

Analysis of types of dermal papillae on fingertips in a group of students from Jan Kochanowski University in the Kielce region of Poland

Analiza typów listewek skórnych na opuszkach palców studentów Uniwersytetu Jana Kochanowskiego z województwa świętokrzyskiego

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Słowa kluczowe: studenci, dermatoglify, opuszki palców.

Abstract

Introduction: The patterns of dermal papillae show a high inter-individual variability, and their geographic and ethnic variability is also observed. Dermatoglyphs, apart from their wide use in the identification of persons, establishing fatherhood, etc., are used as an instrument for the assessment of genetically conditioned diseases, such as: Down syndrome, brachydactyly, and Klinefelter syndrome.

Aim of the research: To test the distribution of the patterns of dermal papillae among university adolescents from Jan Kochanowski University (JKU) in the Kielce Region in comparison to data from other researchers from other regions of Poland.

Material and methods: The research material comprised fingerprints of randomly selected students from the Kielce Region (50 females and 50 males), aged 19–25 years, studying at JKU in Kielce.

Results and conclusions: The conducted study showed that the distribution of the types of patterns was similar to other regional groups and the Polish population, with certain simultaneous specific features. Loop patterns running in the direction of the ulna more often occurred on the fingertip pads of the right hand, whereas radial loops were more frequently observed on the fingertip pads of the left hand. Whorl patterns were more often noted in male than in female students. Arch and loop patterns were more frequently observed in female than in male students. Individual types of patterns showed certain preferences with respect to some fingers (loops – III and V; whorls – II and IV).

Streszczenie

Wprowadzenie: Wzory listewek skórnych wykazują zwykle dużą zmienność osobniczą. Obserwuje się także ich znaczne zróżnicowanie geograficzne i etniczne, na co zwraca uwagę wielu autorów. Dermatoglify poza szerokim zastosowaniem, między innymi w identyfikowaniu osób, ustalaniu ojcostwa, wykorzystywane są jako narzędzie do oceny chorób uwarunkowanych genetycznie, takich jak zespół Downa, brachydaktylia czy zespół Klinefeltera.

Cel pracy: Sprawdzenie rozkładu typów wzorów listewek skórnych na opuszkach palców młodzieży akademickiej Uniwersytetu Jana Kochanowskiego (UJK), pochodzącej z województwa świętokrzyskiego w aspekcie porównawczym i na tle danych innych autorów z różnych regionów Polski.

Materiał i metody: Materiał badawczy stanowiły odfitki linii papilarnych losowo wybranych studentów (50 kobiet i 50 mężczyzn w wieku 19–25 lat) studiujących na UJK w Kielcach, pochodzących z terenu województwa świętokrzyskiego.

Wyniki i wnioski: Przeprowadzone badania wykazały podobny rozkład typów wzorów jak w innych grupach regionalnych i populacji polskiej, przy jednoczesnych pewnych specyficznych cechach. Wzory pętlicowe o kierunku ulnarnym częściej występowały na opuszkach ręki prawej, natomiast wzory pętlicowe o układzie radialnym – na opuszkach ręki lewej. Wzory wirowe częściej obserwowano u studentów niż u studentek. Wzory łukowe i pętlicowy stwierdzano z kolei częściej u studentek niż u studentów. Poszczególne typy wzorów wykazywały pewne preferencje w stosunku do niektórych palców (pętlice – III i V, wiry – II i IV).

Introduction

Dermal papillae (dermatoglyphs) develop at around week six of pregnancy, and their formation takes place between weeks 15 and 17 of foetal life [1, 2]. The arrangement and form of the dermatoglyphs result mainly from the changeable tension of the epidermis, but are also affected by many factors: genetic, physical, diseases, or even the lifestyle of the mother. The complete development of the dermatoglyphic pattern is at approximately six months of foetal life [1, 3].

Dermatoglyphs, apart from their wide use in the identification of persons, establishing fatherhood, etc., are used as an instrument for the assessment of genetically conditioned diseases, such as: Down syndrome, brachydactyly, and Klinefelter syndrome. In brachydactyly, the whorl pattern is observed very rarely, while arch and loop patterns occur very frequently. Klinefelter syndrome is characterised by the presence of an increased number of arch patterns and a decreased value of the total reach count (TRC) count. Considering Down syndrome, similarly to brachydactyly, whorls occur with a decreased frequency, as opposed to loops, which exceed the 'standard' for these patterns observed in healthy populations [4].

Many researchers pay attention to the specific features and characteristics of dermal papillae in various ethnic groups [5, 6]. There are also reports indicating dermatoglyphic specificity of small local communities. An example of this is the report by Gralla [7], who indicated the specificity of dermatoglyphs of the population from the village of Giebło. Similar studies were performed by Liczbińska [8] and Buchwald [9] concerning the dermatoglyphic characteristics in the Kashubian Region. Thus, it seemed interesting to analyse the patterns of the dermal papillae on the fingertip pads of students from the Kielce Region, and to compare these patterns from the quantitative and qualitative aspects with the results from other regions of Poland.

Aim of the research

The objective of the presented study was an analysis of the types of patterns of dermal papillae on the fingertip pads of a randomly selected group of students from the Jan Kochanowski University (JKU) in Kielce, who came from the Kielce Region. The results obtained, combined with the data from other researchers, allowed the determination of the frequency of the occurrence of individual types of dermatoglyphs, on the background of more comprehensive data from other regions of Poland, as well as with respect to the total Polish population.

Material and methods

The research material subjected to analysis was a collection of original prints of dermal papillae col-

lected among students of JKU in Kielce, who came from the Kielce Region. Analysis included fingerprints collected from 100 students (50 males and 50 females), aged 19–25 years. Dermatoglyphs were collected in accordance with the Act of 29 August 1997 in the matter of personal data protection. Students who expressed their consent to participate in the study were subjected to dactyloscopy in the following way: firstly, prints were taken of dermal papillae from the right hand, and then from the left hand. The collection of prints took place by rolling the fingers on an inking plate. The common principle was adopted: rolling fingers of the right hand clockwise, whereas those of the left hand – in the opposite direction. After rolling the finger, the print of dermal papillae was transferred to a previously prepared dactyloscopy chart. The dactyloscopy chart contained the division into the left and right hand, with the consideration of each finger. Each print was analysed by the physical-optical method using a stereoscopic microscope. The collected material (1000 dermatograms) were analysed from the aspect of the occurrence of the types of patterns and their frequency. Analysis of results was performed by means of pattern classification according to Malinowski and Bożiłow [10] and Rogucka [11].

Results

Analysis of the data showed that loop patterns (L) were most frequently observed on the fingertip pads of students from the JKU in Kielce. These patterns constituted 57.8%, followed by whorls (W) in 37%; while among the remaining types of patterns, arches were observed in 4.1% and tented arches (T) in only 1.1%.

In the group of loops, the classic loop pattern (L) was most frequently observed – 48.9%, where ulnar loops constituted 23.3%, and radial loops 25.6%. Loop pattern of the radial type (L^R) occurred in 8.8% of cases (ulnar direction – with the frequency of 4.1%, and radial direction – 4.7%). The least frequent pattern from among the loop patterns was the conchoidal loop (L^M), which was found in only 0.1%.

In the group of whorl patterns plain whorls occurred most frequently (W^1) – 17.4% (mainly symmetrical – 14.4%), whereas ulnar whorls constituted only 1.8%, and radial – 1.2%.

The second type of whorl patterns in the examined group were elliptical whorls (W^E) – 6.8%, and double loop whorls – also 6.8%. In these groups of whorl patterns, the symmetrical arrangement was dominant – 4.4%, elliptical whorls and double loop whorls 3.4%, respectively, while radial or ulnar arrangements constituted only 1.1%.

The subsequent type of whorl patterns occurring with the frequency of 3.4% were atypical whorls (W^{AT}). Double-loop whorl patterns (W^2) were observed in 2.0% of the students in the study, with the ulnar direction – 1.3%, symmetrical – 0.6%, and radi-

Table 1. Frequency of occurrence of dermal papillae on fingertip pads in 100 students examined (50 males, 50 females) at the UJK in Kielce, expressed in percentages

Type of pattern	Direction	Fingers (n = 1000)										Total (%)	
		Right (%)					Left (%)						
		I	II	III	IV	V	I	II	III	IV	V		
A	u												
	s	0.3	1	0.5			0.6	1.1	0.6				4.1
	r												
T	u												
	s		0.3					0.6	0.2				1.1
	r												
L	u	3.8	2.6	5.6	3.2	6.8		0.9	0.2		0.2		23.3
	r		0.7	0.2	0.1	0.3	4.3	2.8	5.7	4.2	7.3		25.6
L ^R	u	0.2	0.3	0.6	1	1.3	0.1	0.4		0.2			4.1
	r	0.2	0.5	0.3	0.1		0.2	0.4	0.5	1.4	1.1		4.7
L ^M	u												
	r		0.1										0.1
W ¹	u	0.1	0.4	0.3	0.2	0.1	0.2		0.1	0.4			1.8
	s	1.9	1.5	1.1	3.6	1.2	1	0.7	0.6	2.1	0.7		14.4
	r	0.2	0.1	0.2	0.4	0.1		0.1			0.1		1.2
W ²	u		0.2		0.1		0.1	0.1	0.4	0.2	0.2		1.3
	s			0.1			0.1	0.4					0.6
	r	0.1											0.1
W ^E	u						0.3	0.1	0.3	0.3	0.1		1.1
	s	0.3	0.7	0.5	0.8	0.2	0.3	0.5	0.4	0.6	0.1		4.4
	r	0.5	0.2	0.2	0.2	0.1		0.1					1.3
W ^W	u							0.1	0.1	0.1			0.3
	s												
W ^{L2}	u	0.1	0.1					0.1					0.3
	s	1.5	0.1	0.1			0.2						1.9
W	u	0.7	0.3				1.2	0.6	0.3	0.2	0.1		3.4
	r			0.1			1.2		0.2				1.5
W		0.1	0.9	0.3	0.3		0.2	0.7	0.4	0.4	0.1		3.4

U – ulnar, s – symmetrical, r – radial.

al – 0.1%. The least frequent type of whorl pattern was the multi-spiral whorl (W^W), observed in only 0.6% of students.

The next group of patterns observed on the fingerprint pads of the examined students were arches (A), which occurred only in a symmetrical arrangement with the frequency of 4.1%. Tented arches were very rarely observed (T) – 1.1%.

Loop patterns more often occurred on fingers III and V (6.7% and 8.5%, respectively), compared to the

remaining fingers, whereas whorl patterns were more frequently observed on finger I (5.5%) and on finger IV (5%). Table 1 demonstrates the frequency of occurrence of individual types of patterns of dermal papillae.

The frequency of the types of dermal papillae on the fingertip pads according to gender (Tables 2 and 3) does not show any significant differences. Both among males and females, loop patterns are the dominant type (61% in females, 54.6% in males), with the classical loop (L) occurring most frequently.

Table 2. Frequency of occurrence of dermal papillae on fingertip pads in the 50 female students examined, expressed in percentages

Type of pattern	Direction	Fingers (n = 500)										Total (%)	
		Right (%)					Left (%)						
		I	II	III	IV	V	I	II	III	IV	V		
A	u												
	s	0.4	1.6	0.8			1	1.8	0.8				6.4
	r												
T	u												
	s		0.6					1	0.4				2
	r												
L	u	4.6	4.4	6.2	3.2	7.		0.8	0.4		0.4		25.2
	r		0.6	0.2	0.2	0.6	4.8	2.2	6	5	7.6		27.2
L ^R	u	0.2	0.6	0.6	1	1.2	0.2	0.6		0.2			4.6
	r	0.2	0.6		0.2		0.2	0.2	0.4	1.4	0.8		4
L ^M	u												
	r												
W ¹	u	0.2	0.6	0.2	0.2		0.2			0.4			1.8
	s	0.8	0.4	1.2	3.8	1	0.2	0.4	0.4	1.6	0.6		10.4
	r	0.4	0.2		0.2								0.8
W ²	u				0.2				0.2	0.2	0.2		0.8
	s							0.4					0.4
	r												
W ^E	u						0.2			0.2			0.4
	s	0.2	0.8	0.4	0.6	0.2	0.4	0.4	0.6	0.8	0.2		4.6
	r	0.2	0.2	0.2	0.2			0.2					1.0
W	u												
	s												
	r							0.2					0.2
WL ²	u	1.6	0.2	0.2			0.2						2.2
	s	1	0.4				1.2	0.8	0.4	0.2			4.0
	r						1.2		0.2				1.4
W		0.2	0.8	0.2	0.4		0.2	0.4	0.2		0.2		2.6

Thorough analysis of the arrangement of the loop patterns allows the presumption that ulnar loops were more often found on the fingertip pads of the right hand, whereas those of a radial arrangement were seen on the pads of the left hand. The second type of patterns of a whorl arrangement was represented by 30.6% of female and 43.6% of male students. In this group plain whorls (W¹) prevailed – 10.4% of female and 18.4% of male students.

Slightly greater differences according to gender were observed with respect to simple patterns – arches

(A) and tented arches (T). In female students there were 6.4% of plain arches and 2.0% of tented arches, whereas among males – only 1.8% and 0.2%, respectively.

Discussion

In order to compare the received results concerning the frequency of occurrence of individual types of dermal papillae patterns, they were compiled in the form of a table with the data from other researchers (Table 4).

Table 3. Frequency of occurrence of dermal papillae on fingertip pads in the 50 male students examined, expressed in percentages

Type of pattern	Direction	Fingers (n = 500)										Total (%)	
		Right (%)					Left (%)						
		I	II	III	IV	V	I	II	III	IV	V		
A	u												
	s	0.2	0.4	0.2			0.2	0.4	0.4				1.8
	r												
T	u												
	s							0.2					0.2
	r												
L	u	3.0	2.8	5.0	3.2	6.4		1.0					21.4
	r		0.8	0.2			3.8	3.4	5.4	3.4	7.0		24
L ^R	u	0.2		0.6	1.0	1.4		0.2		0.2			3.6
	r	0.2	0.4	0.6			0.2	0.6	0.6	1.4	1.4		5.4
L ^M	u												
	r		0.2										0.2
W ¹	u		0.2	0.4	0.2	0.2	0.2		0.2	0.4			1.8
	s	3.0	2.6	1.0	3.4	1.4	1.8	1.0	0.8	2.6	0.8		18.4
	r			0.4	0.6	0.2		0.2				0.2	1.6
W ²	u		0.4				0.2	0.2	0.6	0.2	0.2		1.8
	s			0.2			0.2	0.4					0.8
	r	0.2											0.2
W ^E	u						0.4	0.2	0.6	0.4	0.2		1.8
	s	0.4	0.6	0.6	1.0	0.2	0.2	0.6	0.2	0.4			4.2
	r	0.8	0.2	0.2	0.2	0.2							1.6
W ^W	u							0.2	0.2	0.2			0.6
	s												
	r	0.2	0.2										0.4
WL ²	u	1.4					0.2						1.6
	s	0.4	0.2				1.2	0.4	0.2	0.2	0.2		2.8
	r			0.2			1.2		0.2				1.6
W		1.0	0.4	0.2			0.2	1.0	0.6	0.8			4.2

Analysis of this table allows the presumption that the distribution of the frequency of dermal papillae patterns on fingertip pads in the selected total group of students from the JKU is generally consistent with the data from the whole territory of Poland [12]. A slightly lower frequency may only be observed for the loop patterns among academic adolescents (57.8%), compared to the total Polish population (62.7%).

Considering the distribution of the types of dermal papillae patterns according to gender, some differences were found. For example, in the examined

Polish population, loop patterns constituted 62.0% in males, and 59.8% in females. In the examined group of students this was 54.6% in males and 61.0% in females. Similarly, in the group of whorl patterns, their lower frequency of occurrence was observed among males in the Polish population (34.0%), compared to male students from Kielce (43.6%). The greatest differences concerned arch patterns: in the studies by Szymanderska [13] this was 5.85% in males and 10.25% in females, respectively, whereas among students from Kielce this was only 1.8% in males and 6.4%

Table 4. Frequency of occurrence of main types of patterns (A – arches, L – loops, W – whorls) in various populations, compared to the examined group of students from the UJK

Type of patterns	Poland – Jelisiejew, Marcinkiewicz	Poland – Szymanderska		Kashubian Region – Buchwald		UJK total	UJK	
		Male	Female	Male	Female		Male	Female
A	6.8	5.8	10.2	2.42	5.7	5.5	1.8	6.4
L	62.7	62.0	59.8	59.9	67.16	57.8	54.6	61.0
W	30.5	34.0	30.0	37.66	21.15	32.3	43.6	30.6

in females. Additional information in Table 4 shows a higher frequency of the occurrence of whorl patterns among males compared to females. This is observed in every group in the study, with a difference of as much as 13% (in students from the UJK).

However, many data, also those not published by the author, show that in various randomly selected population groups from the Kielce Region the frequency of occurrence of individual types of dermal papillae on fingertip pads indicates a certain variation: arches from 7.5% to 11.9%, loops from 55.91% to 62%, and whorls from 26.2% to 32.3%. This is related with tremendous individual variation of the dermal papillae. Although generally the types of dermal papillae are inherited, the development of a given arrangement of the papillae is a complex issue that depends on many factors, not only genetic. In any case, the inheritance of types of dermal papillae was used in practice before the age of DNA examinations, for establishing fatherhood [2].

As mentioned in the Introduction, many researchers pay attention to specific features of dermal papillae in various ethnic groups, e.g. Pygmies [6] or Eskimos [5]. In this area, Liczbińska [8] confirmed that in the Kashubian population of the Hel peninsula, a higher frequency of patterns is observed with a lower degree of complication (e.g. arches and tented arches), compared to other Polish population groups. Similar results were obtained by Gralla [7], who proved the specificity of the dermal papillae in the village of Gieblo, in the Zawiercie Province. The researchers explain this status as a certain socially and culturally conditioned isolation.

The examined group of students from the UJK came from the Kielce Region. Although the population from this region is not a separated or isolated ethnic group, considering the lack of data in the relevant literature, the results obtained enrich the dermatological characteristics of the Polish population. As mentioned above, the obtained data do not differ considerably from the results from other areas. However, it may be attempted to select certain differences in the distribution of patterns in the group of students examined. Such features include, among others, a relatively large number of whorl atypical patterns (2.6% in females and 4.2% in males), and a more frequent

occurrence of loop patterns on fingers III and V, and whorl patterns on fingers I and IV.

Conclusions

Generally, the distribution of the frequency of occurrence of individual types of patterns of dermal papillae is similar in the total Polish population. The most frequently occurring type of dermal papillae patterns on the fingertip pads in the examined group were loop patterns (57.8%). Whorl patterns constituted only 32.3%, and arch patterns only 5.5%. Whorl patterns occurred with a higher frequency in male than in female students. In turn, arch and loop patterns were more frequently observed in female than in male students. Loop patterns in the direction of the ulna were more often observed on the fingertip pads of the right hand, whereas radial loops we seen more frequently on the fingertip pads of the left hand. Loop patterns more frequently occurred on fingers III and V, while whorl patterns were more often found on fingers I and IV.

Conflict of interest

The authors declare no conflict of interest.

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