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Diversity in Hypothenar Triradii among some population groups from Indian subcontinent

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In a recent paper Malhotra *et al.* (1980) pointed out that in the existing schemes of palmar formulations, important triradii, the hypothenar triradii, have not received adequate attention. These authors critically examined the schemes proposed by Cummins and Midlo (1934), Penrose and Loesch (1970) and Schaumann and Alter (1976) in respect of the formulations of hypothenar triradii and demonstrated that the schemes suffered from methodological inadequacies.

Malhotra *et al.* (1980) further proposed the following scheme which morphologically is more meaningful and eliminates subjectivity—(*a*) that the hypothenar triradii be designated as *h* to distinguish it from the axial triradii *t* (all previous workers retained label *t* for hypothenar triradii) ; (*b*) those present on the hypothenar eminence, irrespective of their position-center, border etc., be labelled as h^p (superscript p = present on the palm) instead of t^u or t^b (of Penrose and Loesch 1970) and those lying out side the area of ridged skin i. e., extralimital be differentiated by superscript *ext*, i. e., h^{ext} ; and (*c*) that information about *h* should be recorded in the palmar formula after axial triradius i. e., D. C. B. A. t. h ———

The purpose of this paper is to examine (for the first time) the nature and extent of variation in the types of hypothenar triradii among 13 population groups from the Indian sub continent

Material and Method

Bilateral palmar prints of 1243 apparently normal male persons were analysed for types of hypothenar triradii using methods proposed by Malhotra *et al* (1980). While taking

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prints care was taken to print the ulnar border of the palm in order to avoid possibility of missing the hypothenar triradii occasionally present on the border of the hypothenar eminence. The materials presented in this paper were collected as part of the Indo-Soviet Anthropological project in 1978-79. Except for the Nepali sample, which is a mixed sample, the remaining 12 samples pertain to endogamous populations. Except for the Bhils, a tribal population, and the Nepalis, the remaining are caste populations. The subjects belonged to three north-western Indian states, namely Himachal Pradesh, Punjab and Rajasthan. The Nepali sample was drawn from migrant labourers working in the Kangra district of Himachal Pradesh. The names of the populations studied together with their geographical affiliation and number of prints analysed are given in Table 1.

Results

The percentage occurrence of types of hypothenar triradii, separately for each palm, and average for left plus right palms, and for each group is presented in Table 1. An inspection of this table reveals the following main points :

(*i*) *Hypothenar triradii* h^p.—The percentile incidence of triradius h^p among the 13 populations shows wide and statistically heterogeneous variation for either right (range 5.9 — 23.7, $p < 0.001$) or left palms (range 4.2 — 21.0, $p < 0.05$) or average of the two (range 8.0 — 20.0, $p < 0.001$). Except for the Nepali sample ($p < 0.001$), the bilateral differences among other groups are non-significant. It may be noted that usually, when present, only one triradius h^p occurs on a single palm, however, in the present series of 2,486 palms, 4 palms (one left and 3 right) showed 2 h^p each.

(*ii*) *Hypothenar triradii* h^{ext}.—Statistically highly significant inter-group diversity is also observed in respect of triradius h^{ext} for right (range 2.1 — 19.8, $p > 0.001$), left (range 2.0 — 22.0, $p > 0.001$), and average of the two palms (range 4.0 — 20.0, $p < 0.001$). The bilateral differences are non-significant among all the groups except for the Agarwal ($p < 0.05$).

(*iii*) *Hypothenar triradii* h ($h^p + h^{ext}$).—As expected, the sum total for triradii h^p and h^{ext} also depict significant heterogeneity among the groups studied : right palm (range 13.0 — 29.0, $p < 0.001$), left palm (range 11.6 — 31.0, $p < 0.001$), average of both the palms (ange 15.5 — 30.0, $p < 0.001$). The bimanual differences are non-significant in all the groups.

(iv) *Relative incidence of* h^p and h^{ext}.—The triradius h^p in majority of the groups shows preponderance over the triradii h^{ext} ; out of a total of 26 palms — 8 of either side — and 10 out of 13 right plus left totals, show higher incidence of triradius h^p. For the pooled series, the percent frequency of h^p for right, left both palms is 12.95, 12.07, and 12.5, respectively. The corresponding percent frequencies of h^{ext} are 9.65, 8 93 and 9.29, respectively ; these differences are statistically significant for either right ($p < 0.01$) or left palms ($p < 0.05$) or both palms ($p < 0.01$)

It may be noted here that generally on a palm either h^p or h^{ext} triradius occurs. In the present series, however, 11 palms (0.44%) — 5 right, 4 left of different individuals and both palms of one individual — had both these triradii.

(v) *Bilateral asymmetry.*—The degree of bilateral symmetry is high (table 2) in all the groups (range 74% to 85% : average 78.5%), and shows homogeneous distribution among the populations studied ($p < 0.90$).

(vi) *Variation within different states.*—As mentioned earlier, the 13 groups were sampled from the north-western Indian states, namely Himachal Pradesh (N=5, Nepalis were, however, excluded for this analysis), Punjab (N=3) and Rajasthan (N=5). It would therefore be of interest to examine whether the endogamous groups with varying social hierarchies inhabiting a particular state show differences in respect of the hypothenar triradii. For each state the homogeneity between groups, was tested separately for the triradii h^p and h^{ext} and each palm considered separately as well as totals for both palms The chi-square values depict non-significant variation within each state in respect of h^p In the case of h^{ext} the four groups of Himachal Pradesh show homogeneous distribution whereas the five groups of Rajasthan reveal significant differences for right ($p < 0.05$), left ($p < 0.05$) and both palms ($p < 0.001$). The three groups of Punjab depict significant variation only on left plam ($p < 0.05$) It is noteworthy that when the frequency of $h^p + h^{ext}$ were considered only groups in Rajasthan state showed significant variation for right plus left totals (p 0.005)

(vii) *Variation between castes of the same social rank.*—In the present series there were four instances in which a caste with same social status was sampled from more than one state. In order to examine whether castes of same rank sampled in different states show any variation in h^p and h^{ext} Chi square statistics, was applied. It is observed that (a) the three scheduled castes, Ramdasis, Harijan (Chammar)

and Meghwals, who are at the bottom of the social hierarcy, differ significantly for h^p on right palm ($p < 0.025$) and h^{ext} on right Palm ($p < 0.025$), (b) the two Brahmin castes who represent the top of the social hierarchy differ significantly for sum of h^p on both palms ($p < 0.001$) and sum of h^p and h^{ext} on both plams ($p < 0.01$), (c) the two Rajput castes of middle social order differ only for sum of h^{ext} on both palms ($p < 0.05$), (d) the two trading castes— Agarwal and Oswal— differ for sum of h^p on both palms ($p > 0.025$) and sum of h^{ext} on both palms ($p < 0.001$).

(*vii*) *Variation between ethnic groups.*—Of the 13 groups, broadly speaking, the Bhils are Australoids, the Nepalis are Mongoloids, while the rest of the groups represent Caucasoids. The present materials are insufficient for any detailed inter-ethnic study. However, it appears that the frequency of hypothenar triradii among the Mongoloids is minimum, maximum being among Australoids while the Caucasoids occupy an intermediate position. The Bhils differ from Nepalis for h^{ext} on right ($p < 0.001$), left palm ($p < 0.01$) and both palms ($p < 0.001$). Bhils also differ from the pooled Caucasoid sample for h^{ext} of both palms on right ($p < 0.01$), left ($p < 0.001$) and both palms ($p < 0.001$). However, for totals of h^p and h^{ext} differences are only observed on left palm ($p < 0.05$) and on both palms ($p < 0.01$). The Nepalis differ significantly from the pooled Caucasoid sample for h^p on right palm ($p < 0.01$) and h^{ext} on right palm ($p < 0.025$). The observed tendencies get support from the earlier observations that the hypothenar pattern intensities among the Mongoloids are substantially lesser than in either Caucasoids or Australoids (Cummins and Midlo 1973 ; Plato 1975).

Discussion

Numerous earlier studies on palmar dermatoglyphics have reported the occurrence of various types of hypothenar patterns. From these works however, it is not possible to discern frequency of types of hypothenar triradii as proposed by Malhotra *et al.* (1980). The present study clearly demonstrates the existence of wide diversity in the frequency of either h^p or h^{ext} triradii among the groups studied. One of the most striking observations made in this study (for the first time) is the occurrence of extralimital hypothenor triradii (h^{ext}) in nearly 1 out of 10 palms. The highly significant inter-group differences in h^{ext} suggest the existence of enormous variations in the morphology of ridge alignment in the hypothenar area among these groups.

It is noteworthy that the power of discrimination between groups within a state, or between groups of different states, decreases when we consider sum totals of h^p and h^{ext} than each of these treated separately. This further supports our methodology of treating triradii h^p and h^{ext} separately

The observed variation between castes of the same rank was expected, as many earlier works using other characters also reported similar heterogeneity (for a detailed discussion see among others, Sanghvi and Khanolkar 1949; Karve and Malhotra 1968; Malhotra, 1978). The inter-ethnic diversity noticed, though based on limited data, is consistent with earlier observations based on hypothenar patterns.

In conclusion, we strongly feel that the wide heterogeneity observed in the types of hypothenar triradii, its consistent high degree of bilateral symmetry, and high heritability (Loesch 1971) makes this trait highly suitable for population studies.

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Table 1—The percent frequencies of types of hypothenar triradii among 15 population groups.

Population	Side	No. of persons	Percent frequency		
			h^p	h_{ext}	h
HIMACHAL PRADESH					
Brahmins	R	100	23.7	6 0	29.0
	L	100	17.0	6.0	23.0
	R + L	100	20. 0	6.0	26.0
Choudhury	R	100	17.0	5 0	22.0
	L	100	21.0	7.0	28 0
	R + L	100	19.0	6.0	25.0
Harijan (Chammar)	R	48	22.9	2.1	25.0
	L	48	8.3	10 4	18.7
	R + L	48	15.6	6.2	21.8
Gaddi Rajput	R	100	12 0	5.0	17 0
	L	100	12 0	3.0	15 0
	R + L	100	12.0	4.0	16 0
PUNJAB					
Agarwal Bania	R	100	18 0	8.0	26 0
	L	100	16 0	2.0	18 0
	R + L	100	17.0	5 0	22.0
Jat Sikh	R	100	10.0	14.0	24 0
	L	100	13.0	8.0	21 0
	R + L	100	11.5	11.0	22.5
Ramdasis	R	100	15.0	0	24 0
	L	100	7.0	12.0	19.0
	R + L	100	11.0	10.5	21.5

Contd.

RAJASTHAN					
Bhil	R	100	11.0	18 0	2 .0
	L	100	9.0	22.0	31.0
	R + L	100	10.0	20.0	30 0
Brahmin (Paliwal)	R	100	7.0	6.0	13.0
	L	100	10.0	8.0	18.0
	R + L	100	8 5	7 0	15.5
Meghwal	R	100	7.0	16.0	23 0
	L	100	9.0	8 0	17.0
	R + L	100	8 0	12 0	20.0
Rajput	R	100	7,0	11.0	18,0
	L	100	15.0	7.0	22,0
	R + L	100	11.0	9 0	20 0
Oswal Bania	R	101	5.9	19.8	25.7
	L	101	11.9	15.8	27.7
	R + L	101	8.9	17.8	26.7
NEPAL					
Nepali	R	94	18.1	2.1	20.2
	L	94	4 2	7.4	11.6
	R + L	94	11.1	4.7	15 8

TABLE 2 Percent bilateral asymmetry in hypothenar triradii among 13 Population groups

Population	Absent on both palms	h^{p} present on both palms	h^{ext} present on both palms	Palmar symmetry	Palmar asymmetry
Brahmin	64.0	10.0	2.0	76.0	24.0
Choudhury	69.0	8.0	4.0	81.0	19.0
Harijan (Chammar)	72.9	8.3	2.1	83.3	16.7
Gaddi Rajput	72.0	2.0	1 0	75.0	25 0
Agarwal Bania	68.0	6.0	1,0	75.0	25 0
Jat Sikh	72.0	7.0	6.0	85 0	15.0
Ramdasi	69.0	3.0	6.0	78.0	22.0
Bhil	62.0	2.0	10.0	74.0	26.0
Brahmin (Palival)	76.0	2.0	1.0	79.0	21.0
Meghwal	70.0	1.0	6.0	77 0	23.0
Rajput	71.0	4 0	4.0	79 0	21.0
Oswal Bania	63.4	2.0	10.9	76.2	23.8
Nepali	77.7	2.1	2.1	81.9	18.1
Pooled 13 Populations	69.8	4.4	4.3	78 5	21.5

1. Frequencies of the same type of hypothenar triradii or their absence from both palms.

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