00	6.06	8.57
Thenar patterns left	10.00	16.46	21.05	7.50	14.81	29.50	13.64	11.43

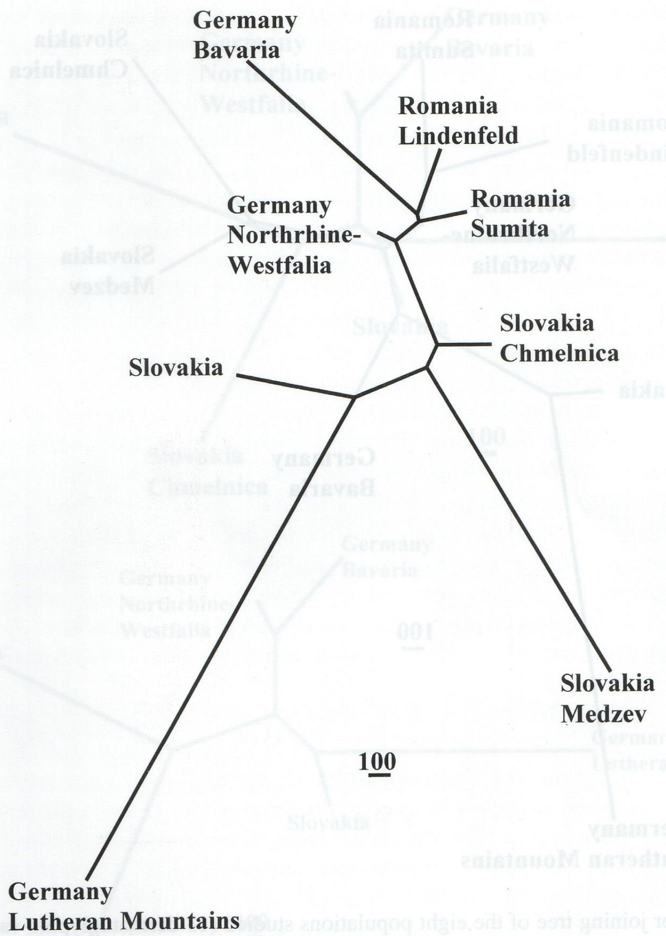


Fig. 1. Neighbor joining tree of the eight populations studied (13 dermatoglyphic variables), based on Hiernaux distances – males.

line C right and left (missing, rudimental, present), hypothenar patterns right and left (missing and arches or patterns and vestiges), thenar patterns right and left (missing and arches or patterns and vestiges). The panel of 12 hemogenetic variables used (the same for males and females) were ABO, MNSs, HPA, TF subtypes, GC subtypes, PI subtypes, ACP, AK, ADA, GLO, PGD and PGM1 subtypes. The data came from the literature (*Germany: Bavaria*: Baitsch & Liebrich 1961, Berg et al. 1974, 1977, Cleve et al. 1978, Gussmann 1970, Rasch 1960, Schwarzfischer & Liebrich 1961, Weidinger & Schwarzfischer 1980, Weidinger et al. 1980, 1984 Wiebeke 1976; *Lutheran Mountains*: Schmidt & Scheil 1996, *Northrhine-Westfalia*: Huckenbeck et al. 1989, Scheil & Koppatz 1991, Scheil et al. 1991, Scheil & Strunz 1996; *Slovakia general, Chmel'nica, Medzev*: Siváková et al. 1995b, 1997).

The dendrograms have been made with the PHYLIP program (Felsenstein 1993), based on the Hiernaux distances (Hiernaux 1965). However, a modified procedure has been used

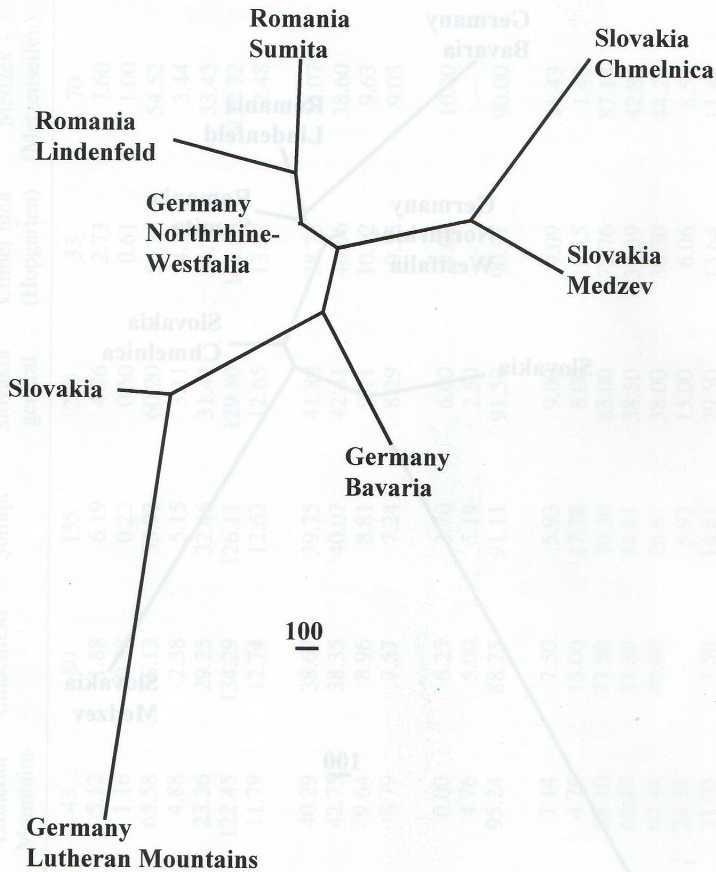
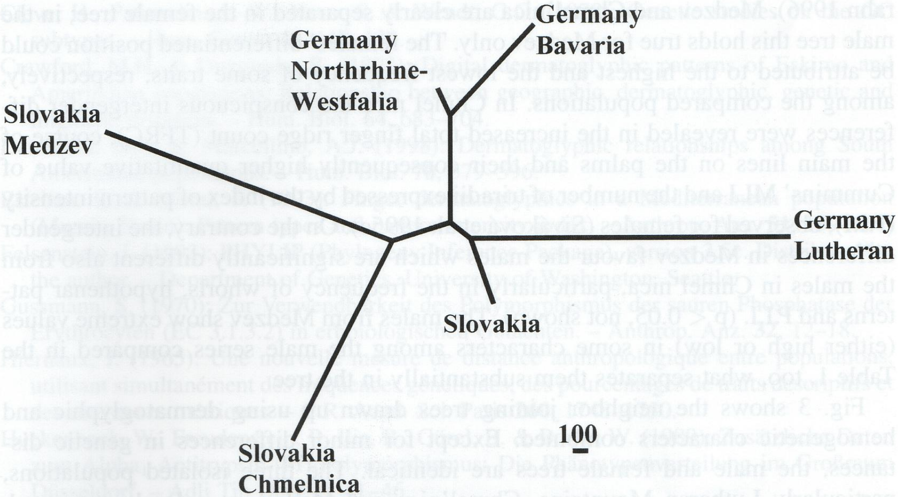


Fig. 2. Neighbor joining tree of the eight populations studied (13 dermatoglyphic variables), based on Hiernaux distances – females.

according to Knußmann (1992); since there are no sufficient data for "W" in the literature, the variation between the studied populations was used.

Results and discussion

Table 1 and Table 2 show the variability of digital and palmar dermatoglyphs in particular male and female samples of the studied populations. As can be seen from the tables there are differential patterns between sexes and the populations, especially in the percentage of whorls, total finger ridge count, development of the mainline C and hypothenar patterns. The neighbor joining trees (Fig. 1 and Fig. 2), drawn up from the Hiernaux distance matrix reflect these differences. In accordance with other studies (e.g. Arrieta et al. 1992, Baltova & Scheil 2007, Scheil



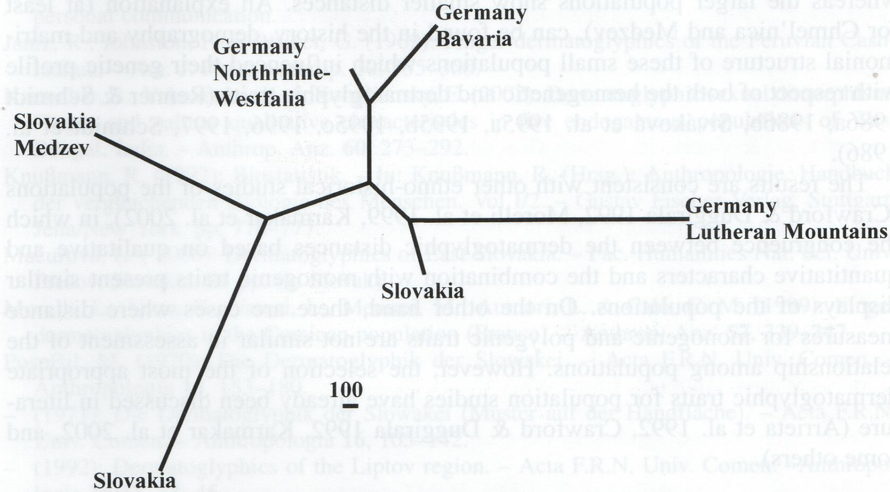


Fig. 3. Neighbor joining tree of the six populations studied (13 dermatoglyphic and 12 hemogenetic variables), based on Hiernaux distances. Top: males, bottom: females.

et al. 2005) the trees are distinctive between males and females. In both cases, the samples of the Lutheran Mountains are clearly separated from the other populations. The populations of Lindenfeld and Şumiţa exhibit more similar position especially in the male tree. This resemblance may be due to inflow of exogamous partners from German families in Şumiţa and from Czech families in Lindenfeld, which mixed in populations. In addition, a certain gene flow between the Germans and the Czechs in Bohemia prior to the emigration to Romania cannot be excluded (Schmidt & Scheffrahn 1996). Medzev and Chmel'nica are clearly separated in the female tree; in the male tree this holds true for Medzev only. The females' differentiated position could be attributed to the highest and the lowest frequency of some traits, respectively, among the compared populations. In Chmel'nica the conspicuous intergender differences were revealed in the increased total finger ridge count (TFRC), course of the main lines on the palms and their consequently higher quantitative value of Cummins' MLI and the number of triradii expressed by the index of pattern intensity (P.I.I), observed for females (Siváková et al. 1995c). On the contrary, the intergender differences in Medzev favour the males which are significantly different also from the males in Chmel'nica, particularly in the frequency of whorls, hypothenar patterns and P.I.I. ($p < 0.05$, not shown). The males from Medzev show extreme values (either high or low) in some characters among the male series compared in the Table 1, too, what separates them substantially in the tree.

Fig. 3 shows the neighbor joining trees drawn up using dermatoglyphic and hemogenetic characters combined. Except for minor differences in genetic distances, the male and female trees are identical. The three isolated populations, particularly Lutheran Mountains, Chmel'nica and Medzev are clearly separated, whereas the larger populations show smaller distances. An explanation (at least for Chmel'nica and Medzev), can be found in the history, demography and matrimonial structure of these small populations which influenced their genetic profile with respect of both the hemogenetic and dermatoglyphic traits (Renner & Schmidt 1986a, 1986b, Siváková et al. 1995a, 1995b, 1995c, 1996, 1997, Schmidt et al. 1986).

The results are consistent with other ethno-historical studies of the populations (Crawford & Duggirala 1992, Morelli et al. 1999, Karmakar et al. 2002), in which the congruence between the dermatoglyphic distances based on qualitative and quantitative characters and the combination with monogenic traits present similar displays of the populations. On the other hand, there are cases where distance measures for monogenic and polygenic traits are not similar in assessment of the relationship among populations. However, the selection of the most appropriate dermatoglyphic traits for population studies have already been discussed in literature (Arrieta et al. 1992, Crawford & Duggirala 1992, Karmakar et al. 2002, and some others).

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