Institute of Experimental Morphology, Pathology and Anthropology with Museum
Bulgarian Anatomical Society

Acta morphologica et anthropologica, 28 (3-4)
Sofia ● 2021

Review Articles

Application of Dermatoglyphics traits of population variation study

Gazmend Temaj

College UBT, Faculty of Medicine and Pharmacy, Kalabriann, Pristina, Kosovo

Corresponding author e-mail:gazmend.temaj@ubt-uni.net

Scientific study of the epidermal ridges in hands, finger, feet, and toes is called dermatoglyphics. The word Dermatoglyphics derives from the Greek word derma = "skin", and glyph = "carving", and was used for first time in 1892 by Sir Francis Galton. Dr. Harold Cummins an American scientist is considered the father of fingerprint analysis.

This field has a lot of applications in modern day population and medical research. The present review is focused on the different aspects of dermatoglyphics and also its applications. A brief account about the development of dermatoglyphic studies in Kosovo and some countries in the southeast of Europe has also been discussed.

Key words: Dermatoglyphic analysis, dermatoglyphs and diseases, qualitative analysis, quantitative analysis, Monozygotic and Dizygotic twins

Introduction

Brief History of Dermatoglyphics

Fingerprint traits have been noticed since the ancient times. In China for example, the people have used their fingerprints to stamp the validity of documents. The use of fingerprint as signature in Japan, India and some countries in Europe were well documented. C. A. Mayer a German doctor wrote: "Although the arrangement of skin ridge is never duplicated in two persons, nevertheless the similarities are evident among some individuals" [5].

The first scientist who started to explain dermatoglyphics was Galton [7, 9, 12]; he searched on fingerprints of people and primates. The work of Galton, Herschel and

Faulds [7, 9, 12] has been essential to establishing the individuality and uniqueness of the images, and by this it is possible to identify humans using finger-palm prints as well [8].

A few years later, it has been possible to make a dermatoglyphic description of a foot. After that, a series of scientists continued to study the foot dermatoglyphics [11].The first monographs are published by Cummins and Middlo [5, 6]: the first monograph was about the skin relief in primates [5] and the second about general dermatoglyphics [6].

We know that Bansal (1965) [1], is the first author who wrote a report about bilateral symmetry, he has done measurements of the distance between the triradii of the third and the fourth finger.

Geographical distribution of palmar dermatoglyphic traits in inhabitants of Kosovo

Dermatoglyphic prints were collected from 800 inhabitants of south west Kosovo (Dukagjin valley). The sample consisted of Albanians (N=400) and Turks (N=400). The qualitative traits of dermatoglyphs which are analyzed during this study are: arch, ulnar and radial loop, whorl, accidental whorl and on palms (I, II, III, IV interdigital areas,thenar, hypothenar, main line index, and the axial »t« triradius position). During this study a significant difference in most of qualitative traits between Albanian and Turkish inhabitants was observed. This finding is a good indication of reproductive isolation between Albanian and Turkish inhabitants, despite the fact that both populations lived very close to each other for several centuries [36].

Dermatoglyphic study in the Albanian population from three Kosovo district regions was conducted to analyze qualitative traits. During this study microevolutionary changes were tried to be obtained.

The number of participants in this research was 641 people of Albanian nationality of both sexes. The analysis included arch, ulnar and radial loop, whorl, and accidental whorl on fingers; and on the palm it included the main line, Thenar, I, II III, IV and hypothenar area.

The significant differences are found on several types between distinct groups in most of the cases. The results from the study by Temaj *et al.* show that inhabitants of the Albanian nationality from South Morava and Kosovo plain are genetically closer; the inhabitants from Dukagjini valley of Albanian nationality are less close to any of them. Temaj *et al.* show that analysis of qualitative dermatoglyphic traits is possible to utilize effectively to track the microevolutionary changes [37].

In order to compare two geographically and culturally isolated ethnic groups of Slavic Muslims from Zhupa and Gora regions in Kosovo, Petranović et al. analyzed their quantitative dermatoglyphic traits, compared them with each other and with the Albanian majority population. The ANOVA analysis showed more differences between the Albanians and both minority populations, i.e. between Zhupa and Gora populations. Petranović et al., 2020, also detected selective inertia in Slavic Muslim women. The canonical discriminant analysis grouped the Gora and the Zhupa women together, and at the same time closer to the Gora men than to the Kosovo Plain women. The Gora and Zhupa men were much closer to each other than to the men from the Kosovo Plain. To conclude, the Gora and Zhupa populations differ less from each other, than from the Kosovo Albanians [27].

Geographical distribution of palmar dermatoglyphic traits in inhabitants of other countries in Europe

The qualitative dermatoglyphic traits are analyzed in 22 populations of Romania. These analyses are made by geographical and historical relationship [34].

A study by Karev shows that radial arch in males has a frequency 2.82% and in females 2.82%, among 2,130 Bulgarians [14].

The study by Karev in 264 right-, 246 mixed- and 360 left-handers in Bulgaria, shows that hypothenar radial arch, has a higher frequency on the right palm rather than on the left one [15].

Results from the study by Paraskova and Mitova show that in the studied population of Central Western Bulgaria: 1) an increased incidence of t; 2) decreased occurrence of images of Hy and a frequency of AIT and 3) the mean values for some of the dermatoglyphic traits analyzed are in the upper limits of the Eurasian scale, characteristic of the European population with Eastern characteristics [25].

The study by Kavgazova and Stoev in the region Gotse Delchev (villages of Kornitsa, Breznitsa and Lazhnitsa) have been studied aiming at the distinction of a dermatoglyphic complex specific of this population. The results from this study show that, the whole investigated sample belongs to the Europoid sphere and it is with well-pronounced South-Europoid features [16]. In the study by Kavgazova et al., during the study of population from Central Rhodopes (South Bulgaria) show similarity between the examination population and a number of populations from Volga region, Northern Caucasus, Middle Asia and Siberia. These similarities can explain by preservation of the genetic inheritance of the proto-Bulgarians, one of the three main components of the modern Bulgarians [17].

In the study of different groups from the region of Stradwa (Bulgaria), the bimanual asymmetry in some dermatoglyphic traits as whorls, DL10, accessorial interdigital triradili, index of Cummins and carpal axial triradii-t, from both sexes of the studied population was established [22].

Dermatoglyphic analysis in 279 Maltesians was carried out also for qualitative and quantitave quantitative traits. The data from Malta people are compared with 17 other groups of the Mediterranean region; the results show that people from Malta are from the same cluster as the people from Greece, Sardinia and Spain [2].

In Croatia, many studies for qualitative and quantitative dermatoglyphic traits among Croatian inhabitants have been carried out. The study from the Island of Olib for finger and palm traits are compared with dermatoglyphic traits from the Silba island. The finding supports the hypothesis about selective inertia of digital and palm dermatoglyphic traits [32].

Milićić, 2002, conducted a study for latent structure of quantitative dermatoglyphic traits in the population of Middle Dalmatia region especially of the inhabitants of the Brać, Hvar and Korcula islands, the peninsula of Peljesac and Makarska coastal region. She analyzed 18 variables of fingers and palms. The analysis from this study gives information about similarities and differences between the inhabitants who live in these islands and inter – individual variabilities in females compared to males [21].

Nagy and Pap have carried out examinations of dermatoglyphic traits in 11 Hungarian and 5 Gypsy population members for finger and also palm samples. In most of dermatoglyphic traits they found statistical significance, and they came to conclusion that both populations have a different origin and an admixture exists between Hungarians and Gypsies [23].

Association of Dermatoglyphics with Disease

Clinical study conducted in 1936 [6]; Cummins, 1936 [6], at the time pointed dermatoglyphic traits in patients with Down syndrome. Since then a number of studies have been conducted among individuals with different syndromes and chromosomal aberration. Results from different publications revealed smaller or greater deviations from normal finger prints and palm findings. The same was reported by many researchers in numerous genetically determined states.

Huge progress to understanding association of dermatoglyphs with medical disorders was made in the last years.

Many researchers have identified an association of chromosomal aberration with Down syndrome, such as decrease of frequency of whorl on fingertips. Many publications by different authors [13, 30, 31] have shown different frequencies of dermatoglyphic traits in a finger and a palm.

In Edwards's syndrome six or more arches in all fingertips are found. Radial loop on the thumb was found also in many patients compared with normal population [18, 39].

In trisomy 13 or Patau syndrome a radial loop with higher frequency was found, and atd angle for females is 186° and for males 196° [26].

Statistical significance for frequencies of dermatoglyphic traits and gonadal dysgenesis are found also, the report by Skrinjaric et al. [35].

Rudan et al. 1980, suggest that indication dermatoglyphic traits could be applied in the early detection of breast cancer, for the selection of the "high risk group" of diseases [33].

Some authors from India suggest that dermatoglyphic patterns can help effectively to study the genetic basis of breast cancer. Dermatoglyphic traits might prove to be an anatomical, non-invasive, inexpensive and effective tool for screening and studying the patterns in the high-risk population [4].

In the study by Raizada et al., 2013 [28] a significant increase in the arch pattern and a decrease in the radial loops in the right thumb, the left thumb, the left index finger and the left middle finger ($p<0.001$) is shown. A comparison for all fingers of both hands (left and right) in patients with breast cancer shows higher frequencies compared with control group. The lower values of the TFRC (total finger right count (below 50) is shown to be associated with carcinoma breast. Also it shows lower values of the AFRC (absolute finger right count) (below 100) to be associated with the cancer patients.

Dermatoglyphic traits are a facilitated marker for detection of predisposition of pituitary tumor development, and can help in early treatment of the patients[10].

The results of the study of Novak-Laus et al., 2005 [24] reveal that patients with glaucoma have genetic predisposition to develop primary open-angle glaucoma, thus emphasizing the relevance of hereditary factors in the etiopathogenesis of this disease.

Statistical significance is found also between patients with psoriasis and control group for loop, arch and composite patterns, but statistical significance for whorl pattern is not observed. Similarly, statistical significance is found between patients with diseases alopecia areata and control group for loop and arch patterns, but no significant difference regarding the whorl pattern. There was no significant difference regarding any of the dermatoglyphic traits between vitiligo and pemphigus vulgaris patients and controls [29].

Dermatoglyphic trait analysis in twin diagnosis

Twins study appeared to be a good method for genetic predisposition and environment influence. This is shown by Galton 1875 [9]; he has made several experiments to explain environmental influence and genetic inheritance. Galton 1875 [9], has prepared different question test to achieve his aim and to explain manner of genetic inheritance. Today different studies from different disciplines such as psychology, morphology and genetics are used to explain influence of environment factors and genetic inheritance in twins.

Dermatoglyphic traits such as qualitative and quantitative traits are an important element of the twin method study. Dermatoglyphic traits in twin method study lead to the advance of discipline such as medicine (used to establish relationship between change in skin and to explain inheritance of chromosomal disorders as well as to determine the zygotic twins); anthropology (used to explain the origin of different population); criminology (used to solve different questions, rejection or identification of an individual).

Polish twins show a higher value of genetic parameters in hypothenar region [19].

Genetic factors appear to play a pivotal role in the determination of dermatoglyphic traits in monozygotic and dizygotic twins; it appears that genetic effect determines the distribution of traits with intermediate value in hypothenar and thenar region [3].

Twins examination in Albanian population of Kosovo for qualitative traits in hypothenar appears to have a sharply higher heritability in thenar and weak genetic component in hypothenar [38].

In Bulgarian twins for qualitative traits it appears that radial loop is higher in hypothenar in monozygotic twins and dizygotic twins; while ulnar arch is higher in the left hand of dizygotic twins and the right hand of monozygotic twins [20].

Conclusion

The present review briefly explains application of dermatoglyphic traits in genetic population study, identification, inheritance, and twins study, association of different diseases and chromosomal aberration with dermatoglyphics. Dermatoglyphic traits study gives higher contribution to explaining the human variation in genetic population, genetic inheritance and diagnosis for different diseases.

“Dermatoglyphics” in the future might play a significant role not only for the purpose of screening but also for studying and behavior of breast and other cancer diseases.

In conclusion, it is noteworthy that comprehensive dermatoglyphic traits research in genetic population and twins is needed to further elucidate the intimate relationships between heritability and environment in human pathology.

References

1. **Bansal, I. J. S.** Palmar dermatoglyphics in maharashtrians in India. – *Acta geneticae medicae et gemellologiae*, **14**(4), 1965, 431-437.
2. **Bozicevic, D., J. Milicic, J. Ndhlowu, D. Pavicevic, P. Rudan, A. Vassalo.** Dermatoglyphic Traits in the Malta Population. – *Coll. Antropol*., **17(1)**, 1993, 137-146.
3. **Callegari-Jacques, S. M., F. M. Salzano, H. F. Pena.** Palmar dermatoglyphic patterns in twins. – *Hum. Hered*., **27**, 1977, 437-443.
4. **Chintamani Khandelwal, R., A. Mittal, S. Saijanani, A. Tuteja, A. Bansal, D. Bhatnagar, S. Saxena.** Qualitative and quantitative dermatoglyphic traits in patients with breast cancer: a prospective clinical study. – *BMC Cancer*, **13**, 2007,7, 44.
5. **Cummins, H.** The topographic history of volar pads (walking pads, Tastballen) in the human embryo. – *Contrib. Embryol. Carnegie. Inst. Wash.*, **20**, 1929, 103-126.
6. **Cummins, H., C. Midlo.** *Fingerprints, Palms, and Soles. An Introduction to Dermatoglyphics*. New York, USA, Dover Publications, 1961.
7. **Faulds, H.** *Guide to Finger-print Identification*. Hanley, Wood, Mitchell & Co Ltd, 1905.
8. **Fournier, N., H. Ross.** Sex, ancestral, and pattern type variation of fingerprint minutiae: A forensic perspective on anthropological dermatoglyphics. – J. Am. Phys. Anthrop., **158**(3), 2015, 78-84.
9. **Galton, F.** The history of twins, as a criterion of the relative powers of nature and nurture. – *Fraser's Magazine*, **12**, 1875, 566-576.
10. **Gradiser, M., M. Matovinovic Osvatic, D. Dilber, I. Bilic-Curcic.** Assessment of Environmental and Hereditary Influence on Development of Pituitary Tumors Using Dermatoglyphic Traits and Their Potential as Screening Markers. – *Int. J. Environ. Res. Public Health*, **13**(3), 2016, 330.
11. **Hepburn, D.** *The Papillary Ridges of the Hands and Feet of Monkeys and Men*. – Royal Dublin Society, **538**, 1895.
12. **Herschel, W. J.** *The Origin of Finger-Printing*. Oxford University Press, London, 1916
13. **Holt, S. B., J. Lindsten.** Dermatoglyphic anomalies in Turner's syndrome. – *Ann. Hum. Genet*. Lond., **28**, 1964, 87-100.
14. **Karev, G. B.** Hypothenar radial arch in man: observations on its distribution, morphology, symmetry, and inheritance. – *Am. J. Phys. Anthropol*., **84**(4), 1991, 479-487.
15. **Karev, G. B.** Three palmar dermatoglyphic traits and their asymmetry in Bulgarian right-, mixed- and left-handers. – *Anthropol. Anz*., **68**(3), 2011, 291-307.
16. **Kavgazova, L., R. Stoev.** Dermatogliphic characteristics of a population from Gotse Delchev region (South-Western Bulgaria). – *Acta morphol. anthropol.,* **5**, 2000, 115-120.
17. **Kavgazova, L., R. Stoev, Z. Mitova.** Dermatoglyphic characteristics of a population from the Central Rhodopes (South Bulgaria). – *Anthr. Anzeiger,* **57**(4), 2000, 349-360.
18. **Loeffler, L.** Papillary ridges and cutaneous furrows (Papillarleisten-und Hautfurchensystem). In Becker, P. E. (Ed.): Humangenetik. Stuttgart, Georg ThiemeVerlag, **Vol. I/2**, 1969**,** pp. 205-408.
19. **Loesch, D.** Genetical studies of the palmar and sole patterns and some derrnatoglyphic measurements in twins. – *Ann. Hum. Genet.*, **43**(1), 1979, 37-53.
20. **Maslarski, I. I., L. F. Belenska.** Qualitative analysis of prints of palms and fingers of twins. – *J. Global Biosci*., **4,** 2015, 2833-2841.
21. **Milićić, J.** Latent structure of quantitative dermatoglyphic traits of middle Dalmatia (Croatia). – *Coll. Antropol*., **26**, 2002, 39-45.
22. **Minkov, Tsv., V. Dimitrova, S. Maximova.** Anthropological characterization of Bulgarian population from the region of Strandja according to dermatogliphic data. – *Glasnik ADJ,* **36**, 2001, 123-130.

23. **Nagy, A. S., M. Pap**. Comparative analysis of dermatoglyphic traits in Hungarian and Gypsy populations. – *Hum. Biol*.,**76**(3), 2004, 383-400.
24. **Novak-Laus, K., J. Milicić, E. Tedeschi-Reiner, R. Iveković, V. Mijić, S. Masnec-Paskvalin, O. Zrinsćak, Z. Mandić.** Analysis of the quantitative dermatoglyphic traits of the digito-palmar complex in patients with primary open angle glaucoma. – *Coll. Antropol*., **29**(2), 2005, 637-642.
25. **Paraskova, N., Z. Mitova.** Southeuropoid Speciphics in the Dermatoglyphic Characteristics of the Bulgarian Population from Central Western Bulgaria. – Acta morphol. anthropol., **26**(1-2), 2019, 71-78.
26. **Penrose, L. S., S. B. Holt.** Note on dermatoglyphic data in a brachydactylous family. – *Ann. Hum. Genet*., **29**,1966, 383.
27. **Petranović, M. Z., Ž. Tomas, T. Škarić-Jurić, A. Moder, S. Xharra, K. Sopi, R. HadŽiselimović, H. Nefić, G. Temaj.** Palmar and Finger Ridge Count in Two Isolated Slavic Muslim Populations (Zhupa and Gora) from Kosovo in Comparison with Kosovo Albanians. – *Acta morphol. anthropol.*, **27**(3-4), 2020, 82-93.
28. **Raizada, A., V. Johri, T. Ramnath, D. Chowdhary, R. Garg.** A cross-sectional study on the palmar dermatoglyphics in relation to carcinoma breast patients. – *J. Clin. Diagn. Res*., **7**(4), 2013, 609-612.
29. **Rather, A. P., I. Hassan, S. Naaz, R. Khan, F. Rasool.** Dermatoglyphic Patterns in Various Dermatoses among Kashmiri Population: A Case Control Study. – *Egyptian Dermatology Online Journal*, **10**(1), 2014, 1-11.
30. **Reed, T.** Dermatoglyphics in Down's syndrome. – *Clinical Genetics*., **(6)**, 1974, 236.
31. **Reed, T. E., D. S. Borgaonkar, P. M. Conneally, P. Yu, W. E. Nance, J. C. Christian.** Dermatoglyphic nomogram for the diagnosis of Down's syndrome. – *J. Pediat*., **77**, 1970, 1024-1032.
32. **Rudan, P., D. Letinic, A. Chaventre.** Digital and Palm Dermatoglyphs of the Population of the Island of Olib (Yugoslavia)-Analysis of Microevolutionary Patterns. – *Coll. Antropol*., **8**(2), 1984, 201-212.
33. **Rudan, P., Z. Pisl, B. Basek, I. Skrinjaric, F. Budiman, P. Nola, N. Rudan, Z. Maricic, I. Prodan.** Quantitative dermatoglyphic traits in patients with breast cancer-preliminary report. – *Acta med. Iug*., **34**, 1980, 73-79.
34. **Scheil, H. G., H. D. Schmidt, C. Vulpe, A. Tarcă.** Dermatoglyphic studies in Romania. – *Anthropol. Anz*., **66**(3), 2008, 273-279.
35. **Skrinjaric, I., Z. Kaic, Z. Poje, M. Dumic, Lj. Zergollern.** Dermatoglyphic in gonadal dysgenesis: analysis of palmar patterns. – *Acta med. Iug*., **40**, 1986, 39-48.
36. **Temaj, G., J. Milicić, T. SkarićJurić, I. Behluli, N. Smolej-Narancić, R. Hadziselimović, H. Nefić.** Comparative analysis of dermatoglyphic traits in Albanian and Turkish population living in Kosovo. – *Coll. Antropol*., **33**(4), 2009, 1001-1005.
37. **Temaj, G., M. Z. Petranović, T. Skarić-Jurić, I. Behluli, N. S. Narancić, S. Xharra, R. Sopi, J. Milicić.** A detection of microevolutionary changes by the analysis of qualitative dermatoglyphic traits: an example of Albanians from Kosovo. – *Anthropol. Anz*., **69**(4), 2012, 461-472.
38. **Temaj, G., T. Škarić-Jurić, Ž. Tomas, I. Behluli, N. Smolej-Narančić, R. Sopi, M. Jakupi, J. Miličić.** Qualitative dermatoglyphic traits in monozygotic and dizygotic twins of Albanian population in Kosovo. – *Homo,* **63**(6), 2012, 459-467.
39. **Uchida, I. A., H. C. Soltan.** Evaluation of dermatoglyphics in medical genetics. – *Pediatr. Clin. North Am*., **10**, 1963, 409.