

Dermatoglyphics in juvenile epilepsy. I. Finger patterns and ridge counts

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ABSTRACT

Fingerprints of 136 patients with generalized (GE) or focal (FE) epilepsy, aged from 6 to 15 years, were compared with those of 136 non-epileptic normal controls (NC), matched for sex, age, ethnic group and socio-economic status. Finger patterns in the three groups were compared and the result revealed significant differences in loop frequencies in the left hand among male white subjects (GE > NC > FE). Considering separately each fingertip, the comparison between epileptic groups (GE vs. FE) exhibited highly significant differences ($P < 0.01$) in loop frequencies in the right finger I and in the left finger III, the values being higher among G epileptics; otherwise, whorls had higher proportions in the right finger I among male FE patients. In female epileptics, loop frequencies were significantly higher in the right finger III of group GE, all discrepancies being restricted to the white subjects. Comparisons between epileptics (GE + FE) and their respective controls displayed highly significant differences of loop proportions in left finger III among white males (higher in group GE) and females (lower in group FE). The remaining differences which are described below were significant at the 5% level, but not at the 1% level. Among males, whorls were more frequent in the left finger I of the non-white FE patients and in left finger I, II, III of non-white G epileptics. Among females, loops had lower proportions in the left fingers II and III of white FE patients and whorls occurred more often in the left finger III of white and non-white F epileptics. The largest statistical differences were detected in finger III between epileptics and controls, and in finger I between the two epileptic groups. This suggests an epigenetic connection between embryonic regions I-III and normal physiology of the CNS. The differences of total ridge counts between patients and controls were not statistically significant.

INTRODUCTION

Epilepsy is a chronic brain disturbance of varied and complex origins, characterized by recurrent convulsive seizures, not necessarily presenting a defined external trigger factor.

Epileptic syndromes are classified mainly by brain location (generalized, partial or focal) and seizure type (clonic, tonic, akinetic, simple, absence or unconsciousness) which, together with electroencepha-

lographic studies, define the differential diagnostic (discussion in Delgado-Escueta *et al.*, 1982; Lancet, 1990).

The etiology of the epilepsies allows a classification of syndrome features into two groups: idiopathic or cryptogenic epilepsy, which has isolated primary symptoms without apparent cause and is probably hereditary, with onset mainly between two and fourteen years of age; the second group is symptomatic epilepsy, of genetic or acquired origin associated with other clinical features. Furthermore, symptomatic epilepsy also occurs in isolated cases, due to cranial traumatism or as a result of infection, intoxication, brain tumors, hypo-

glycemia, drug abstinence, etc. Epileptic manifestations are commonly associated with hereditary metabolic and neurological disturbances, with or without mental deficiency.

Jacksonian seizures displaying only motor manifestations without impairment of consciousness are typical among focal epilepsies. Generalized epilepsies include isolated absence episodes (*petit mal*), as well as tonic-clonic seizures (*grand mal*). The former condition is well represented by the centrencephalic epilepsy of subcortical origin and in childhood onset, identified as the classic three-per-second spike and wave discharge, widely investigated by Metrakos and Metrakos (1960, 1961, 1974), who considered the syndrome to be determined by a dominant gene with age-dependent penetrance and expressivity. The massive bilateral seizures which characterize Lundborg's (1903) juvenile progressive myoclonic epilepsy are also heritable, determined by an autosomic gene in homozygosis, and almost confined to the baltic region. The genetic investigation carried out by Weinberg in 1912 is of special historic interest because it was the first statistical-segregational analysis of a human pathological condition (McKusick, 1992).

About a decade ago genetic investigation of epilepsy was relatively rare, mainly because of its phenotypic expression, represented by heterogeneous convulsive disturbances, hampering the definition of the various epileptic syndromes and, consequently, its differential diagnosis. These difficulties, at first considered by Lennox and Lennox (1960) and Metrakos and Metrakos (1969), have been overcome by the improvement of the diagnostic techniques (Metrakos and Metrakos, 1974), which differentiate more and more cases of primary epilepsy from symptomatic seizures. Thus, from 1980 onwards, research on the genetics of various epileptic syndromes has been reported, and models designed for analysis of its familial segregation (Anderson *et al.*, 1982).

Isolated idiopathic epilepsies with Mendelian inheritance do not encompass 5% of hereditary convulsive syndromes (Anderson and Hauser, 1993), which are predominantly associated with chromosomic aberrations, metabolic disturbances and neurological deficiency. As to the gene location of these epilepsies, results are scarce and inconclusive. The probable genetic link between the gene responsible for the familial form of juvenile myoclonic epilepsy with recessive inheritance (Janz, 1985), and the locus of the HLA system on chromosome 6 (Greenberg and Delgado-Escueta, 1993) was confirmed by RFLP analysis (Durner *et al.*, 1991). The gene of progressive epilepsy, responsible for the Unverricht-Lundborg

form of epilepsy with baltic distribution (Norio and Koskiniemi, 1979; Berkovic *et al.*, 1993), was localized at the distal point of the long arm of chromosome 21 (q 22) in Finnish families (Lehesjoki *et al.*, 1991). The probably autosomic dominant gene responsible for the familial benign neonatal convulsions (Rett and Teubel, 1964) was also mapped by RFLP and found on the long arm of chromosome 20 (q 13.3) (Leppert *et al.*, 1989). However, the clinical and genetic heterogeneity of this epileptic syndrome (Ryan *et al.*, 1991) renders the localization of this gene doubtful. In mice, fourteen different gene loci, almost all autosomic recessive (one dominant and another localized on the X chromosome), responsible for epileptoid convulsions of the spike-wave type (Treiman, 1993) were localized mainly on chromosome 8. This species is, therefore, an excellent animal model for the experimental study of constitutional epilepsies, as are other species such as baboons, dogs and chickens (Noebels, 1993).

Other genetic-molecular approaches involve neurotransmitters. Inhibition of gamma-aminobutyric acid (GABA) synthesis in gerbils (*Gerbillus*) susceptible to epileptogenic factors (Fukuyama *et al.*, 1979) produces convulsive activity of similar origin to human epilepsy in the temporal lobe (Olsen *et al.*, 1984). The GABA receptors include sub-units (α , β , γ) with different neuro-functional properties and regional expression in the brain. The genes responsible for sub-unit α , for example, were localized on autosomes 4 and 5, and on the X chromosome, by *in situ* hybridization (Gardiner, 1990). The same genetically controlled epileptogenic model is being researched in other neurotransmitters (Meldrum, 1986).

Finally, the genetic study of epilepsy includes dermatoglyphic analysis, since fingerprint configurations are inherited with an embryonic origin common to the nervous system. Their alterations could indicate pleiotropic effects of the genotypes responsible for encephalographic irregularities and convulsive seizures and/or the action of exogenous teratogenic agents on the embryogenesis of the nervous system.

Several studies of fingerprints in epilepsy have preceded the present one. After the research carried out by Galton (1891) on the various patterns of ridges on the fingertips of different people, classifying them into patterns and assuring their life time permanence, Féré (1905) may have done the pioneer study on fingerprints in epileptics. Many other investigators reported several studies of fingerprints in individuals affected by non-specific types of epilepsy (Portius, 1937; Brown and Paskind, 1940; Katzenstein-Sutro, 1945; Cherrill, 1950; Alter, 1966; Rosner *et al.*, 1967; Razavi, 1975; Lopez and Lopez, 1977; Karitonov *et al.*, 1979; Schaumann and

Mayersdorf, 1979; Schaumann *et al.*, 1982; Cisarik *et al.*, 1985; Marinina and Drabktsina, 1988).

A revision of these studies demonstrates variable significance of the association between fingerprints and epilepsy. However, when comparing these studies several methodological discrepancies emerge. The most crucial appear to be the terminology employed, the diagnostic criterion for the different clinical manifestations, the sample size and the choice of the control groups, classified by sex, ethnic group and socio-economic status, as well as statistical test adequacy and significance level. Some of these problems may explain the conflicting results found by the authors.

In the present study, differences in the distributions of fingerprint patterns of patients classified into two main epilepsy groups were assessed in order to evaluate whether such discrepancies may be useful for the diagnosis and prognosis of epilepsy.

MATERIAL AND METHODS

Finger and palm prints were taken from the hands of 136 epileptic patients who had been diagnosed with focal or generalized epilepsy by neurologists belonging to the staff of the Epilepsy Out-patient Clinic at the Neurology Department of the Hospital das

Clínicas da Faculdade de Medicina of the University of São Paulo.

The patients, aged from six to 15, were grouped according to age, sex, ethnic group and socio-economic status. There were 77 males (54 whites, 16 "mulattoes" and seven blacks) and 59 females (49 whites, seven "mulattoes", two blacks and one Japanese) (Table I). Patients with illnesses other than epilepsy, such as cerebral palsy, mental deficiency, or with pathological conditions of organic nature, were eliminated from the statistical analysis. The families of probands were also investigated for incidence of diseases and associated clinical signs and personality traits peculiar to epilepsy. The controls were 136 students who did not have symptoms of epilepsy, examined in state primary and high schools in the same geographic area. They were selected from families with no clinical signs of epilepsy in brothers, parents, uncles and maternal or paternal grandparents.

Each patient was paired with his control according to sex, age, ethnic group, and socio-economic status, totalizing 136 sets of patients and their respective controls (Table I). The pairing was important to eliminate differences due to environmental, cultural and social factors between patients and controls which could have a heterogeneous influence on the epileptic manifestation. Likewise, racial differences arising from

Table I - Distribution of focal (F) and generalized (G) epilepsy patients and their controls according to diagnosis, sex, and ethnic group.

Patients						
Diagnosis	Ethnic group					Total
	Sex	White	Black	Mulatto	Japanese	
F. epilepsy	male	27	4	10	0	41
	female	33	1	4	0	38
G. epilepsy	male	27	3	6	0	36
	female	16	1	3	1	21
Total	-	103	9	23	1	136
Controls						
Sex	Ethnic group				Total	
	White	Black	Mulatto	Japanese		
Male	54	7	16	0	77	
Female	49	2	7	1	59	
Total	103	9	23	1	136	

comparisons among different groups could also be eliminated.

Fingerprints from the group of 272 individuals were analyzed in a blind test, that is, without previous knowledge of the individuals' identity, according to criteria described by Cummins and Midlo (1961), Holt (1968), Saldanha (1968) and Schaumann and Alter (1976).

For comparisons of the qualitative and quantitative dermatoglyphic characteristics, individuals were grouped as focal epileptics (FE), generalized epileptics (GE) and their normal controls (NC), subdivided by sex and ethnic group (white and non-white).

The following types of configurations were studied in the qualitative analysis: arch, loops and whorls (Figure 1) and complex patterns, represented by the combination of two or more configurations, such as loop with whorl, triple loop and other less common designs (Figure 2). The quantitative analysis was carried out by counting the number of fingerprint ridges in the finger patterns, known as the TRC (total ridge count) parameter, which reflects the pattern complexity (Figure 1).

A more detailed description of the methodological criteria of this study has been previously reported by Mattos-Fiore (1982).

For statistical analysis, the mean frequency of each basic pattern (arch, loop and whorl) of the left hand, right hand and both hands of each epileptic patient and its normal control was estimated and the distribution normalized by the arc-sin transformation (Freeman and Tukey, 1950). The loop frequencies were then compared in the three diagnostic groups (FE-GE-NC) using a single factor, unequal class size model, by the analysis of variance for the left, right and both hands, carried out separately for each sex and ethnic group. This model was also used for comparison of the TRC values in the three groups. The significance of the differences among the groups (GE vs. NC; FE vs. NC; GE vs. FE) was assessed by the Student *t*-test.

The frequencies of each fingerprint configuration (simple or complex), for each individual finger of the left and right hands, were then compared using the Fisher exact test.

RESULTS

Appendices A and B show the distribution of fingerprint patterns, classified by finger, hand and diagnosis, of the white and non-white individuals (within parentheses) as well as male and female samples, respectively.

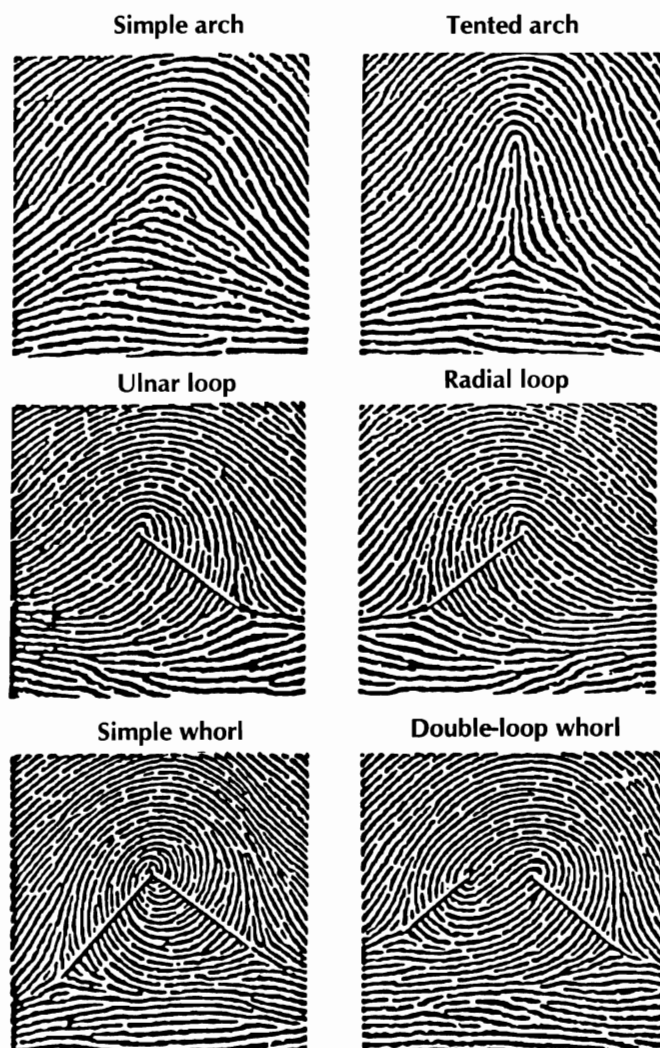


Figure 1 - Basic digital patterns indicating ridge count between pattern center and triradius.

Tables II and III show the frequency of basic fingerprint patterns, according to ethnic groups, diagnosis and hand, observed in male and female individuals.

In white individuals, the loop (ulnar and radial) frequencies of both hands of the male sample (Table II) were higher in patients with GE (72.96%) and lower in the patients with FE (51.85%), while normal controls showed intermediate values (61.48%). In the female sample (Table III), these proportions showed similar but less sharp discrepancies (GE = 70.63%; FE = 55.76%; NC = 66.19%). In the male sample, the differences in the frequency of loops among the three groups were higher in the left hand, whereas in the female sample the loop patterns predominated in the right hand, especially in the GE group. These comparisons suggest that the inter-group differences result from pronounced bilateral asymmetry with a predominance of loops on

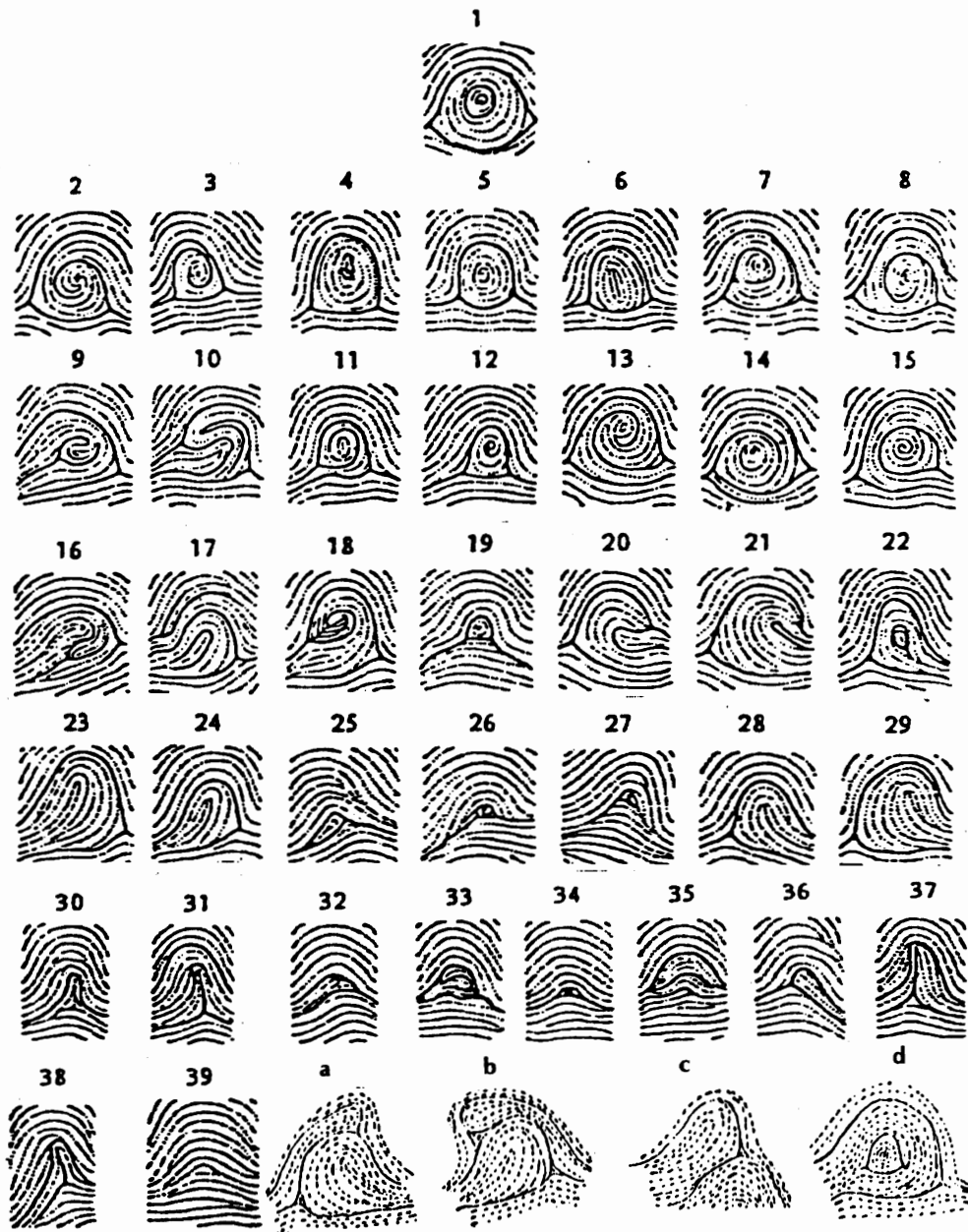


Figure 2 - Transition configurations associated with basic digital patterns, by decreasing complexity (1-39), described by Cummins and Midlo (1961), enlarged by four patterns observed in the present investigation (a,b,c,d).

the left hand of the two male epileptic groups, compared to controls.

The analysis of variance showed that the proportions of loops in both hands of the three male groups were significantly different ($F = 3.30; P < 0.05$) and the comparison tests indicated that the two epileptic groups also differ between themselves ($t = 3.62; P < 0.05$) but not from their controls. The analysis of variance further showed that loop frequencies on the left hand of the three groups were also significantly different ($F = 3.33; P < 0.01$). The differences between the GE group and the controls ($t = 2.86; P < 0.01$) were also

significant, but the difference between the FE group and the controls were not ($P > 0.05$). In the female sample, the difference in the proportion of loops among diagnostic groups was not statistically significant. In non-white individuals, the loop frequency of controls was higher than that of epileptics. However, these variations might have resulted from the reduced size of the samples of non-white individuals.

Furthermore, considering each finger separately, the comparison between the GE and FE white male groups showed highly significant differences ($P < 0.01$) in the loop frequencies of finger I of the right

Table II - Frequency in percent of digital patterns among males according to their ethnic group, diagnosis, and hand.

Ethnic group	Diagnosis (no.)	Hand	Pattern			
			Arch	Ulnar loop	Radial loop	Whorl
White	F. epilepsy (27)	L	6.67	53.33	3.70	36.30
		R	5.93	42.96	3.70	47.41
		L+R	6.30	48.15	3.70	41.86
	G. epilepsy (27)	L	1.48	74.07	3.70	20.74
		R	2.22	65.19	2.96	28.89
		L+R	1.85	69.63	3.33	24.81
	Control (54)	L	7.04	61.11	3.33	28.15
		R	5.19	55.19	3.33	36.30
		L+R	6.11	58.15	3.33	32.22
Non-white	F. epilepsy (14)	L	7.14	61.43	0	31.43
		R	2.86	54.29	2.86	40.00
		L+R	5.00	57.86	1.43	35.71
	G. epilepsy (9)	L	6.67	46.67	2.22	44.44
		R	6.67	44.44	6.67	42.22
		L+R	6.67	45.56	4.44	43.33
	Control (23)	L	7.83	70.43	5.22	18.26
		R	6.96	67.83	2.61	22.61
		L+R	7.39	69.13	3.91	20.43

F = Focal; G = generalized.

Table III - Frequency in percent of digital patterns among females according to their ethnic group, diagnosis, and hand.

Ethnic group	Diagnosis (no.)	Hand	Pattern			
			Arch	Ulnar loop	Radial loop	Whorl
White	F. epilepsy (33)	L	11.52	49.70	4.85	35.76
		R	9.70	53.94	3.03	34.55
		L+R	10.61	51.82	3.94	35.15
	G. epilepsy (16)	L	12.50	58.75	6.25	22.50
		R	3.75	73.75	2.50	20.00
		L+R	8.13	66.25	4.38	21.25
	Control (49)	L	9.05	55.97	9.05	25.93
		R	8.16	64.89	2.45	24.49
		L+R	8.61	60.45	5.74	25.20
Non-white	F. epilepsy (5)	L	20.00	36.00	0	44.00
		R	20.00	52.00	4.00	24.00
		L+R	20.00	44.00	2.00	34.00
	G. epilepsy (5)	L	4.00	44.00	4.00	48.00
		R	0	44.00	4.00	52.00
		L+R	2.00	44.00	4.00	50.00
	Control (10)	L	6.00	66.00	0	28.00
		R	2.00	66.00	0	32.00
		L+R	4.00	66.00	0	30.00

F = Focal; G = generalized.

hand and a significant difference in the loop frequency of finger III on the left hand ($P < 0.05$). These loop frequencies were higher in the GE patients. Inversely, the whorls occurred more frequently on finger I of the right hand ($P < 0.05$) of male patients with FE. Significantly larger frequencies of loops on finger III of the right hand ($P < 0.05$) were found in white female patients in the GE group, compared to the FE group (Table IV).

Also, in the separate finger analyses the comparison between GE and FE white individuals and their respective controls showed a highly significant difference ($P < 0.01$) in the proportion of loops on the fingers III of the left hand, more frequent in the male GE sample and less frequent in the female FE sample. The other differences were significant only at the 5% level of probability. Among male individuals, whorls were more frequent on finger I on the left hand of non-white FE patients and on fingers I, II and III of the left hand among the non-white GE patients. Among the female individuals, the radial and ulnar loops and other sub-types were less frequent on fingers II and III of the left hand of white FE patients while whorls were more frequent on finger III of the left hand of white and non-white FE patients (Table V).

Table IV - Significant differences in the frequencies of fingerprint patterns observed among males and females affected by focal or generalized epilepsy, classified by finger, hand and ethnic group.

Pattern	Hand	Finger	Comparison	Ethnic group	Statistical significance
Male sample					
L ^u	L	III	F < G	W	*
L ^u	R	I	F < G	W	**
L ^u + L ^{ut}	L	III	F < G	W	*
L ^u + L ^{ut}	R	I	F < G	W	**
L	L	III	F < G	W	*
L	L	I	F < G	W	**
W ^s	R	I	F > G	W	*
W	R	I	F > G	W	*
Female sample					
L ^u	R	III	F < G	W	*
L ^u + L ^{ut}	R	III	F < G	W	*
L	R	III	F < G	W	*

Key: R = right; L = left; F = focal; G = generalized; W = white; L = all loops.
 L^u = Ulnar loop.
 L^{ut} = Ulnar transitional loop.
 W = All whorls; W^s = simple whorl.
 < = Lesser than; > = greater than.
 Probability: * = $P < 0.05$; ** = $P < 0.01$.

No significant TRC mean differences ($P > 0.05$) were detected between patients and controls (Table VI).

DISCUSSION

Schaumann and Mayersdorf (1979) found an increase in radial loops in white adult patients with idiopathic epilepsy, not observed in patients with familial epilepsy. The latter, however, showed a significantly higher proportion of ulnar loops than that of controls. These results were not confirmed in a later investigation (Schaumann *et al.*, 1982) which did, however, find a higher frequency of ulnar loops in the familial cases.

Table V - Significant differences in the frequencies of fingerprint patterns observed among males and females affected by focal or generalized epilepsy, and their normal controls, classified by finger, hand and ethnic group.

Pattern	Hand	Finger	Comparison	Ethnic group	Statistical significance
Male sample					
L ^u	L	III	G > C	W	**
L	L	III	G > C	W	*
W ^s	L	III	G > C	NW	*
W ^s	L	II	G > C	NW	*
W ^s	L	I	G > C	NW	*
W	L	III	G > C	NW	*
W	L	II	G > C	NW	*
W ^s	L	I	F > C	NW	*
Female sample					
L ^u	L	III	F < C	W	*
L ^r	L	II	F < C	W	*
[(L ^r) + (L ^{rt}) + (L ^r /W ^a) + (L ^r /A ^s) + (L ^r /I ^a)]	L	II	F < C	W	*
L	L	III	F < C	W	**
W ^s	L	III	F > C	W	*
W ^s	L	III	F > C	NW	*
W	L	III	F > C	W	*

Key: L = left; F = focal; G = generalized; C = controls; W = white; NW = non-white.
 L = All loops; L^u = ulnar loop; L^r = radial loop; L^{rt} = radial transitional loop.
 W = All whorls; W^s = simple whorl; L^r/W^a or A^s or I^a = double-pattern (radial loop and abortive patterns: whorl, simple arch and loop).
 < = Lesser than; > = greater than.
 Probability: * = $P < 0.05$; ** = $P < 0.01$.

Table VI - Average total ridge count values of epileptic patients and their controls, classified by ethnic group, sex, and hand.

Ethnic group	Sex	Hand	Diagnosis					
			F. epilepsy		G. epilepsy		Control	
			No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD
White	Male	L	27	78.37 \pm 34.55	26	73.23 \pm 22.96	54	71.52 \pm 28.75
		R	27	78.48 \pm 28.91	26	75.12 \pm 23.46	54	72.30 \pm 25.99
		L+R	27	156.81 \pm 62.32	26	148.35 \pm 45.51	54	143.81 \pm 53.92
	Female	L	33	63.76 \pm 27.75	16	54.13 \pm 30.58	49	61.16 \pm 24.92
		R	33	64.61 \pm 24.30	16	58.50 \pm 26.07	49	65.29 \pm 23.10
		L+R	33	128.36 \pm 50.19	16	115.63 \pm 56.16	49	126.45 \pm 46.65
Non-white	Male	L	14	71.71 \pm 34.30	9	73.44 \pm 29.23	23	62.61 \pm 26.30
		R	14	75.93 \pm 33.05	9	78.78 \pm 24.40	23	65.70 \pm 31.38
		L+R	14	147.64 \pm 66.43	9	152.22 \pm 52.75	23	128.30 \pm 56.54
	Female	L	5	60.00 \pm 36.00	5	85.40 \pm 37.19	10	73.30 \pm 16.64
		R	5	63.60 \pm 36.56	5	82.40 \pm 34.61	10	80.10 \pm 15.79
		L+R	5	123.60 \pm 71.93	5	167.80 \pm 71.70	10	153.40 \pm 31.95

Similar discrepancies were confirmed in the present study, in the white male group on the left hand as well as on both hands, as disclosed by analysis of variance. Moreover, a higher frequency of loops occurred on the left hand of white GE patients comparatively to FE patients and to their controls. However, FE patients did not differ from their respective controls. Also, the loop frequency in both hands differed significantly between GE or FE patients. Furthermore, neither of these two groups of patients revealed significant differences in relation to their respective controls.

In both the male and female white samples, the loops were more frequent in the three groups in the following order, GE > NC > FE, so that the epileptic patients (FE and GE) are more different from each other than in relation to their respective controls. These differences are more accentuated in the male sex and in the left hand, which showed greater variability in the three diagnostic groups. This could result from bilateral asymmetry mediated by embryonic distortions associated with pleiotropic gene action during the epigenesis of the nervous system.

The presence of exotic or rare patterns and the total absence of certain fingerprint patterns with low frequency in the general population were also observed in this sample.

In the non-white group, the tented arch (A^t) pattern was completely absent in male GE patients and

their controls, as well as in FE and GE females (Appendices A and B).

The transitional ulnar loop (L^{ut}), although present in all the controls, was not observed in the epileptics, except in the white FE patients.

The double pattern represented by an ulnar loop associated with an abortive loop ($L^u/1^a$) was completely absent in the non-white sample, but present in white patients in the three diagnostic categories (Appendices A and B).

The radial loop was absent in the non-white female controls but fairly frequent in the other groups. The transitional radial loop (L^{rt}) was present only in the controls of both ethnic and sex groups (Appendices A and B).

A double pattern with a radial loop associated with an abortive pattern ($L^r/A^s, L^r/W^s, L^r/1^a$) was very rare in the present sample. A low percentage was found in the male controls of both ethnic groups and in white female FE patients (Appendices A and B).

Comparing the frequencies of the patterns on each finger separately, in the GE and FE epileptic groups only a difference in fingers I and III was observed. Finger I of the right hand in the male GE sample showed a higher loop frequency, while the lowest frequency occurred in the male FE sample, which, in turn, presented a higher proportion of whorls on the same finger of this hand. However, when comparing the GE and FE patient groups, loops on

finger III predominated on the left hand of the male GE individuals and on the right hand of the female individuals of the GE sample.

Comparisons between FE and GE patients and their respective controls displayed significant differences only in fingers I, II and III on the left hand of white and non-white individuals, while finger III presented the greater number of differences in whorl frequencies. Male FE and GE patients showed higher loop and whorl frequencies on the fingers I and II in relation to their respective controls. In the female white and non-white samples, the only significant differences on those fingers were between FE patients and their controls.

In the present study, the greatest statistical discrepancies in the pattern frequencies between epileptics and controls were on finger III. Between GE and FE patients, these discrepancies were ascribed to finger I, while in a previous report (Schaumann and Mayersdorf, 1979) significant differences for fingers were found only on finger II (radial loop) in adult male white epileptics with different etiologies. These results suggest that embryogenic changes in primordial digital regions I, II and III may be epigenetically associated with the pathological function of the central nervous system.

In spite of the significant differences in the digital pattern frequencies, the quantitative analysis, that is, the total ridge count of the patterns on the ten fingers of each individual (TRC), did not show any significant difference between the epileptic groups and their controls. Previous research among adult males with idiopathic or familial epilepsy showed lower TRC values, although not significant at the 5% level of probability, comparatively to the controls (Schaumann and Mayersdorf, 1979; Schaumann *et al.*, 1982).

However, it must be remembered that the TRC has a typically polygenic sex-influenced inheritance (Holt, 1968), while the main fingerprint patterns (Figure 1) are probably dependent on a reduced number of epistatic gene loci, identified to be seven in segregational analysis of Yemenite Jewish families ("habanite" isolate) in Israel (Slatis *et al.*, 1976).

Consequently, differences among the TRC means are hardly detected, even among racially diverse groups, when the samples are small. As in nearly all populations (Saldanha, 1968), the TRC means were significantly ($P < 0.05$) higher in male than in female groups for both epileptics and controls. The mean TRC values in the male GE and FE samples were greater than those of their controls, a situation not found in the female groups (Table VI).

The TRC means of the male white GE (148.35 ± 53.84) or FE (156.81 ± 62.32) patients were higher, although not significantly, than those of the controls

(143.81 ± 53.84), whose values (Table VI) were much closer to the mean value (142.16 ± 45.30) found in a sample of 106 men of the São Paulo population. Likewise, the white female control mean (126.45 ± 46.65) was fairly similar to that of 100 women sampled in São Paulo (127.17 ± 49.89) (Toledo *et al.*, 1969).

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RESUMO

Investigaram-se as configurações dermopapilares de 136 pacientes com epilepsia generalizada (EG) ou focal (EF), entre seis e 15 anos, emparelhadas segundo o sexo, idade, grupo étnico e nível sócio-econômico, com aquelas de 136 controles normais (CN), quanto aos sinais epiléticos. As frequências dos padrões dermatoglíficos foram comparadas revelando diferenças significativas ($P < 0,05$) na frequência de presilhas da mão esquerda de indivíduos masculinos brancos na seguinte ordem: $EG > CN > EF$. Considerando-se cada dedo isoladamente, as comparações entre os dois grupos de diagnóstico (EG e EF) revelaram diferenças altamente significativas ($P < 0,01$) na frequência de presilhas no dedo I da mão D e diferenças significativas na frequência também de presilhas no dedo III da mão E, sendo maior nos epiléticos G; inversamente, os verticilos ocorreram com maior proporção no dedo I da mão D, nos pacientes masculinos EF. Nos pacientes femininos, registraram-se frequências significativamente maiores de presilhas, no dedo III da mão D no grupo EG; todas as referidas diferenças registraram-se no grupo branco. As comparações entre epiléticos (EG + EF) e seus respectivos controles mostraram diferenças altamente significativas na proporção de presilhas nos dedos III da mão E, na amostra masculina (maior no grupo EG) e na amostra feminina (menor no grupo EF), todos caucasóides. As demais diferenças atingiram somente o nível de significância de 5% de probabilidade. Entre indivíduos masculinos, os verticilos foram mais frequentes nos pacientes EF não brancos no dedo I da mão E e, entre os pacientes EG, também não brancos, nos dedos I, II e III da mão E. Entre os indivíduos femininos, as presilhas radiais, ulnares ou de vários subtipos atingiram menor proporção entre pacientes EF brancos, nos dedos II e III da mão E, e os verticilos ocorreram com maior frequência entre os pacientes EF brancos e não brancos, no dedo III também da mão E. As maiores discrepâncias estatísticas entre epiléticos e controles localizaram-se no dedo III e, entre epiléticos G e F, no dedo I, sugerindo que as regiões I - III possam estar associadas epigeneticamente, de algum modo, à fisiologia normal do SNC. Não foram encontradas diferenças significativas nas médias do TRC entre pacientes e controles.

APPENDIX

Appendix A - Frequency of fingerprint patterns classified by finger, hand and diagnosis among white and non-white (within parentheses) males.

Finger	Diagnosis no.	Hand	Pattern												
			Arch		Loop							Whorl			
			A ^s	A ^t	L ^u	L ^{ut}	L ^u /I ^a	L ^r	L ^{rt}	L ^r /A ^s	L ^r /W ^a	L ^r /I ^a	W ^s	W ^d	
I	FE 27 (14)	L	2 (1)	0 (0)	13 (6)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (5)	7 (2)
		R	2 (0)	0 (0)	7 (6)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (4)	4 (4)
	GE 27 (9)	L	1 (1)	0 (0)	18 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (4)	4 (0)
		R	1 (1)	0 (0)	18 (3)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (4)	3 (1)
	NC 54 (23)	L	3 (1)	0 (0)	31 (16)	1 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	10 (1)	8 (4)
		R	1 (2)	0 (0)	26 (13)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19 (3)	7 (5)
II	FE 27 (14)	L	1 (1)	1 (0)	8 (6)	0 (0)	0 (0)	5 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (6)	0 (1)
		R	2 (1)	2 (0)	6 (4)	0 (0)	0 (0)	3 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (5)	3 (2)
	GE 27 (9)	L	0 (1)	1 (0)	15 (2)	0 (0)	0 (0)	5 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (6)	0 (0)
		R	1 (1)	1 (0)	9 (2)	0 (0)	0 (0)	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (4)	1 (0)
	NC 54 (23)	L	7 (3)	1 (0)	20 (11)	1 (0)	0 (0)	7 (3)	1 (0)	0 (0)	1 (0)	0 (0)	0 (0)	13 (6)	2 (0)
		R	6 (3)	1 (0)	18 (11)	1 (0)	0 (0)	6 (3)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (6)	1 (0)
III	FE 27 (14)	L	3 (1)	0 (1)	15 (8)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7 (4)	1 (0)
		R	1 (1)	0 (0)	16 (10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (3)	1 (0)
	GE 27 (9)	L	0 (1)	0 (0)	24 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (4)	0 (0)
		R	0 (1)	0 (0)	22 (5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (3)	0 (0)
	NC 54 (23)	L	6 (3)	0 (0)	32 (18)	3 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (2)	1 (0)
		R	2 (2)	0 (0)	36 (19)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (2)	3 (0)
IV	FE 27 (14)	L	0 (0)	0 (0)	12 (11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (3)	2 (0)
		R	0 (0)	0 (0)	9 (7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (7)	0 (0)
	GE 27 (9)	L	0 (0)	0 (0)	19 (5)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (3)	0 (0)
		R	0 (0)	0 (0)	15 (4)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (4)	0 (0)
	NC 54 (23)	L	1 (1)	0 (0)	28 (16)	3 (1)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	21 (5)	1 (0)
		R	3 (1)	0 (0)	21 (15)	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	26 (5)	0 (0)
V	FE 27 (14)	L	2 (1)	0 (0)	22 (12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1)	0 (0)
		R	1 (0)	0 (0)	20 (11)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (3)	1 (0)
	GE 27 (9)	L	0 (0)	0 (0)	24 (6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (3)	1 (0)
		R	0 (0)	0 (0)	24 (6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3)	0 (0)	3 (3)	0 (0)
	NC 54 (23)	L	1 (1)	0 (0)	43 (19)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (3)	0 (0)
		R	1 (0)	0 (0)	38 (18)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (5)	1 (0)

FE: Focal epilepsy; GE: generalized epilepsy; NC: controls; L: left; R: right.

Appendix B - Frequency of fingerprint patterns classified by finger, hand and diagnosis among white and non-white (within parentheses) females.

Finger	Diagnosis no.	Hand	Pattern												
			Arch		Loop						Whorl				
			A ^s	A ^t	L ^u	L ^{ut}	L ^u /I ^a	L ^r	L ^{rt}	L ^r /A ^s	L ^r /W ^a	L ^r /I ^a	W ^s	W ^d	
I	FE 33 (5)	L	1 (1)	0 (0)	17 (1)	0 (0)	1 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (1)	5 (2)
		R	3 (1)	1 (0)	14 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (2)	7 (1)
	GE 16 (5)	L	0 (0)	0 (0)	10 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0)	3 (4)
		R	0 (0)	0 (0)	11 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3)	2 (0)
	NC 49* (10)	L	4 (0)	0 (0)	24 (3)	1 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (4)	6 (2)
		R	1 (0)	0 (0)	30 (3)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (3)	9 (3)
II	FE 33 (5)	L	4 (1)	1 (0)	11 (2)	0 (0)	0 (0)	3 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	14 (1)	0 (1)
		R	3 (1)	0 (0)	14 (2)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	14 (1)	0 (0)
	GE 16 (5)	L	0 (1)	2 (0)	7 (0)	0 (0)	0 (0)	3 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (3)	0 (0)
		R	1 (0)	0 (0)	10 (1)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (2)	0 (1)
	NC 49 (10)	L	5 (1)	1 (1)	13 (5)	0 (0)	0 (0)	15 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	14 (3)	1 (0)
		R	6 (1)	1 (0)	17 (4)	2 (0)	1 (0)	5 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	14 (3)	2 (0)
III	FE 33 (5)	L	4 (1)	4 (0)	12 (1)	0 (0)	0 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (3)	0 (0)
		R	4 (1)	1 (0)	19 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7 (0)	2 (0)
	GE 16 (15)	L	2 (0)	2 (0)	10 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)
		R	0 (0)	0 (0)	15 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)
	NC 49 (10)	L	5 (1)	1 (0)	32 (8)	0 (0)	0 (0)	4 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7 (0)	0 (1)
		R	6 (0)	1 (0)	37 (9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (1)	0 (0)
IV	FE 33 (5)	L	2 (1)	0 (0)	13 (2)	0 (0)	1 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	15 (2)	0 (0)
		R	2 (1)	0 (0)	17 (2)	0 (0)	0 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (2)	0 (0)
	GE 16 (5)	L	1 (0)	0 (0)	9 (2)	0 (0)	0 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (3)	0 (0)
		R	1 (0)	0 (0)	10 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (3)	0 (0)
	NC 49 (10)	L	3 (0)	0 (0)	27 (6)	1 (2)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	17 (3)	0 (0)
		R	3 (0)	0 (0)	26 (4)	2 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (5)	0 (0)
V	FE 33 (5)	L	2 (1)	1 (0)	26 (3)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1)	0 (0)
		R	1 (1)	1 (0)	25 (4)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (0)	0 (0)
	GE 16 (5)	L	2 (0)	1 (0)	11 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)
		R	1 (0)	0 (0)	13 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)
	NC 49* *(10)	L	3 (0)	0 (0)	38 (8)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (1)	0 (0)
		R	2 (0)	0 (0)	40 (9)	3 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1)	0 (0)

FE: Focal epilepsy; GE: generalized epilepsy; NC: controls; L: left; R: right.

* Includes an individual bearing an impaired print on the left finger I.

** Includes an individual bearing an impaired print on the left finger V.

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