G. D. GUPTA AND A. SHARMA

A STUDY OF THE ASSOCIATION BETWEN FINGERBALL AND FINGERTIP CONFIGURATIONAL COMPLEXES

Considerable amount of work has been done over the existence of various triradii occurring on the finger, palmar and plantar surfaces. During all these years, "finger dermatoglyphics" referred only to the patterns existing on the fingerball skin, i.e. the ventral surface of the last phalanx. In the existing literature, with particular reference to the rare aberrant and peculiar configurational patterns, one comes across a linear sketch made from a photographic enlargements of the prints (from Poll's collection) of "a supernumerary loop lying outside pattern area of a thumb" (Cummins and Midlo 1961: Fig. 49 : 66) and, presumably, it refers to the area close to the fingernail which in this study has been constantly referred to as "fingertip area" (Sharma 1968: Pers. Confs.). Even the first and second phalanges have attracted attention (e.g. Wasinski 1966: 41—56) but all this leaves the region from nail to fingerball untouched. This area and its dermal complexes have attracted Sharma's attention first in 1968 discovering the occurrence of terminal triradius close to the margin where the soft ridge portion of the distal phalanx comes to an end against the nail of the finger and the discovery had been promptly announced and reported in brief (Sharma et al. 1969: 548) on the basis of inked impression of the area on 70 unrelated males resident in Delhi, "terminal triradius" being the term used to denote triradius in this area to distinguish it from the rest. As expected, the loop and arch configurational peculiarities differ both from person to person and from digit to digit.

PROBLEM

Association tests between the fingerball and fingertip configurational complexes are being investigated on two large series of males in the present study.

MATERIAL AND METHODS

Total Material consists of bilateral inked impressions of fingertips of 300 Brahman and 300 Rajput males from Nainital and Ranikhet in Kumaon Hills (U.P., India) in the Himalayas.

There are 52 "kinship categories" (Leach 1954: 211) of inter-marrying type belonging to a "common gene pool" (Dobzhansky 1955: 1) in the Brahman series. Out of these, four "kinship categories" (Joshi, Pandey, Pant and Tiwari) constitute the major part (63.75 %) of the total field sample, the rest 48 accounting for 36.25 % (Gupta 1974: 16—22). Similarly, there are 81 "kinship categories" of inter-marying type in the Rajput series. Five of these (Bisht, Mehra, Negi, Rawat and Thakur) constitute the major part (58.89 %) of the total field sample, the rest 76 accounting for as much as 41,11 % (Gupta 1974: 23—33).

Use has been made of the cotton T-pad (Sharma 1963: 231—239) for spreading a thin film of ink on slab. This film is then transfered to the broad area (called fingertip) of each of the five digits of each hand giving full attention to the most
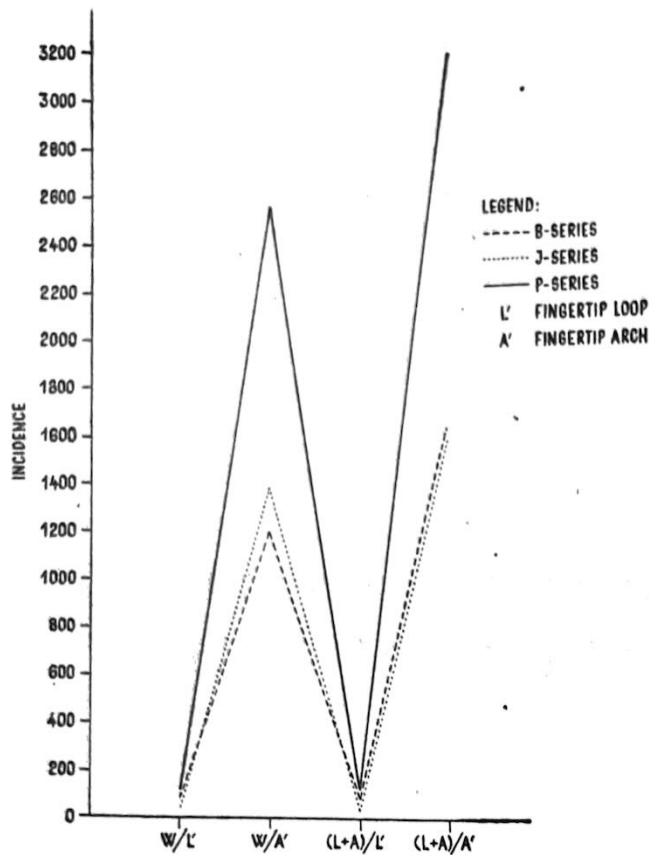
For combinations and of fingerball (W₃L + A) and fingertip configurational complexes (L + A).

FIG. 1. *Occurrence of fingerball and fingertip configurational complexes in rights and lefts pooled together ignoring the digitwise distinction in the Brahman, Rajput and in the two series pooled together.*

distal zone of the distal phalanx covering the dermatoglyphic (ridge surface upto the nail margin on the one hand and radial and ulnar sides of the fingertip area to be printed with the help of the said T-pad. After inking the fingertip areas of both hands in a single operation as defined, a piece of white paper is placed on tabletop in such a manner that the distal edge of paper coincides with the frontal edge of the tabletop. The fingertip is braught against the paper surface by the edgeside touching the radial side first and then giving the entire fingertip a radio-ulnar movement (as is usually done in obtaining fingerball impressions) so as to obtain a rolled impression of the area comparable to the rolled fingerball impression, thereby not making use of the recommended practice of ulno-radial movement in digits IV—V. On examining such an inked impression of fingertip area, one clearly sees the inked impression of the entire fingertip including the mark of freshly clipped fingernail. To avoid smudging, the subject is asked to remain relaxed and passive to ensure the research worker's total freedom in manipulating the radio-ulnar movement of the entire finger.

Methods of identifying the fingertip configurations and triradii (S h a r m a and G u p t a 1976: unpublished cf. Gupta 1974: 41—44) are basically the same as in the ALW terminology of fingerball dermatoglyphics, but loops and arches occurring on the fingertip area are designated as L' and A' respectively distinguish it from loops (L) and arches (A) on the main fingerball (S h a r m a 1968: Pers. Confs.). In finger dermatoglyphic patterns, the *complex patterns* (= Whorls) are differentiated from the relatively *simpler patterns* (= Loops and Arches) in a two-fold grouping of the ALW-system, but the same practice may not be followed in "fingertip area" since there is complete absence of whorls. As a natural corollary, therefore, loops designated by L' and arches by A' are coveniently considered as relatively "complex" and "simpler" patterns respectively. This enunciation is pertinent in view of the groupings of patterns followed in statistical evaluation. As a matter of added safety, the patterns on fingerballs have been recorded by following visual observation method as well besides adjudging from the inked impressions for purposes of the present study.

RESULTS

Table 1 shows the distributional differences for the occurrence of fingerball patterns (A—L—W) ignoring handwise and digitwise distinction in both the Brahman and Rajput series as significant. Likewise, the population differences between Brahmans and Rajputs in the occurrence of fingertip configurational complexes are significant (*Table 2*).

TABLE 1

Chi-square Test for Assessing the Population Differences Between Brahmans and Rajputs in the Occurrence of Fingerball Configurational Complexes Ignoring the Handwise and Digitwise Distinction

Group	W	L	A	Total
Brahmans	1268	1610	122	3000
Rajputs	1392	1519	89	3000
Total	2660	3129	211	6000

Chi-square = 13.59 : d.f. = 2: P < 0.001: Significant

TABLE 2

Chi-square Test for Assessing the Population Differences Between Brahmans and Rajputs in the Occurrence of Fingertip Configurational Complexes Ignoring the Handwise and Digitwise Distinction

Group	L'	A'	Total
Brahmans	214	2786	3000
Rajputs	80	2920	3000
Total	294	5706	6000

Chi-square = 64.20: d.f. = 1: P < 0.001: Significant

TABLE 3

Chi-square Test Between Fingerball and Fingertip Complexes in Rights, Fefts and Rights-an-Lefts Pooled Together Considering and Ignoring the Digitwise Distinction in the Brahman Series.

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Rights Only)	I L'	A'	II L'	A'	III L'	A'	IV L'	A'	V L'	A'	(ItoV) L'	A'
W	7	148	6	123	6	81	10	179	17	74	46	605
L	6	130	8	138	1	195	3	105	39	170	57	738
A	–	9	2	23	–	17	1	2	–	–	3	51
Total	13	287	16	284	7	293	14	286	56	244	106	1394

Statistical Inference

	I	II	III	IV	V	Total
Chi-square	0.12	0.04	8.76 **	0.14	0.001	0.001
d.f.	1	1	1	1	1	1

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Lefts Only)	I L'	A'	II L'	A'	III L'	A'	IV L'	A'	V L'	A'	(ItoV) L'	A'
W	10	126	10	118	5	89	5	178	14	74	44	585
L	13	139	8	140	8	174	4	107	26	744.	59	744
A	2	10	2	22	1	23	–	2	–	2	5	63
Total	25	275	20	280	14	286	9	291	40	260	108	1392

Statistical Inference

	I	II	III	IV	V	Total
Chi-square	0.17	0.30	0,40	0.46	0.72	0.03
d.f.	1	1	1	1	1	1

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Rights + Lefts Pooled)	I L'	A'	II L'	A'	III L'	A'	IV L'	A'	V L'	A'	(ItoV) L'	A'
W	17	274	16	241	11	170	15	357	31	148	50	190
L	19	269	16	278	9	369	7	212	65	352	116	1482
A	2	19	4	45	1	40	1	8	–	2	8	114
Total	38	562	36	564	21	579	23	577	96	504	214	2786

Statistical Inference

	I	II	III	IV	V	Total
Chi-square	0.11	0.04	5.17*	0.01	0.33	0.001
d.f.	1	1	1	1	1	1

TABLE 4

Chi-square Test Between Fingerball and Fingertip Complexes in Rights, Fefts and Rights-an-Lefts Pooled Together Considering and Ignoring the Digitwise Distinctions in the Rajput Series.

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Rights Only)	I L'	A'	II L'	A'	III L'	A'	IV L'	A'	V L'	A'	(ItoV) L'	A'
W	1	185	2	142	1	90	4	198	9	97	17	712
L	3	108	3	126	1	195	1	96	15	177	23	702
A	–	3	1	26	–	13	–	1	–	2	1	45
Total	4	296	6	294	2	298	5	295	24	276	41	1459

Statistical Inference

	I	II	III	IV	V	Total
Chi-square	1.07	0.10	0.93	0.01	0.19	0.90
d.f.	1	1	1	1	1	1

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Lefts Only)	I L'	A'	II L'	A'	III L'		IV L'	A'	V L'	A'	(ItoV) L'	A'
W	3	152	3	135	2	98	3	178	6	86	17	649
L	2	137	2	139	3	183	1	117	15	192	23	768
A	–	6	–	21	–	14	–	1	–	1	–	43
Total	5	295	5	295	5	295	4	296	21	279	40	1460

Statistical Inference

	I	II	III	IV	V	Total
Chi-square	0.008	0.03	0.60	0.01	0.001	0.09
d.f.	1	1	1	1	1	1

Fingerball Configurational Complexes	Fingertip Configurational Complexes										Total	
(Rights + Lefts Pooled)	I L'	A'	II L'	A'	III L'	A'	IV L'	A'	V L'	A'	(ItoV) L'	A'
W	4	337	5	277	3	188	7	376	15	183	34	1361
L	5	245	5	265	4	378	2	213	30	369	46	1470
A	–	9	1	47	–	27	–	2	–	3	1	88
Total	9	591	11	589	7	593	9	591	45	555	81	2919

	I	II	III	IV	V	Total
Chi-square	0.16	0.03	1.13	0.30	0.001	0.81
d.f.	1	1	1	1	1	1

TABLE 5

Chi-square Test Between Fingerball and Fingertip Complexes in Rights, Fefts and Rights-an-Lefts Pooled Together Considering and Ignoring the Digitwise Distinction in the Brahman and Rajput Series Pooled Together.

Fingerball Configurational Complexes	Fingertip Configurational Complexes												Total	
(Rights Only)	I		II		III		IV		V		(ItoV)			
	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'		
W	8	333	8	265	7	171	14	377	26	17	64	1317		
L	9	238	11	264	2	390	4	201	54	347	80	1440		
A	–	12	3	49	–	30	1	3	–	2	4	..		
Total	17	583	32	578	9	591	19	581	80	520	147	2853		

Statistical Inference

Chi-square	0.35		0.42		7.74		0.50		0.001		0.71	
d.f.	1		1		1		1		1		1	

(Lefts Only)	I		II		III		IV		V		(ItoV)	
	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'
W	13	278	13	253	7	197	8	356	20	160	61	1234
L	15	276	10	279	11	357	5	224	41	376	82	1512
A	2	16	2	43	1	37	–	7	–	3	5	105
Total	30	570	25	575	19	581	13	587	61	539	148	2852

Statistical Inference

Chi-square	0.32		0.66		0.40		0.05		0.23		0.25	
d.f.	1		1		1		1		1		1	

(Rights + Lefts Pooled)	I		II		III		IV		V		Ito V	
	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'	L'	A'
W	21	611	21	518	14	358	22	733	46	331	124	2551
L	24	514	21	543	13	747	9	425	95	713	162	2952
A	2	28	5	92	1	67	1	10	–	5	9	202
Total	47	1153	47	1153	28	1172	32	1168	141	1059	295	5705

Statistical Inference

Chi-square	1,42		0.001		4.78*		0.64		0.10		0.70	
d.f.	1		1		1		1		1		1	

Tables 3 to 5 show the incidence of association between the two concerned attributes in the Brahman series *(T. 3)*, the Rajput series *(T. 4)* and the two series pooled together *(T. 5)*. Each of these three Tables has three constituent parts (rights, lefts and rights-and-lefts pooled) so as to assess the nature of association handwise in the two series. It is clear that the distributional differences are largely non-significant *(Fig. 1)* with a single exception involving the III digit of the Brahman series *(T. 3)* which in turn also affects the distributional peculiarity in the pooled series *(T. 5)* likewise. Hence, the two attributes in question, viz. configurational patterns on the fingerball and fingertip areas of the hand are *a l m o s t* invariably not associated but independent of each other.

EPILOGUE

Obviously, the genes responsible for the formation of patterns and ridge peculiarities on the fingertip area are not the same as those responsible for the morphological expression of the fingerball configurations. The new variable needs to be investigated further not only in case of a female series but also for finding out, *firstly the* mode of inheritance by sibpair analysis and, *secondly,* heretability estimates through twin studies.

SUMMARY AND CONCLUSION

A new dermatoglyphic area termed "fingertip" lying at the terminus of distal phalanx close to the naileage of each digit having been identified earlier, association tests between configurational complexes of the fingerball and fingertip areas have been done on the basis of field material consisting of bilateral inked impressions of fingertips of 300 Kumaoni Brahman and Rajput males. Symbols L' and A' have been employed to designate loops and arches of the fingertip area so as to distinguish the same from the symbols L for fingerball loops and A for arches located on the same terminal phalanx. Two major findings shown by two Mendelian population samples are:

1. Considering the digitwise distinction, configurational complexes of the fingerball and fingertip areas of the hand are *a l m o s t* invariably not associated but independent of each other.

2. Ignoring the digitwise distinction, the two concerned attributes are totally independent of each other.

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G. D. Gupta and A. Sharma,
Department of Anthropology,
University of Delhi,
Delhi — 110007, India