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A STUDY OF ASSOCIATION BETWEEN FINGERBALL CONFIGURATIONAL COMPLEXES AND TERMINAL TRIRADIUS

ABSTRACT: A new dermatoglyphic area termed "fingertip" lying at the terminus of the distal phalanx close to the nailedge of each digit having been identified earlier, association tests between fingerball configurational complexes and terminal triradius have been done on the basis of 300 Kumaoni Brahman and 300 Rajput males. Symbols + and – have been employed to designate the presence and absence of the terminal triradius. Two major findings shown by two Mendelian population samples are:
1. Considering the digitwise distinction, fingerball configurational complexes and the terminal triradius of the hand are almost invariably not associated but independent of each other.
2. Ignoring the digitwise distinction, the two concerned characters are almost invariably not associated but independent of each other.

KEY WORDS: Terminal triradius — Fingertip configurational complexes — Fingerball configurational complexes — Association — Brahman — Rajput.

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 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 the study has been constantly referred to as "fingertip area". Even the first and second phalanges have attracted attention (e.g. Wasinski 1966) 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) on the basis of inked impression of the area on 70 unrelated males residents in Delhi, "terminal triradius" being the term used to denote triradius in this area to distinguish it from the rest. Subsequently, a more detailed work on symmetry in terminal triradius and fingertip configurational complexes (Gupta 1974), the association between fingerball and fingertip configurational complexes (Gupta and Sharma 1978), the association between fingertip configurational complexes and terminal triradius (Gupta 1982) has been reported. A recent study (Gupta 1990) reported on the methodology of fingertip configurational complexes and terminal triradius alongwith a detailed categorisation. 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 configurational complexes and terminal triradius are being investigated in two large series of males in the present study.

MATERIAL AND METHODS

The 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 W. Himalayas.

There are 52 "kinship categories" (Leach 1954) of intermarrying type belonging to a "common gene pool" (Dobzhansky 1955) in the Brahman series. Out of these, four "kinship categories" (Joshy, Pandey, Pant and Tiwari) constitute the major part (63.75%) of the total field sample, the remaining 48 accounting for 36.25% (Gupta 1974). Similarly, there are 81 "kinship categories" of intermarrying 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 remaining 76 accounting for as much as 41.11% (Gupta 1974).

The cotton T-pad has been used (Sharma 1963) for spreading a thin film of ink on a glass slab. This film has then been transferred to the broad area (called fingertip) of each of the five digits of each hand giving full attention to the most distal zone of the distal phalanx covering the dermatoglyphic-ridge surface up to 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 has been placed on a tabletop in such a manner that the distal edge of the paper coincided with the

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 population differences between Brahmans and Rajputs in the occurrence of terminal triradius ignoring the handwise and digitwise distinction.*

Group	+	−	Total
Brahmans	277	100	377
Rajputs	2723	2900	5623
Total	3000	3000	6000

Chi-square = 88.66; d.f. = 1; P > 0.001; Significant

TABLE 3. *Chi-square test between fingerball configurational complexes and terminal triradius in rights, lefts and rights-and-lefts pooled together considering and ignoring the digitwise distinction in the Brahman series.*

Fingerball configurational complexes (Rights only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	3	152	8	120	1	78	14	175	21	68	47	593
L + A	7	138	13	159	11	210	7	104	49	162	87	773
Total	10	290	21	279	12	288	21	279	70	230	134	1366

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	1.83	0.17	1.80	0.87	0.005	3.45
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Lefts only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	9	127	17	111	8	86	8	175	18	69	60	568
L + A	11	153	13	159	11	195	5	112	43	170	83	789
Total	20	280	30	270	19	281	13	287	61	239	143	1357

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	0.001	2.64	1.18	0.001	0.01	0.001
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Rights + Lefts pooled)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	12	279	25	231	9	164	22	350	39	137	107	1161
L + A	18	291	26	318	22	405	12	216	92	332	170	1562
Total	30	570	51	549	31	569	34	566	131	469	277	2723

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	0.92	0.91	0.001	0.71	0.02	1.63
d.f.	1	1	1	1	1	1

frontal edge of the tabletop. The fingertip has been brought 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 the 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 researcher's total freedom in manipulating the radio-ulnar movement of the entire finger.

Methods of identifying the fingertip configurations and triradii (Sharma and Gupta 1976, unpublished cf. Gupta 1974) are basically the same as in the ALW terminology of fingerball dermatoglyphics, but the presence and absence of terminal triradius on the fingertip area are designated as + and − respectively (Sharma 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 the "fingertip area" since there is a complete absence of whorls. As a natural corollary, therefore, loops designated by L' and arches by A' are conveniently considered as relatively

TABLE 4. *Chi-square test between fingerball configurational complexes and terminal triradius in rights, lefts and rights-and-lefts pooled together considering and ignoring the digitwise distinction in the Rajput Series.*

Fingerball configurational complexes (Rights only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	2	183	3	140	1	90	6	196	7	99	19	708
L + A	−	115	3	154	1	208	1	97	19	175	24	749
Total	2	298	6	294	2	298	7	293	26	274	43	1457

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	2.06	0.02	0.51	0.80	0.77	0.31
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Lefts only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	1	154	7	130	4	96	4	177	8	84	24	641
L + A	1	144	2	161	3	197	3	116	24	184	33	802
Total	2	298	9	291	7	293	7	293	32	268	57	1443

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	0.003	3.68	1.81	0.06	0.43	0.13
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Rights + Lefts pooled)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	3	337	10	270	5	186	10	373	15	183	43	1349
L + A	1	259	5	315	4	213	4	213	43	359	57	1551
Total	4	596	15	585	9	591	14	586	58	542	100	2900

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	0.59	2.50	2.18	0.37	1.54	0.37
d.f.	1	1	1	1	1	1

"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 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 (ALW) 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 terminal triradius are significant (Table 2).

Tables 3 to 5 show the incidence of association between the two concerned attributes in the Brahman series (Table 3), the Rajput series (Table 4) and the two series pooled together (Table 5). Each of these three tables has three constituent parts (rights,
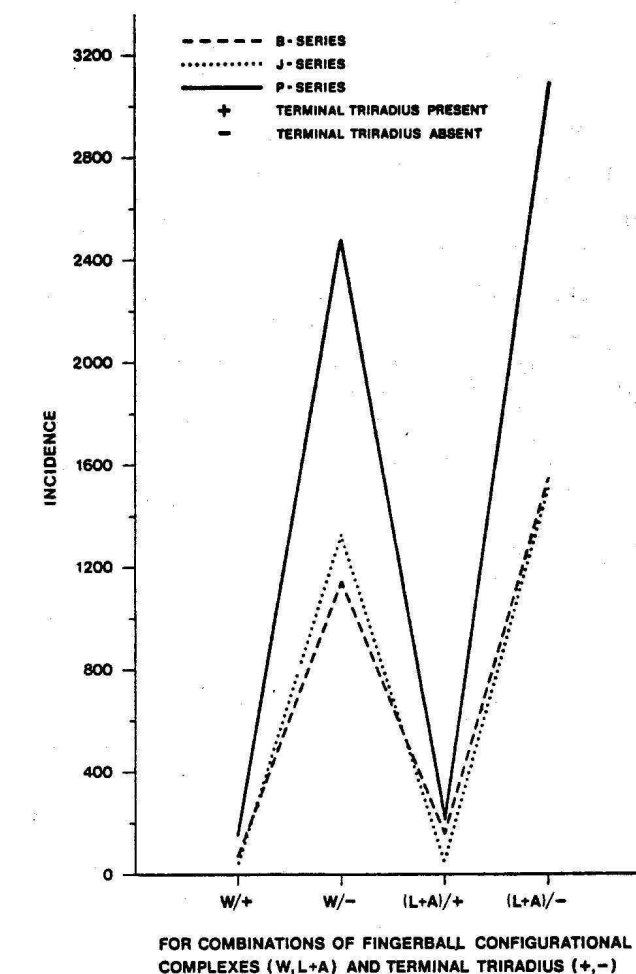
TABLE 5. *Chi-square test between fingerball configurational complexes and terminal triradius in rights, lefts and rights-and-lefts pooled together considering and ignoring the digitwise distinction in the Brahman and Rajput series pooled together.*

Fingerball configurational complexes (Rights only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	5	335	11	260	2	168	20	371	28	167	66	1301
L + A	7	253	16	313	12	418	8	201	68	337	111	1522
Total	12	588	27	573	14	586	28	572	96	504	177	2823

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	1.11	0.23	1.59	0.52	0.59	5.20*
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Lefts only)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	10	281	24	241	12	182	12	352	26	153	84	1209
L + A	12	297	15	320	14	292	8	228	67	354	116	1591
Total	22	578	39	561	26	574	20	580	93	507	200	2800

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	0.09	4.69*	2.25	0.004	0.19	0.11
d.f.	1	1	1	1	1	1

Fingerball configurational complexes (Rights + Lefts Pooled)	I +	I −	II +	II −	III +	III −	IV +	IV −	V +	V −	(I to V) +	(I to V) −
W	15	616	35	501	14	350	32	723	54	320	150	2510
L + A	19	550	31	633	26	810	16	429	135	691	227	3113
Total	34	1166	66	1134	40	1160	48	1152	189	1011	377	5623

Statistical inference

	I	II	III	IV	V	(I to V)
Chi-square	1.00	1.96	0.42	0.30	0.71	3.37
d.f.	1	1	1	1	1	1

* indicates probability level between 0.05 and 0.01.
Absence of * indicates probability level > 0.05.

FIGURE 1. *Occurence of fingerball configurational complexes and terminal triradius in rights-and-lefts pooled together ignoring the digitwise distinction in the Brahman, Rajput and the two series pooled together.*

lefts and rights-and-lefts pooled) so as to assess the association handwise in the two series. It is clear that the distributional differences are largely non-significant (see *Fig. 1*) with a single exception involving the IInd digit of the pooled series (*Table 5*) which in turn also affects the distributional peculiarity in the pooled series (*Table 5*) ignoring the digitwise distinction likewise. Hence, the two attributes in question, viz. configurational patterns on the fingerball and terminal triradius of the hand, are almost invariably not associated but independent of each other.

CONCLUSION

Obviously, the genes responsible for the formation of terminal triradius are not the same as these responsible for the morphological expression of the fingerball configurations. The new variable needs to be investigated further not only in female series but also in order to find out, firstly, the mode of inheritance by sib-pair analysis and, secondly, heredity estimates through twin studies.

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