

Dermatoglyphics of Twins

A Study based on a new Systematics

Bo Brismar

Introduction

The papillary line patterns on fingers, palms and soles have, after the basic work of Wilder (1902; 1904), been the object of a thorough study out of as well a systematic as a genetic character (Bonnievie, 1924; Cummins and Midlo, 1961).

The Author has in earlier works (Brismar, 1965; 1966) given an account of a partly new systematics for the papillary line patterns. The pattern types of the various fingers have been brought together to a qualitative value: A-pattern, AL-pattern, L-pattern, LW-pattern and W-pattern according to the division of the number of the incoming pattern types. The patterns in the interdigital areas which have been analyzed after a systematics based on the structure of the third triradius and the course of main line C, have been possible to divide into U (ulnar loops), R (radial loops), O (open field patterns) and V (vestiges), while the patterns in the hallucal area in the sole have been systemized after the pattern direction in whorls, longitudinal, transverse and open field patterns. With this systematics the Author has received a mother/child correlation of $r = 0.39 - 0.47$ for particular pattern types (Tab. I).

The intention with the present work has been to test the systematics worked out by the Author on a twin material of a comparable Swedish population.

A great number of twin and family investigations have been carried out, partly with the aim to try to show the hereditary nature for these patterns (Steffens, 1938; Geipel, 1952; Holt, 1957) and partly papillary line patterns have been used as a diagnostic aid at twin diagnostics (Smith and Penrose, 1955).

Geipel found at the investigation of the patterns of the soles of forty MZ twin pairs a homolateral concordance of 80%, while Steffens could prove a corresponding concordance for the qualitative values in fingerprints of fifty MZ twin pairs. At her investigation of the total ridge-count in fingers Holt received an intraclass correlation for MZ twin pairs of 0.95 ± 0.01 . None of the authors have, however, specified after which norms the diagnosis of zygosity has been made.

Tab. I. Mother/child correlations for papillary patterns in different areas

		Mother/child correlation
Qualitative value	L/W-patterns	$r = 0.46 \pm 0.06$
Interdigital spac.	U/R-patterns	right hand $r = 0.39 \pm 0.08$
		left hand $r = 0.43 \pm 0.10$
Hallucal area	I/-patterns	$r = 0.47 \pm 0.05$

Methodology

The twin pairs have been examined partly with finger, palm and sole prints and partly with blood group analyses. The diagnosis of zygosity which has been based on a comparison between the morphological particularities and on a statistic analysis of the results of the blood typing (ABO, Rh, MNS, P, Kell, Lewis, Duffy, Kidd) according to principles worked out by Fisher (1951) and Smith and Penrose (1955), have shown a relative chance of dizygosity of 0.0190-0.0757 for the concordant twin pairs.

The papillary line patterns have been analyzed after the Author's worked out systematics, completed with calculations of the total ridge-count (Holt, 1955).

Material

The material consists of 34 non-selected twin pairs, who took part in an after-investigation of twin pairs from elementary schools within the Stockholm area (whose face skeletons have previously been investigated by Lundström, 1954). The members within each twin pair was of the same sex. After blood analyses of the 34 pairs, 19 pairs (8 m, 11 w) were interpreted as MZ, and 15 pairs (5 m, 10 w) as DZ, the average age in both group being of 27 years (24-32 years).

Frequency Distribution

The frequency distribution for the various papillary line pattern types of the investigated twin pairs showed a good concordance with the values that the Author has earlier received from a large Swedish population (Tab. II).

In no case the differences in frequency are significant, because the investigated twin material in this respect can be regarded to represent a normal Swedish population.

Concordance Calculations

At comparison between the members within each MZ twin pair, a concordance of 84.2-89.5% was found for total qualitative value, for total ridge-count and for the hallucal patterns against 33.3-53.3% for the DZ twin pairs (Tab. III). For the

Tab. II. Frequency distribution for papillary patterns in different areas

		Twins %	Swedish population %	Difference %
Qualitative value	A	2.9	2.9	± 0.0
	AL	7.4	3.6	+ 3.8
	L	58.8	60.9	- 2.1
	LW	17.6	21.2	- 3.6
	W	13.2	11.4	+ 1.8
	Total	99.9	100.0	
Interdigital patterns	U	19.9	29.8	- 9.9
	R	15.4	19.3	- 3.9
	O	52.2	45.5	+ 6.7
	V	12.5	5.4	+ 7.1
	Total	100.0	100.0	
Hallucal patterns	I	51.5	52.8	- 1.3
	W	30.9	29.6	+ 1.3
	O	5.1	5.1	± 0.0
	—	12.5	12.6	- 0.1
	Total	100.0	100.1	
Total ridge-count	0-89	23.5	22.4	+ 1.1
	90-129	20.6	23.5	- 2.9
	130-159	23.5	24.0	- 0.5
	160-	32.4	30.2	+ 2.2
	Total	100.0	100.1	

Tab. III. Concordance between MZ twins for papillary patterns in different areas

	MZ %	DZ %	Unrelated %
Qualitative value	84.2	53.3	54.5
Interdigital patterns	55.3	53.6	30.8
Hallucal patterns	84.2	33.3	48.9
Total ridge-count	89.5	40.0	25.9

interdigital patterns a concordance of only 55.3% was found for the MZ pairs which, however, can be explained by that the pattern types O (open field) and V (vestiges) do not form differentiated patterns as well as U (ulnar loops) and R (radial loops) for which a corresponding concordance of 100% was received (Tab. IV). A concordance of 100% was received also for the total qualitative value within the pattern

Tab. IV. Correlation between MZ twins for the papillary patterns in the interdigital spaces

Twin 1/Twin 2	U	O	V	R	Total
U	5	—	1	—	6
O	3	11	1	3	18
V	1	3	2	1	7
R	—	3	1	3	7
Total	9	17	5	7	38

groups L versus W and for the hallucal patterns a concordance of 98% for transverse patterns versus longitudinal patterns (Tables V-VII).

The high concordance for the above mentioned pattern types is interesting as it is just for these that the Author has in earlier works received the highest mother/child correlation ($r = 0.39-0.47$).

Tab. V. Correlation between MZ twins for the papillary patterns in fingers

Twin 1/Twin 2	A	AL	L	LW	W	Total
A	—	—	—	—	—	—
AL	—	1	—	—	—	1
L	—	—	11	1	—	12
LW	—	—	2	1	—	3
W	—	—	—	—	3	3
Total	—	1	13	2	3	19

Tab. VI. Correlation between MZ twins for the papillary patterns in the hallucal area

Twin 1/Twin 2	W	I	—	O	Total
W	10	—	—	—	10
I	3	16	—	1	20
—	1	1	4	—	6
O	—	—	—	2	2
Total	14	17	4	3	38

Tab. VII. Correlation between MZ twins for the total ridge-count in fingers

Twin 1/Twin 2	0-89	90-129	130-159	160-	Total
0-89	3	—	—	—	3
90-129	1	3	—	—	4
130-159	—	—	5	—	5
160-	—	—	1	6	7
Total	4	3	6	6	19

Acknowledgements

I should like to bring my sincere thanks to Prof. Anders Lundström who has given me the possibility to investigate the related twin material. I should also like to express my gratitude to Dr. Arnold Korbi who has carried out the statistical rearrangement of the blood group analyses.

Summary

1. The Author has investigated on a twin material of 34 twin pairs the papillary line patterns on the fingers, the interdigital areas of the palms, and the hallucal area of the soles according to a systematics accounted for by the Author in earlier works.
2. The diagnosis of zygosity has been based on a comparison for the morphological particularities and on blood group analyses, in the cases in which the relative chance for dizygosity for the concordant pairs has been calculated.
3. The frequency distribution for the papillary line patterns of the twin pairs showed no significant divergence with respect to the large Swedish population, earlier investigated.
4. The 19 MZ twin pairs showed a concordance of 84.2-89.5% for the total qualitative value, total ridge-count and for the hallucal patterns.

References

- BONNEVIE K. (1924). Studies on papillary patterns of human finger. *J. Genet.*, **15**: 1.
- BRISMAR B. (1965). Dermatoglyphics in the hallucal area of the sole. *Mother/child correlation. A.Ge.Me.Ge.*, **14**: 86.
- (1965). Qualitative value in finger prints. *Mother/child correlation. A.Ge.Me.Ge.*, **14**: 421.
- (1966). Palm prints. The patterns in the interdigital spaces. *A.Ge.Me.Ge.*, **15**: 314.
- CUMMINS H., MIDLO C. (1961). *Finger Prints, Palms and Soles*. Dover Publ., New York.
- FISCHER R. (1951). Standard calculations for evaluating a blood-group system. *Heredity*, **5**: 95.
- GEIPEL G. (1952). Die Konkordanz der Fusssohlenmerkmale bei Zwillingen, ein Versuch des Nachweises ihrer Erblichkeit. *Z. Morph. Antrop.*, **44**: 70.
- HOLT S. (1955). Genetics of dermal ridges: frequency distributions of total finger ridge-count. *Ann. Hum. Genet. (London)*, **20**: 270.

- Quantitative genetics of dermal ridge-patterns on fingers. *Acta Genet. (Basel)*, **6**: 473, 1956/57.
- LUNDSTRÖM A. (1954). The importance of genetic and nongenetic factors in the facial skeleton studied in 100 pairs of twins. *Europ. Orthod. Soc.*, 92.
- SMITH M., PENROSE L. (1955). Monozygotic and dizygotic twin diagnosis. *Ann. Hum. Genet. (London)*, **19**: 273.
- STEFFENS C. (1938) Über Zehenleisten bei Zwillingen. *Z. Morph. Anthrop.*, **37**: 218.
- WILDER H. Palms and soles. *Amer. J. Anat.*, **1**: 423, 1902.
- (1904). Racial differences in palm and sole configuration. *Amer. Anthrop.*, **6**: 244.

RIASSUNTO

1. L'Autore ha preso in esame 34 coppie di gemelli e ne ha studiato i disegni delle linee papillari delle dita delle regioni interdigitali del palmo e della regione dell'alluce della pianta del piede, con un sistema che è stato già descritto dall'Autore in lavori precedenti.

2. La diagnosi di zigtismo è basata sul confronto delle caratteristiche morfologiche e sull'analisi dei gruppi sanguigni in quei casi nei quali è stata calcolata la relativa probabilità di dizigtismo per le coppie concordanti.

3. La distribuzione della frequenza dei disegni delle linee papillari delle coppie di gemelli non rivelava nessun significativo scarto rispetto alla numerosa popolazione svedese esaminata precedentemente.

4. Le 19 coppie di gemelli giudicati MZ mostrano una concordanza dell'84.2-89.5% per i valori qualitativi e quantitativi totali come anche per i disegni dell'alluce.

RÉSUMÉ

1. Les dessins papillaires digitaux, interdigitaux et hallucaux ont été étudiés chez 34 couples de jumeaux d'après une méthodologie précédemment décrite.

2. Le diagnostic de zygotisme se base sur les caractères morphologiques et sur les groupes sanguins dans les cas où la probabilité de zygotisme pour les couples concordants a été calculée.

3. La distribution des fréquences des dessins n'a pas démontré d'écart significatifs vis-à-vis de la population suédoise précédemment examinée.

4. Les 19 couples jugés MZ présentent une concordance de 84.2-89.5% pour les valeurs qualitatives et quantitatives.

ZUSAMMENFASSUNG

1. Der Verfasser hat auf ein Zwillingsmaterial von 34 Zwillingen die Papillarlinienmuster von den Fingern, von den Interdigitalzonen der Handfläche und von den Halluxbereich der Fusssohlen untersucht, nach einer bei der Verfasser in früher Arbeiter erklärten Systematik.

2. Die Zwillingsdiagnose ist auf einem Vergleich von den morphologischen Besonderheiten und Blutgruppenanalyse gegründet, wobei auch die relative Chance für Zweieiigkeit für die konkordante Paaren ist berechnet.

3. Die Frequenzverteilung für die Papillarlinienmuster bei den Zwillingspaaren zeigte keine signifikative Abweichung von die Verteilung der früher untersuchten grossen Schwedischen Population.

4. Die 19 Zwillingspaaren beurteilten als Homozygoten, zeigten eine Konkordanz von 84.2-89.5% für totales qualitative und quantitative Wert und für die Halluxmuster.