



FINGERPRINT PATTERNS AND THEIR BILATERAL DIFFERENCES IN PATIENTS WITH MENTAL DISORDERS AND HEALTHY CONTROLS

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ABSTRACT

Background: Patients with schizophrenia and bipolar disorder (BD) type 2 display an increased prevalence of apparently innocent changes in their patterns and count of their dermatoglyphics.

Aim: The aim of the present study is to assess the variability and bilateral asymmetry of fingerprint patterns in healthy individuals and mentally diseased patients and established their relationship with disease.

Methods: The study included 344 subjects of Bulgarian ethnicity, aged 18-64 years, 285 mentally healthy and 59 schizophrenia and BD Type I patients. The patients met DSM-V criteria for schizophrenia and BD Type I. Fingerprints were obtained by the typographic method, in a rotating manner. Papillary patterns were classified into four main types. The data were analyzed statistically with SPSS 17.0 software.

Results: The differences in fingerprint patterns on both hands of healthy and mentally diseased males show a trend of statistical significance in their distribution ($p = 0.065$). We found that Furuhashi and Poll's indices are lower in mentally diseased males, that seems logical from the standpoint of lower frequency of whorls and higher frequency of ulnar loops presented in them. Our results show the greater asymmetry between fingerprint images of homologous digits of the diseased males on the second finger, and of the diseased females – on second and on the third finger.

Conclusion: The results of this study provide a perspective on potential biomarkers and support neurodevelopmental concepts of the etiology, pathogenesis and diagnosis of psychotic disorder.

Keywords: fingerprint patterns, bilateral differences, mental disorders,

INTRODUCTION

Dermatoglyphic ridges are resistant, permanent throughout life and diagnostically sensitive traits, varying in most cases independently from each other. The very early stabilization of skin ridges, between the third and fifth month of fetal development, allows making a direct assessment of the influence of various factors in the process of their formation. [1] A large number of modern studies address the relationship between fingerprints and a genetically determined tendency for mental disorders. [2] Apparently, impaired ridges and deviations from the normal configurations can be due only to genetic or prenatal exogenous factors. The central nervous system shares embryonic origins with dermatoglyphic traits, and both neural tissue and the epidermis are derived from the embryonic ectoderm. Patients with schizophrenia display an increased prevalence of apparently innocent changes in their patterns and count of their dermatoglyphics. [3]

The patterns of distal phalanges are classified into three main types – loops, whorls and arches. Any disturbances in hereditary or environmental factors at the time of ridge formation may alter the dermatoglyphic pattern. Individuals with schizophrenia and people with high levels of schizotypy have been found to have lower total finger ridge count (TFRC), more arch patterns, fewer whorl patterns than unaffected controls. [4] On the other hand, there are findings, in which undergraduate students with schizotypal personality features displayed disproportionately high rates of loops [5, 6]. The results by Chakraborty et al., 2001 [7] reveal that the radial loop was increased in bipolar mood disorder. Unexpected significant relationships between dermatoglyphics and schizotypal features emerged in the first degree relatives show that greater disorganized features of schizotypy were significantly associated with higher TFRC and fewer arches [5]. There is a study, in which the observed frequency of loop pattern was more common, and some differences were found between the index fingers of the two groups [8]. Langsley et al., 2005 [4] found that unaffected individuals with a strong family history of

schizophrenia displayed an intermediate pattern (between patients and controls) of “dermatoglyphic complexity”. A similar observation was made by Chok, Kwapil and Scheuermann, 2005 [6] who reported less complex pattern types in schizophrenic patients.

In the general investigations of dermatoglyphic patterns, there are differences found in the two hands: right-left. These findings can be useful in anthropology to identify the relationships in different human groups, in studying the bilateral symmetry of the body. The study of possible prenatal factors involved in the etiology of certain diseases represents an assessment of the extent of asymmetry in terms of the dermatoglyphic characteristics [9]. According to Ponnudurai, 1999 [10] minor physical asymmetry of a parallel structure are anthropometric markers that have been observed in schizophrenia and may reflect prenatal insult, but the evidence is still inconclusive. This determined our interest in the present study.

The aim of the present study is to assess the variability and bilateral asymmetry of fingerprint patterns in healthy individuals and mentally diseased patients and established their relationship with disease.

MATERIALS AND METHODS

The study includes 344 individuals of Bulgarian ethnic origin, without kinship with each other, clinically healthy (mean age – 21.7±3.6) and psychiatric patients (mean age – 44.8±10.2) with a diagnosis of schizophrenia and bipolar disorder type I. Of these subjects, females were 249 (219 controls and 30 cases), and 95 were male (66 controls and 29 cases). The sample of psychiatric patients is formed from adult individuals who have received hospital or outpatient treatment at the State Psychiatric Hospital in Radnevo, Bulgaria, the largest psychiatric hospital on the Balkan Peninsula and the Psychiatry Clinic at the Medical University Hospital in Plovdiv (the second largest city of Bulgaria). An analysis of the case histories and symptomatology of the patients indicated that they met DSM-V criteria for schizophrenia and bipolar disorder Type I. [11]

Potential respondents were excluded from the study in the case of non-Bulgarian ethnicity of one of the parents and grandparents, history of severe neurological disease, history of psychotic disorder, first degree relatives with a history of psychotic disorder, pathological condi-

tions characterized with abnormal dermatoglyphic status: psoriasis, congenital heart disease, diabetes, etc.

The study design and methodology were approved by the Ethics Committee of Plovdiv Medical University. Written Informed Consent Forms were obtained from the 59 mentally diseased patients and a control group of 285 after introduction to the aim and objectives of the study.

Rolled fingerprints were obtained using the ink method and examined with slight magnification (6D). Fingerprint patterns were read as described by Cummins and Midlo [12] and identified as arches (A), ulnar loops (U), radial loops (R), whorls (W). The whorls group included all varieties of circular images (twin loop, central pocket loop, lateral pocket loop, and accidental).

The type model of the papillary finger images was determined through the following indices: Whorl/loop index of Furuhashi = $\{(\%whorls/\%loops) \times 100\}$, Arch/whorl index of Dankmeijer = $\{(\%arches/\%whorls) \times 100\}$, Arch/whorl index of Poll = $\{(\%arches/\%loops) \times 100\}$, the pattern intensity index = $\{(2 \times \%whorl + \%loop)/2\}$.

The data were analyzed statistically with SPSS 17.0 software. Descriptive statistics were used to summarize the data. Student's *t*-test was used to test the differences in fingerprints between the groups. The level of significance was set at $p < 0.05$. The frequency distributions of fingerprint patterns were assessed in the mentally diseased patients and compared with distributions in the control subjects using the χ^2 -test. To determine the degree of compatibility between papillary patterns on parallel regions of both hands, we used the coefficient of Krippendorff.

RESULTS

Table 1 shows the frequency of fingerprint patterns in mentally diseased and healthy males. The most common fingerprint pattern – ulnar loop, show higher frequency in mentally diseased males in the right hand (56.0% vs 49.0%) as well as in the left hand (60.0% vs 54.0%). Whorls and arches are the most frequent patterns on both hands of healthy males, and radial loops are most commonly found on both hands of mentally diseased subjects. The differences in fingerprint patterns on both hands of healthy and mentally diseased males show a trend of statistical significance in their distribution ($p = 0.065$).

Table 1. Frequency of fingerprint papillary patterns in mentally diseased and healthy males.

Patterns	Males						
	Controls (n = 66)		Cases (n = 29)		Statistical significance		
	N	%	N	%	χ^2	df	p
Right hand					4,42	3	0.220
A	21	6,4	6	4,1			
R	12	3,6	9	6,2			
U	163	49.0	81	56.0			
W	134	41.0	49	34.0			

Left hand					3,89	3	0.274
A	26	7,9	5	3,4			
R	17	5,2	8	5,5			
U	191	58.0	93	64.0			
W	96	29.0	39	27.0			
Right and left hand					7,24	3	0.065
A	47	7,1	11	3,8			
R	29	4,4	17	5,9			
U	354	54.0	174	60.0			
W	230	35.0	88	30.0			

The frequency of fingerprint papillary patterns in healthy and mentally diseased females are presented in Table 2. Ulnar loops are the most frequent pattern in mentally diseased females, in comparison with the healthy subjects on the right hand (61.3% vs 55.71%). Whorls and arches are the most common fingerprint patterns in healthy

females on both hands. Radial loops show the lowest frequency on the left hand of the mentally diseased subjects (8.0%), a similar tendency is observed on the left hand of the controls (4.02%). In our study, the differences in the distribution of fingerprint patterns in females of both groups do not reach statistical significance.

Table 2. Frequency of fingerprint papillary patterns in mentally diseased and healthy females.

Patterns	Females						
	Controls (n =219)		Cases (n =30)		Statistical significance		
	N	%	N	%	χ^2	df	p
Right hand					2,36	3	0.502
A	62	5,66	6	4.0			
R	26	2,37	2	1,33			
U	610	55.71	92	61.3			
W	397	36.26	50	33.3			
Left hand					5,64	3	0.130
A	89	8,31	9	6.0			
R	44	4,02	12	8.0			
U	570	52.1	79	52.7			
W	392	35.8	50	33.3			
Right and left hand					4,12	3	0.249
A	151	6,90	15	5.0			
R	70	3,20	14	4,7			
U	1180	54.0	171	57.0			
W	789	36.0	100	33.0			

Table 3 shows the calculating of mean values of dermatoglyphic indices in healthy and mentally diseased subjects of both sexes. Our results amplified the dactyloscopic image. We found that Furuhashi and Poll's indices

are lower in mentally diseased males, that seems logical from the standpoint of lower frequency of whorls and higher frequency of ulnar loops presented in diseased males. This indicates the presence of intersexual differences.

Table 3. Mean values in index characteristics of fingerprint papillary patterns in healthy controls and mentally diseased patients of both sexes.

Indices	Controls		Cases	
	Males	Females	Males	Females
	Mean	Mean	Mean	Mean
Dankmeijer	31.21	22.14	30.43	29.81
Furuhata	117.88	136.07	57.17	141.90
Poll	15,10	16,11	6,48	8,21
Dl ₁₀	1,28	1,29	1,27	1,28

Table 4 shows the level of matching in the papillary images on homologous fingers of healthy and mentally diseased subjects of both sexes. Coefficient α ranged between 0 to 1. If the coefficient allies to 1, it points out that two variables are matching. Confidence interval (95% CI) shows if the coefficient is significant. The lower level

of matching in papillary patterns is used as criteria for a higher level of asymmetry. We found the greater asymmetry between fingerprint images of homologous digits of the diseased males on the second finger ($\alpha = 0.295$), and of the diseased females – on second ($\alpha = 0.224$) and on third finger ($\alpha = 0.121$).

Table 4. The level of matching of the papillary image types on homologous fingers in healthy controls and mentally diseased patients of both sexes.

Finger	Males				Females			
	Controls (n = 66)		Cases (n = 29)		Controls (n = 219)		Cases (n = 30)	
	α	95% CI	α	95% CI	α	95% CI	α	95% CI
I	0.429	0.201, 0.629	0.804	0.607, 1.000	0.530	0.423, 0.637	0.474	0.182, 0.766
II	0.319	0.149, 0.489	0.295	-0.007, 0.547	0.469	0.376, 0.555	0.224	-0.018, 0.467
III	0.583	0.375, 0.762	0.556	0.187, 0.852	0.592	0.479, 0.696	0.121	-0.246, 0.487
IV	0.506	0.313, 0.698	0.519	0.218, 0.760	0.589	0.486, 0.683	0.356	0.064, 0.649
V	0.626	0.401, 0.850	0.624	0.123, 1.000	0.511	0.365, 0.656	0.678	0.355, 1.000

DISCUSSION

A number of studies reveal out fingerprint papillary patterns, finger ridge count, a-b ridge count and atd angle as significantly distinctive dermatoglyphic characteristics between healthy subjects and mentally diseased patients. [13-15] Bilateral differences in the dermatoglyphic patterns have been demonstrated as criteria for the ability of the body to neutralize harmful effects during the prenatal period. [16, 17] The results of our study show the variability and bilateral asymmetry in fingerprint patterns between healthy and mentally diseased Bulgarians and searching for their relationship with mental disorders.

Our data are partially consistent with publication of Chakraborty et al., 2001 [7] who found a significantly higher frequency of radial loops in patients with bipolar disorder type I. Our results show a higher frequency of both ulnar loops and radial loops in mentally diseased subjects, the tendency of significance is observed in males, while in

females significant differences are not present. A similar pattern has been observed by Chok, Kwopil and Scheuermann, 2005 [6], who found a higher frequency of loops in mentally diseased patients. In the present study, arches and whorls have been observed in healthy controls, consistent with our results are the data obtained by Gabalda and Compton 2010, [5], but only for arches. The differences in fingerprint patterns, which are established in our study and their discrepancy with the results of previous studies, maybe due to racial peculiarities in the fingerprint pattern.

Golembo-Smith et al. 2012 [18] conduct meta-analyze, including research of bilateral differences in papillary patterns. Results provide raw data, effect sizes, and z-values for four studies reporting three-pattern classification (i.e., whorl, loop, or arch) fingertip pattern asymmetry data. There was significance between study heterogeneity ($p < 0.05$). According to Mellor, 1992 [19], there was no significant difference between male and female schizo-

phrenics in the proportions of discordant patterns. The lower level of matching in fingerprint patterns, which shows higher bilateral asymmetry, is a well-established difference in mentally diseased males on the second finger and in the diseased females on second and on the third finger. Our results support previous data of Sivkov et al., 2007 [20] but only for mentally diseased females.

CONCLUSION

Our data demonstrate that in both sexes loops are more frequent in mentally diseased patients. Typographic diversity in fingerprint papillary patterns is more pronounced in males, and the differences between controls and

cases show a tendency to significance. The bilateral comparison reveals a higher level of mismatching in fingerprint patterns on the second finger of both sexes in cases, and also on the third finger, but only in mentally diseased females. The results of this study provide a perspective on potential biomarkers and support neurodevelopmental concepts of the etiology, pathogenesis and diagnosis of psychotic disorder.

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