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PALMAR DERMATOGLYPHIC DISTANCE ANALYSIS AMONG 20 DHANGAR CASTES OF MAHARASHTRA, INDIA

ABSTRACT — The paper deals with palmar dermatoglyphic distance analysis among 3,000 individuals belonging to 20 Dhangar castes of Maharashtra. The obtained relationships between the Dhangar castes are compared with the relationships based on ethnographic evidence and other biologic data — anthropometry, genetic markers and finger dermatoglyphics. On each palmar print 11 qualitative and 9 quantitative variables were scored. The qualitative and quantitative distance coefficients were calculated using Sanghvi's (1953) Chi-square statistics and Mahalanobis's D^2 — statistics, respectively. Dendrograms were generated using single linkage techniques. The main findings of the study are:

(i) The two palms, irrespective of the qualitative or quantitative variables, demonstrate broad agreement in the pattern of relationships between the Dhangar castes;

(ii) The dendrograms based on combined variables of both palms, irrespective of qualitative or quantitative variables show strong congruence between the observed relationships among the Dhangar castes based on palmar variables and those based on ethnohistorical evidence, and

(iii) A comparison of palmar distances with other biologic distances reveal marked intervariable — set differences. The best congruence is, however, seen between palmar distances and distances based on genetic markers; unlike the pattern of differentiation based on geographic proximity as revealed by anthropometry, palmar and genetic distances primarily are not influenced by geographic proximity.

KEY WORDS: Palmar dermatoglyphics — Dhangar castes — Maharashtra.

INTRODUCTION

Population groups resemble or differ from each other in terms of genetic traits. This of great interest, particularly for physical Anthropology as it is assessing biological variability since Galton, 1892, 1895; Henry, 1900 and was further elaborated by the fundamental works of Wilder, 1904, 1922; Cummins, 1923, 1935; Bonnevie, 1924, 1929, 1931; Newman, 1930, 1934; Giepel, 1937; Weninger 1937.

A great deal of interest has been generated in recent years regarding population relationships obtained from dermatoglyphic data and how these relate to those obtained from other data, such as anthropometric, genetic markers etc. A number of investigations in the recent past have included dermatoglyphic data with other biologic data to evaluate the population relationships and majority of them found that dermatoglyphics seem to reveal relationships less clearly and produce a set at relationships differing from other sets of data (see among others Chai, 1972; Neel et. al., 1974; Friedlaender, 1975; Rothhammer et al. 1979). However, quite a few others observed close congruence between dermatoglyphic and other biologic data (see among others, Rothhammer et al. 1977; Malhotra, 1978b;

Jantz et. al. 1982). At least part of the differences observed in the above studies are due clearly to the choice of dermatoglyphic variables (see Jantz and Chopra, 1976; Jantz, 1979). It is therefore, the considerable interest or the main objective of the present report to compare the observed palmar dermatoglyphic relationship between the 20 Dhangar castes with the relationship based on ethnographic evidence and other biologic data — anthropometry, genetic markers and finger dermatoglyphics.

MATERIAL AND METHODS

Data

The present study deals with palmar qualitative and quantitative analysis of 3436 normal males between the ages 10 and 60 years comprising 20 endogamous Dhangar castes. Prints of 436 individuals due to imperfect impressions could not be utilized, leaving a total of 3,000 for final consideration. The sample sizes varies from 62 to 538 with a series average of 150 subjects. The names, estimated population sizes of the 20 castes investigated are given in *Table 1*. The palmar prints were obtained by standard ink method on specially designed glased paper during 1971—1974 from 177 villages spread over 82 Tehsils (taluka) of all the 26 districts of Maharashtra. The *Figure 1* shows their geographical location in the state of Maharashtra and the distribution of sample in 26 districts is presented in *Table 2*. A multistage sampling design, devised by Drs. T. V. Hanurao and R. Chakraborty of Indian Statistical institute, Calcutta, was used to select

TABLE 1. *Dermatoglyphic data by Dhangar Castes*

Dhangar Castes	No. of individuals		Number of sampled		
	Total	Utilized	Villages	Tahsils	Districts
1. AHIR		289	17	9	7
2. DANGE		180	17	5	4
3. GADHARI-DHENGAR	110	103	5	5	3
4. GADHARI-NIKHAR	108	86	6	4	3
5. HANDE	99	86	3	1	1
6. HATKAR	653	538	40	20	10
7. KANNADE	93	86	6	2	2
8. KHATIK	169	163	13	11	7
9. KHUTEKAR	520	432	30	18	10
10. KURMAR	106	85	4	2	1
11. LADSHE	122	105	4	2	2
12. MENDHE	184	166	7	5	2
13. SANGAR	89	85	3	3	3
14. SHEGAR	83	83	5	3	2
15. TELANGI	92	84	7	4	2
16. THELLARI	117	112	6	3	2
17. UNNIKANKAN	67	62	3	2	2
18. VARHADE	77	73	4	3	2
19. ZENDE	78	107	3	3	2
20. ZADE	160	75	14	5	3
ALL DHENGAR CASTES	3 436	3 000	177*	72*	26*

TABLE 2. *Distribution of the sample in 26 districts of Maharashtra (after Malhotra et. al 1980)*

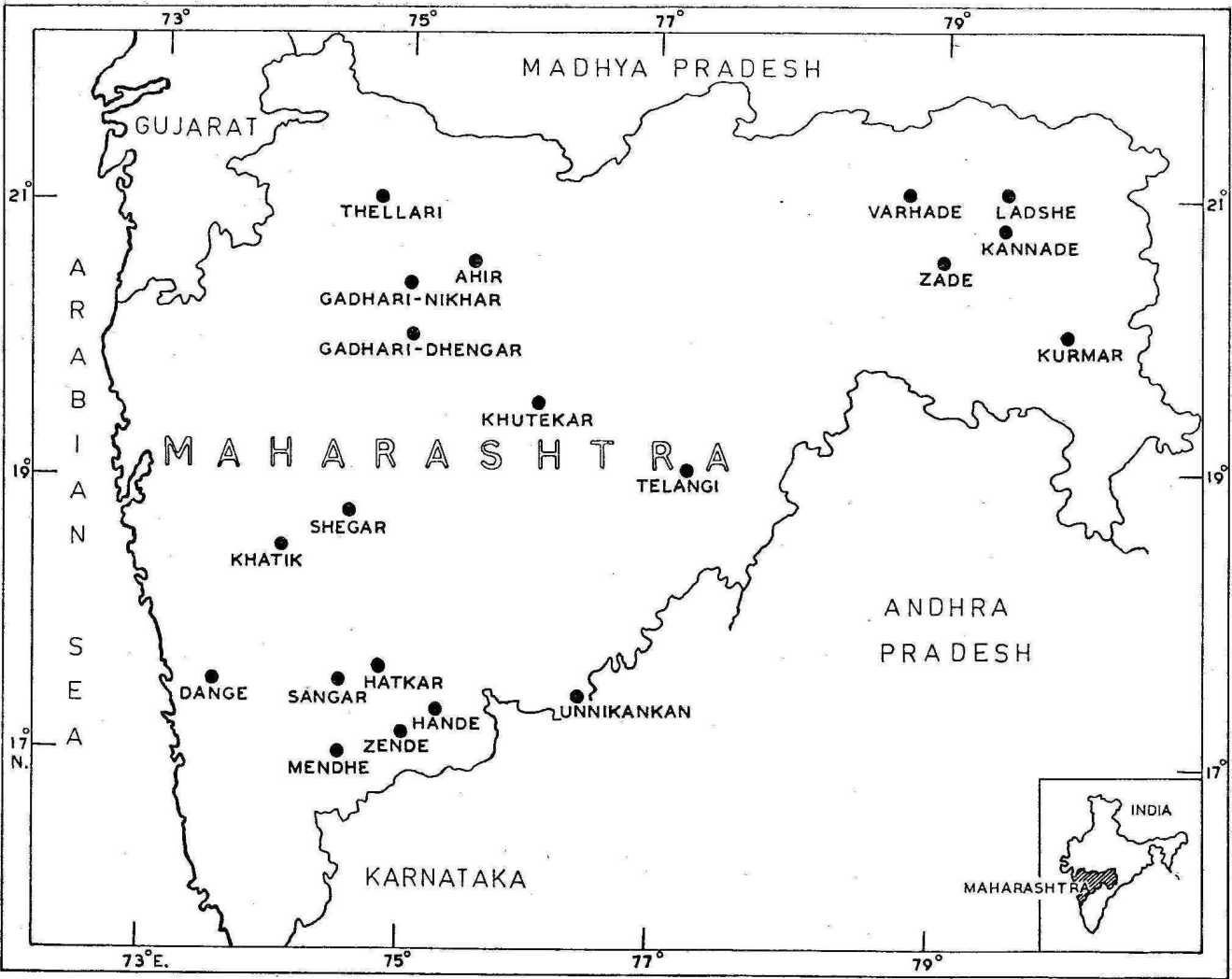| Dhangar castes	Ahmednagar	Akola	Amravati	Aurangabad	Bhandara	Bhir	Bombay	Buldhana	Chandrapur	Dhulia	Jalgaon	Kolaba	Kolhapur	Nagpur	Nanded	Nasik	Osmanabad	Parbhani	Pune	Ratnagiri	Sangli	Satara	Sholapur	Thana	Wardha	Yeotmal	Total Sample
1. AHIR	64		34					77		13	63	51	83			51				29		38					308
2. DANGE		16								40	3					7			116		99	117	154			48	201
3. GADHARI-DHENGAR			93	61	25	10	39			17	84			68	61	85	49	2	70			20	2	4		33	110
4. GADHARI-NIKHAR	38		35	22	87	40			106	41		1	128			33	57				56	48	1				108
5. HANDE													20			20											99
6. HATKAR	145																		78			28	41			1	653
7. KANNADE										114			13	63	68		19	24			107	5	48		76	15	93
8. KHATIK																							40				169
ALL DHANGAR CASTES	245	16	162	83	112	50	89	77	106	231	143	52	244	131	129	196	125	26	284	29	202	256	286	4	7	92	3 436

FIGURE 1. *Geographic location of 20 Dhangar castes in the state of Maharashtra, India (after Malhotra, 1979).*

individuals from the 20 Dhangar castes. For each of the 26 districts, a random sample of talukas was chosen. Within each taluka, all villages were stratified into one of two categories large or small, depending on the population size; the sizes of the villages were obtained from the 1961 Census of India Reports. Ultimate sample subjects were chosen from a stratified random sample of villages drawn from the selected talukas. The number of samples to be selected from the chosen villages was decided upon by making a proportional allocation of the total sample size to villages. In all, a total of 3436 individuals were thus selected.

Most of the palmar variables have been scored following the method of Cummins and Midlo (1943); palmar crease types were obtained after Bhanu (1974); palmar pattern ridge counts were analysed as per the procedure detailed in Malhotra et al. (1982); interdigital ridge counts were scored according to the method of Holt (1968). For qualitative traits, interpopulation distance coefficients were calculated based on the principle of Sanghvi's G^2 (1953) and Mahalanobis D^2 statistics (1936) for quantitative

TABLE 3. *List of qualitative and quantitative palmar variables scored on the Dhangar castes*

	Qualitative traits:
1.	Palmar patterns in hypothenar area
2.	Palmar patterns in thenar I interdigital area
3.	Palmar patterns in thenar II interdigital area
4.	Palmar patterns in thenar III interdigital area
5.	Palmar patterns in thenar IV interdigital area
6.	Palmar crease types
7.	Axial triradii
8.	Terminations of main line D
9.	Terminations of main line C
10.	Terminations of main line B
11.	Terminations of main line A

	Quantitative traits:
1.	Pattern ridge counts in hypothenar area
2.	Pattern ridge counts in hypothenar II interdigital area
3.	Pattern ridge counts in hypothenar III interdigital area
4.	Pattern ridge counts in hypothenar IV interdigital area
5.	Angle atd
6.	Palmar triradii
7.	Interdigital ridge counts a—b
8.	Interdigital ridge counts b—c
9.	Interdigital ridge counts c—d

variables. These distance matrices were subjected to cluster analysis and the dendrograms were drawn following single linkage method. Total 20 palmar variables are considered in this study and are set out in Table 3.

Ethnography of the Dhangar castes

The Dhangar caste clusters, numbering over 3 million and comprising 23 endogamous castes are found in all the 26 districts of Maharashtra. Some of the castes are highly localized in distribution whereas others — Hatkars and Khutekars in particular are found in several districts. They show considerable variation in population size from a few thousands to 100,000. They are in different stages of sedentarization; some are settled, others are seminomads and a few continue to be true nomads.

Although popularly the word Dhangar refers to shepherds these castes are engaged in a variety of traditional occupations: sheep rearing, woollen blanket weaving, cattle breeding, agriculture, meat selling and cotton blanket weaving. At least, four different languages — Marathi, Hindi, Telugu, Kannada — are spoken by these people. The occupation, language, distribution etc. are given in Table 4. Although consanguineous marriages occur in all castes, their incidence and type vary considerably (Malhotra, 1976). Some of the castes have been living in their present habitat for the last several centuries while a few such as Thillari and Kurmar, are recent immigrants. The rate of admixture between these castes is of the order of 1 in 10,000 marriages (Chakraborty, Chakravarti and Malhotra, 1977). Ethnographic data show that at least some of the castes have arisen due to fussion for example Thillari

and Hatkar (Malhotra, 1977). Archaeological evidence, in the form of sheep bones, suggest that the present Dhangars migrated into this Western state of India from the North-Western part of the country arround 5,000—10,000 years B. P., and that possibly more than one wave of migration was involved (Chakraborty et. al. 1977). Further details are given by Malhotra and Gadgil (1981). In addition, a series of articles based on these castes reported their sociocultural and biological aspects (Malhotra et. al, 1977, 1978; Das et. al., 1974; Mukherjee et. al, 1976, 1977; Undevia et. al. 1973; Majumder and Malhotra, 1979; Chakraborty and Malhotra, 1981).

RESULTS AND DISCUSSION

Qualitative Variables

The obtained distance matrices based on Sanghvi's G^2 — statistics for right, left and combined palms between the 20 Dhangar castes are presented in tables 5, 6 and 7 respectively.

It appears from the tables that the overall distance values between various pairs of Dhangar castes vary considerably. The observed range of

distances for right, left and right plus left palms are 0.63 to 8.83, 0.57 to 11.64 and 0.49 to 8.18, respectively.

The dendrograms from cluster analysis are given in Figures 2, 3 and 4 for right, left and right plus left palms, respectively. An inspection of the figure 2 dendrogram (for right) reveals the following salient features:

1. The 20 Dhangar castes constitute two distinct clusters. In cluster one there are 11 castes while in cluster two there are 9 castes. The separation between these two clusters takes place fairly early.

2. In cluster one there are 3 sub-clusters:
   (i) comprises the Gadhari-Dhengar and Khatik;
   (ii) has the Sangars and Shegars and
   (iii) has 7 castes, namely, the Ahir, Hatkar, Kannade, Kurmar, Ladshe, Gadhari-Nikhar and the Khutekar.

3. In cluster two there are 2 sub-clusters:
   (i) consists of the Telangi, Varhade and Zende while (ii) comprises of the Zade, Mendhe, Unnikankan, Dange and Thellari. To these two sub-clusters attached are the Hande.

TABLE 4. *Population size, distribution, language and traditional occupation of the Dhangar castes in Maharashtra (after Malhotra and Gadgil, 1981)*

Dhangar castes	Estimated population	Mother tongue	Distribution in districts	Traditional occupation
AHIR	300 000	Marathi	A'Nagar, Akola, Amraoti, Aurangabad, Buldhana, Dhulia, Jalgaon, Nasik	Sheep-keeping and wool-weaving
DANGE	100 000	do	Kolaba, Kolhapur, Pune, Ratnagiri, Sangli, Satara	Buffalo-keeping
GADHARI-DHENGAR	20 000	Hindi	Akola, Amraoti, Aurangabad, Dhulia, Jalgaon	Sheep-keeping
GADHARI-NIKHAR	5 000	do	Akola, Amraoti, Aurangabad, Dhulia, Jalgaon	Sheep-keeping and wool-weaving
HANDE	4 000	do	Sangli, Sholapur	Sheep-keeping
HATKAR	573 000	Marathi	Ahmednagar, Akola, Amraoti, Aurangabad, Bhir, Buldhana, Dhulia, Jalgaon, Kolhapur, Nanded, Nasik, Osmanabad, Parbhani, Pune, Sangli, Satara, Sholapur, Wardha, Yeotmal	Sheep-keeping
KANNADE	15 000	do	Bhandara, Chanda, Nagpur, Wardha	Sheep-keeping
KHATIK	15 000	do	Ahmednagar, Aurangabad, Bhir, Bombay, Kolaba, Nasik, Pune, Satra, Sholapur, Thana	Meat-sellers
KHUTEKAR	550 000	do	Ahmednagar, Akola, Amraoti, Aurangabad, Bhir, Buldhana, Jalgaon, Kolaba, Nagpur, Nanded, Nasik, Osmanabad, Parbhani, Pune, Ratnagiri, Satara, Sholapur, Wardha, Yeotmal	Sheep-keeping and wool-weaving
KURMAR	15 000	Kannada	Bhandara, Chanda	Sheep-keeping
LADSHE	6 000	Marathi	Amraoti, Bhandara	Sheep-keeping and cotton-weaving
MENDHE	30 000	do	Kolhapur, Pune, Sangli, Satara, Sholapur	Sheep-keeping and wool-weaving
SANGAR	10 000	do	Ahmednagar, Bhir, Kolhapur, Pune, Ratnagiri, Sangli, Satara, Sholapur	Wool-weaving
SHEGAR	40 000	do	Ahmednagar, Aurangabad, Bhir, Osmanabad, Pune, Sholapur	Sheep-keeping and wool-weaving
TELANGI	5 000	Telugu	Nanded, Parbhani	Sheep-keeping and wool-weaving
THELLARI	7 000	Marathi	Dhulia, Jalgaon, Nasik	Sheep and cattle keeping
UNNIKANKAN	6 000	do	Osmanabad, Sholapur	Sheep-keeping and wool-weaving
VARHADE	150 000	do	Akola, Amraoti, Bhandara, Chanda, Nagpur, Wardha, Yeotmal	Sheep-keeping and cotton-weaving
ZADE	15 000	do	Chanda, Nagpur, Wardha, Yeotmal	Sheep-keeping and wool-weaving
ZENDE	80 000	Marathi	Kolhapur, Sholapur	Sheep and horse keeping

TABLE 5. *Values of Sanghvi's X^2 distance, based on percentage frequencies of categories of 11 palmar qualitative traits on right palm, between the 20 Dhangar castes*

POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	5.38	2.25	2.63	6.71	1.47	3.10	2.94	1.35	2.67	1.93	6.36	3.02	3.09	6.17	5.80	5.95	5.86	6.93	6.02
2. DANGE	—	—	5.54	7.23	1.77	6.29	7.98	6.39	6.13	7.66	7.11	1.24	6.33	5.90	2.44	0.77	0.80	1.99	2.26	1.54
3. GADHARI-DHENGAR	—	—	—	3.12	6.70	2.64	4.16	1.77	2.09	3.88	3.55	6.02	2.55	2.03	8.04	5.82	5.95	7.42	7.18	7.38
4. GADHARI-NIKHAR	—	—	—	—	8.09	1.92	0.98	3.53	0.63	1.17	1.04	8.51	2.67	2.96	7.06	7.80	6.87	7.08	5.28	7.26
5. HANDE	—	—	—	—	—	8.31	8.47	6.40	6.57	7.92	7.22	3.48	7.24	8.03	2.13	2.43	1.67	2.71	2.92	1.95
6. HATKAR	—	—	—	—	—	—	1.99	3.93	1.11	1.77	2.23	6.37	2.72	3.18	7.32	7.22	6.89	7.01	7.05	7.18
7. KANNADE	—	—	—	—	—	—	—	4.17	1.00	1.04	1.15	8.83	3.82	3.80	6.75	8.49	7.32	6.72	6.02	6.88
8. KHATIK	—	—	—	—	—	—	—	—	2.26	3.62	3.19	8.76	2.82	2.37	7.43	6.81	6.63	7.38	7.04	7.19
9. KHUTEKAR	—	—	—	—	—	—	—	—	—	0.90	0.78	7.21	2.09	2.30	5.50	6.26	6.79		5.64	7.07
10. KURMAR	—	—	—	—	—	—	—	—	—	—	1.67	8.64	2.27	2.67	6.68	8.62	6.79	7.03		5.84
11. LADSHE	—	—	—	—	—	—	—	—	—	—	—	8.54	2.77	3.09	6.16	7.22	6.66	6.23		5.80
12. MENDHE	—	—	—	—	—	—	—	—	—	—	—	—	7.95	7.80	4.14	1.52	2.27	3.48	3.95	3.49
13. SANGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	1.62	7.51	7.26	5.97	7.97	6.95	6.47
14. SHEGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.15	6.94	6.07	8.05	7.10	6.93
15. TELANGI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.21	2.12	1.54	1.53	1.87
16. THELLARI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.17	2.08	2.77	1.84
17. UNNIKANKAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.06	1.89	1.48
18. VARHADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.41	1.63
19. ZENDE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.33
20. ZADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 6. *Values of Sanghvi's X^2 distance, based on percentage frequencies of categories of 11 palmar qualitative traits on left palm, between the 20 Dhangar castes*

POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	1.11	5.61	3.88	7.11	1.15	3.15	2.91	2.11	1.77	2.32	1.66	4.07	4.65	2.52	6.06	6.80	2.02	2.43	6.22
2. DANGE	—	—	3.62	5.66	8.30	2.36	5.03	3.32	3.32	2.96	3.84	2.53	5.00	5.16	3.54	6.38	7.37	8.35	3.59	7.15
3. GADHARI-DHENGAR	—	—	—	8.89	11.64	6.18	8.07	6.11	6.66	7.29	9.18	6.36	7.03	6.83	7.38	9.13	9.40	7.74	8.28	10.49
4. GADHARI-NIKHAR	—	—	—	—	7.69	2.42	0.73	4.24	1.50	1.46	2.69	4.13	3.75	5.38	1.95	9.18	9.17	1.83	1.17	7.48
5. HANDE	—	—	—	—	—	6.47	7.49	7.14	6.16	6.73	7.51	7.27	6.28	8.59	7.54	2.74	2.36	7.94	6.61	2.14
6. HATKAR	—	—	—	—	—	—	1.78	3.66	1.72	1.05	1.81	3.52	4.76	2.09	6.17	6.78	0.86	1.86		6.37
7. KANNADE	—	—	—	—	—	—	—	4.26	1.27	0.84	1.96	3.41	4.04	5.64	1.92	8.70	8.32	1.10	1.64	0.72
8. KHATIK	—	—	—	—	—	—	—	—	1.78	2.82	4.29	3.36	2.35	2.31	3.00	7.46	7.63	4.44	2.60	6.55
9. KHUTEKAR	—	—	—	—	—	—	—	—	—	0.69	1.95	2.44	2.04	2.74	0.57	7.49	7.03	1.90	0.78	5.59
10. KURMAR	—	—	—	—	—	—	—	—	—	—	1.49	2.00	3.20	4.09	1.06	7.58	7.45	1.24	0.87	6.25
11. LADSHE	—	—	—	—	—	—	—	—	—	—	—	3.53	3.93	0.65	2.61	9.04	9.09	1.85	2.24	7.18
12. MENDHE	—	—	—	—	—	—	—	—	—	—	—	—	3.46	3.41	2.90	6.43	6.79	2.78	2.66	6.27
13. SANGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	1.65	3.19	8.34	7.16	5.04	2.62	6.81
14. SHEGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.67	8.51	7.38	6.67	3.50	7.99
15. TELANGI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.15	8.08	2.40	0.98	6.27
16. THELLARI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.99	7.72	7.99	2.41
17. UNNIKANKAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8.52	8.10	1.93
18. VARHADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.25	7.42
19. ZENDE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6.21
20. ZADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 7. *Values of Sanghvi's X² distance based on percentage frequencies of categories of 11 palmar qualitative traits on combined totals for right and left palms between the 20 Dhangar castes*

POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	1.28	3.13	2.91	6.03	1.05	2.82	2.06	1.49	1.74	1.66	2.16	2.99	3.41	2.29	5.59	6.00	2.02	2.90	5.50
2. DANGE	—	—	3.52	4.18	2.74	2.41	4.42	2.37	2.62	2.96	3.05	1.40	3.32	3.19	1.84	3.20	3.46	2.17	2.40	3.50
3. GADHARI-DHENGAR	—	—	—	5.02	7.58	3.79	5.35	2.31	3.43	4.34	5.24	3.80	3.54	3.41	4.97	6.65	6.63	5.01	5.07	7.88
4. GADHARI-NIKHAR	—	—	—	—	7.07	1.72	0.53	2.93	0.81	0.78	1.17	4.22	2.74	3.72	2.22	7.87	7.43	2.20	1.41	6.56
5. HANDE	—	—	—	—	—	6.63	7.13	5.65	5.75	6.10	6.00	4.52	6.16	7.38	3.81	1.65	1.39	4.18	3.94	1.48
6. HATKAR	—	—	—	—	—	—	1.67	2.97	1.09	1.08	1.39	1.87	2.53	3.45	2.27	6.17	6.45	1.64	2.44	6.16
7. KANNADE	—	—	—	—	—	—	—	3.42	0.83	0.61	0.93	4.35	3.15	4.24	2.14	8.18	7.45	1.98	1.93	6.50
8. KHATIK	—	—	—	—	—	—	—	—	1.57	2.38	2.68	3.77	1.77	1.71	2.82	6.10	6.0	3.59	2.69	5.93
9. KHUTEKAR	—	—	—	—	—	—	—	—	—	0.49	0.91	2.98	1.81	2.32	1.23	6.47	5.96	1.76	1.33	5.61
10. KURMAR	—	—	—	—	—	—	—	—	—	—	0.61	3.21	2.23	2.94	1.52	7.24	6.59	1.77	1.44	6.00
11. LADSHE	—	—	—	—	—	—	—	—	—	—	—	3.91	2.58	3.85	1.69	7.40	7.00	1.73	1.77	5.56
12. MENDHE	—	—	—	—	—	—	—	—	—	—	—	—	3.59	3.51	2.71	3.45	4.01	2.51	2.80	4.26
13. SANGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	1.27	3.31	7.15	6.10	4.23	2.74	6.14
14. SHEGAR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.93	7.11	6.15	5.28	3.40	6.72
15. TELANGI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4.80	4.36	1.29	0.74	3.62
16. THELLARI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.78	4.33	4.70	1.62
17. UNIKANKAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4.51	4.38	1.34
18. VARHADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.35	3.92
19. ZENDE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.64
20. ZADE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

The dendrogram given in *Figure 3* based on left palm depicts unlike in the previous case, here 6 Dhangar castes which separate from the rest of the 14 castes fairly early.

The remaining 14 castes constitute four clusters. Cluster one has two populations, the Ladshe and Shegar; cluster two has the Ahir and the Dange; cluster three has the Mendhe, Hatkar and Varhade, while cluster four has 7 castes namely the Zende, Kurmar, Khutekar, Telangi, Gadhari-Nikhar, Kannade and Zade.

From the dendrogram given in *Figure 4*, based on combined variables of right plus left palms, reveals the following:

1. The 20 Dhangar castes cluster in two clusters. Cluster one has only four castes, namely, the Hande, Zade, Thellari and Unnikankan, while cluster two has the remaining 16 castes.

2. The most meaningful sub-cluster in cluster two is the one comprising nine castes, the Telangi, Zende, Ahir, Hatkar, Ladshe, Khutekar, Kurmar, Gadhari-Nikhar and Kannade.

3. The closest similarities observed, however, are between five Dhangar castes, namely, Ladshe, Khutekar, Kurmar, Gadhari-Nikhar and Kannade.
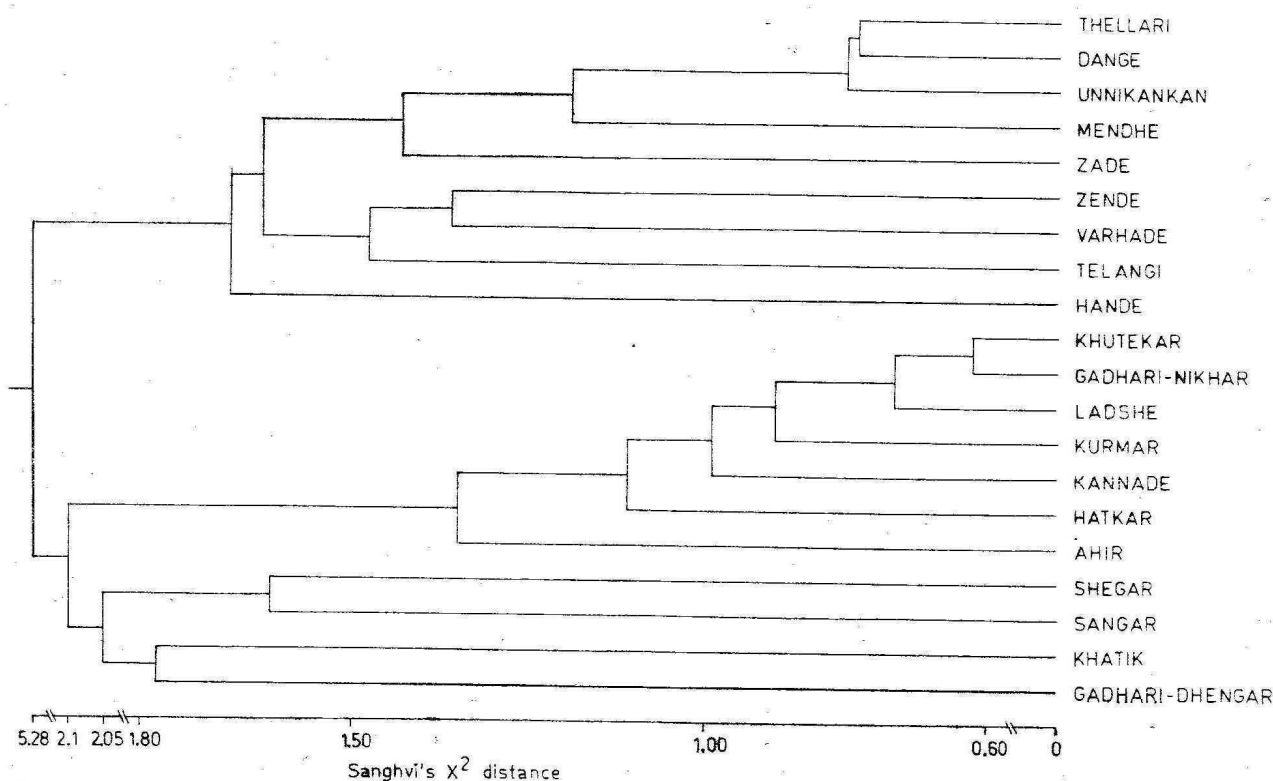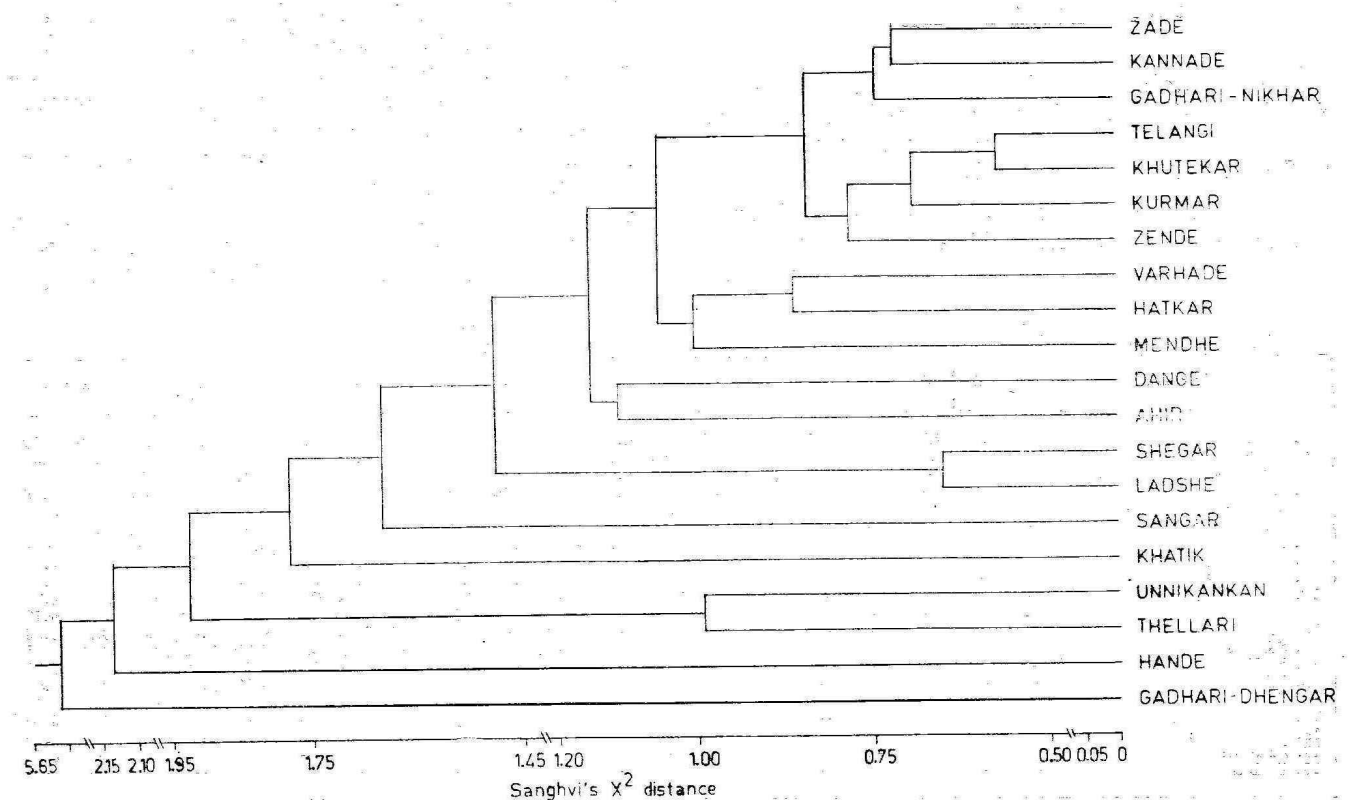
FIGURE 3. *Dendrogram of the 20 Dhangar castes based on Sanghvi's Chi-square distance in respect of 11 palmar qualitative traits of left palms.*

FIGURE 2. *Dendrogram of the 20 Dhangar castes based on Sanghvi's Chi-square distance in respect of 11 palmar qualitative traits of right palm.*
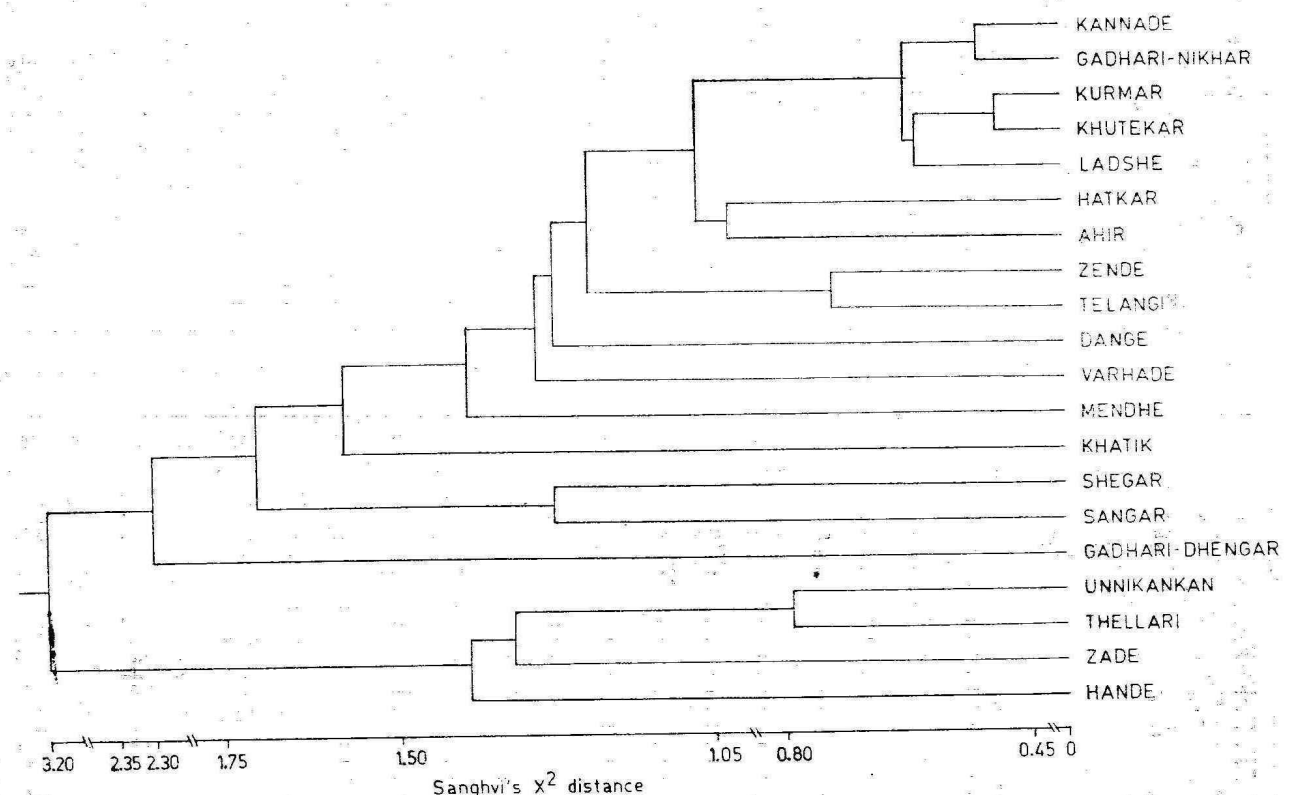
FIGURE 4. *Dendrogram of the 20 Dhangar castes based on Sanghvi's Chi-square distance in respect of 11 palmar qualitative traits of right plus left palms.*

Quantitative Variables

The obtained D^2 distance matrices separately for right, left and right plus left palms, based on *Mahalanobis' Generalized distance* method, are set out in *Tables 8, 9* and *10* respectively.

From the tables it appears that the D^2 distance values between the various Dhangar caste pairs do not show much variation. The range of variation observed in the D^2 values for the right, left and right plus left palms are 0.14 to 1.68, 0.11 to 1.85 and 0.10 to 1.46 respectively. The dendrograms from *cluster analysis* separately for right, left and combined palms are given in *Figures 5, 6* and *7*.

Figure 5 in respect of right palm reveals the following salient features:
1. Three castes, the Kannade, Shegar and Hande, stand out separately from each other as well as from the rest of the 17 Dhangar castes.

TABLE 8. *Mahalanobis's D^2-statistics based on 9 palmar quantitative variables on right palm among the 20 Dhangar castes*

POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	0.34	0.52	0.27	0.57	0.35	0.84	0.41	0.19	0.46	0.55	0.22	0.31	0.78	0.39	0.37	0.64	0.44	0.28	0.20
2. DANGE		—	0.62	0.66	0.25	0.72	1.03	0.56	0.20	0.36	1.20	0.21	0.47	0.43	0.87	0.93	0.99	0.70	0.57	0.31
3. GADHARI-DHENGAR			—	0.39	0.79	0.30	0.56	0.49	0.28	0.60	0.77	0.46	0.26	0.69	0.33	0.42	0.33	0.19	0.43	0.50
4. GADHARI-NIKHAR				—	0.84	0.17	0.76	0.47	0.39	0.38	0.26	0.29	0.18	1.00	0.43	0.23	0.27	0.30	0.03	0.36
5. HANDE					—	0.92	0.60	0.78	0.35	0.33	1.36	0.32	0.80	0.27	0.96	1.18	0.99	0.65	0.68	0.38
6. HATKAR						—	0.63	0.45	0.34	0.40	0.19	0.52	0.24	1.00	0.38	0.13	0.20	0.14	0.27	0.43
7. KANNADE							—	0.62	0.47	0.51	1.13	0.70	0.91	0.49	0.66	0.83	0.70	0.29	0.76	0.56
8. KHATIK								—	0.19	0.54	0.98	0.49	0.35	0.71	0.62	0.40	0.81	0.37	0.51	0.55
9. KHUTEKAR									—	0.28	0.84	0.18	0.32	0.32	0.47	0.48	0.66	0.27	0.38	0.18
10. KURMAR										—	0.75	0.28	0.51	0.49	0.73	0.73	0.47	0.40	0.37	0.25
11. LADSHE											—	0.84	0.51	1.68	0.66	0.25	0.29	0.45	0.34	0.76
12. MENDHE												—	0.42	0.48	0.62	0.73	0.69	0.49	0.19	0.20
13. SANGAR													—	0.95	0.44	0.19	0.83	0.31	0.23	0.45
14. SHEGAR														—	1.24	1.32	1.32	0.76	0.86	0.35
15. TELANGI															—	0.39	0.30	0.25	0.54	0.67
16. THELLARI																—	0.30	0.24	0.35	0.62
17. UNNIKANKAN																	—	0.17	0.34	0.76
18. VARHADE																		—	0.35	0.49
19. ZENDE																			—	0.34
20. ZADE																				—

TABLE 9. *Mahalanobis's D^2-statistics based on 9 palmar quantitative variables on left palm among the 20 Dhangar castes*

POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	0.28	0.66	0.41	0.52	0.26	0.73	0.46	0.40	0.33	0.57	0.39	0.50	0.84	0.49	0.32	0.72	0.44	0.15	0.68
2. DANGE		—	0.67	0.77	0.20	0.59	0.47	0.32	0.19	0.28	1.43	0.37	0.64	0.37	0.87	0.59	0.70	0.58	0.50	0.36
3. GADHARI-DHENGAR			—	0.46	0.83	0.32	0.29	0.64	0.49	0.41	1.01	1.13	0.38	0.79	0.45	0.27	0.09	0.11	0.62	0.63
4. GADHARI-NIKHAR				—	0.77	0.11	0.70	0.75	0.75	0.37	0.44	0.78	0.30	1.10	0.48	0.29	0.56	0.22	0.19	0.99
5. HANDE					—	0.63	0.35	0.30	0.19	0.25	1.52	0.27	0.53	0.32	1.03	0.88	0.74	0.70	0.60	0.49
6. HATKAR						—	0.52	0.41	0.48	0.30	0.39	0.60	0.13	0.85	0.30	0.19	0.37	0.16	0.23	0.66
7. DANNADE							—	0.43	0.27	0.27	1.43	0.84	0.43	0.44	0.72	0.61	0.34	0.41	0.80	0.32
8. KHATIK								—	0.27	0.26	1.09	0.43	0.47	0.49	0.85	0.66	0.55	0.50	0.73	0.40
9. KHUTEKAR									—	0.23	1.31	0.41	0.40	0.24	0.53	0.60	0.53	0.50	0.64	0.21
10. KURMAR										—	0.78	0.38	0.47	0.43	0.65	0.52	0.38	0.25	0.38	0.50
11. LADSHE											—	1.08	0.87	1.85	0.77	0.75	0.98	0.65	0.52	1.67
12. MENDHE												—	0.62	0.38	1.01	1.09	0.92	0.89	0.53	0.71
13. SANGAR													—	0.85	0.36	0.37	0.41	0.34	0.44	0.54
14. SHEGAR														—	1.02	1.19	0.66	0.85	1.05	0.32
15. TELANGI															—	0.31	0.68	0.37	0.62	0.80
16. THELLARI																—	0.52	0.18	0.33	0.77
17. UNNIKANKAN																	—	0.18	0.64	0.75
18. VARHADE																		—	0.37	0.78
19. ZENDE																			—	1.03
20. ZADE																				—

TALBE 10. *Mahalanobis's D^2-statistics based on 9 palmar quantitative variables on summed totals of right and left palms among the 20 Dhangar casts*

| POPULATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. AHIR	—	0.31	0.71	0.38	0.59	0.35	0.98	0.31	0.38	0.48	0.61	0.35	0.46	1.02	0.44	0.39	0.71	0.51	0.25	0.49
2. DANGE		—	0.68	0.69	0.19	0.61	0.86	0.20	0.15	0.29	1.34	0.20	0.45	0.33	0.71	0.79	0.79	0.63	0.57	0.21
3. GADHARI-DHENGAR			—	0.53	0.81	0.35	0.38	0.43	0.43	0.60	1.08	0.91	0.35	0.78	0.30	0.41	0.17	0.14	0.67	0.58
4. GADHARI-NIKHAR				—	0.78	0.15	0.81	0.42	0.63	0.39	0.36	0.57	0.27	1.21	0.51	0.28	0.51	0.29	0.10	0.75
5. HANDE					—	0.73	0.59	0.27	0.22	0.20	1.41	0.26	0.60	0.27	1.02	1.03	0.77	0.65	0.65	0.33
6. HATKAR						—	0.67	0.29	0.46	0.41	0.33	0.66	0.14	1.09	0.30	0.16	0.28	0.17	0.31	0.54
7. KANNADE							—	0.47	0.42	0.48	1.46	1.11	0.79	0.70	0.77	0.56	0.34	0.94	0.57
8. KHATIK								—	0.11	0.25	1.01	0.47	0.22	0.57	0.45	0.33	0.54	0.26	0.43	0.31
9. KHUTEKAR									—	0.28	1.27	0.35	0.40	0.27	0.50	0.63	0.66	0.41	0.59	0.17
10. KURMAR										—	0.92	0.34	0.49	0.51	0.65	0.73	0.52	0.37	0.46	0.33
11. LADSHE											—	1.07	0.72	2.17	0.74	0.57	0.64	0.67	0.47	1.31
12. MENDHE												—	0.55	0.47	0.91	1.03	0.86	0.81	0.37	0.44
13. SANGAR													—	0.82	0.19	0.26	0.36	0.28	0.34	0.52
14. SHEGAR														—	1.27	1.48	1.05	0.97	1.12	0.29
15. TELANGI															—	0.32	0.39	0.20	0.64	0.81
16. THELLARI																—	0.45	0.22	0.40	0.82
17. UNNIKANKAN																	—	0.11	0.54	0.80
18. VARGADE																		—	0.44	0.64
19. ZENDE																			—	0.77
20. ZADE																				—
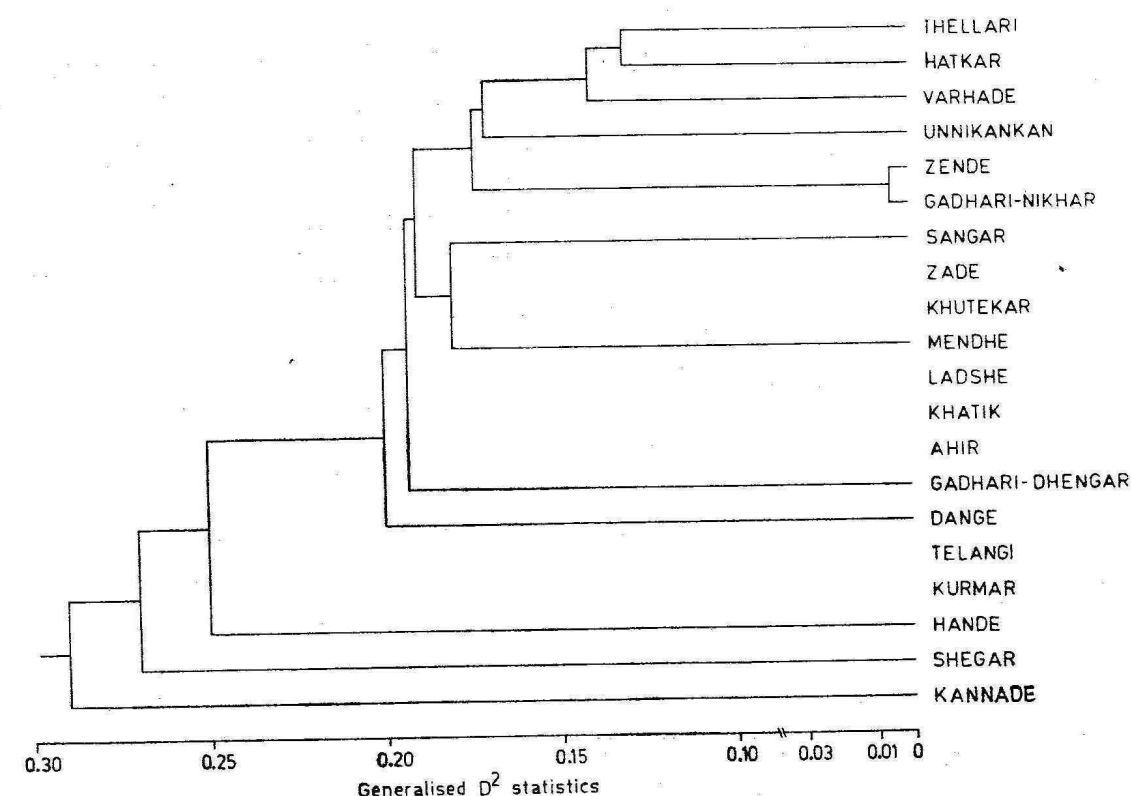
FIGURE 5. *Dendrogram of the 20 Dhangar castes based on Mahalanobis's Generalised D^2 statistics in respect of 9 palmar quantitative variables of right palm.*
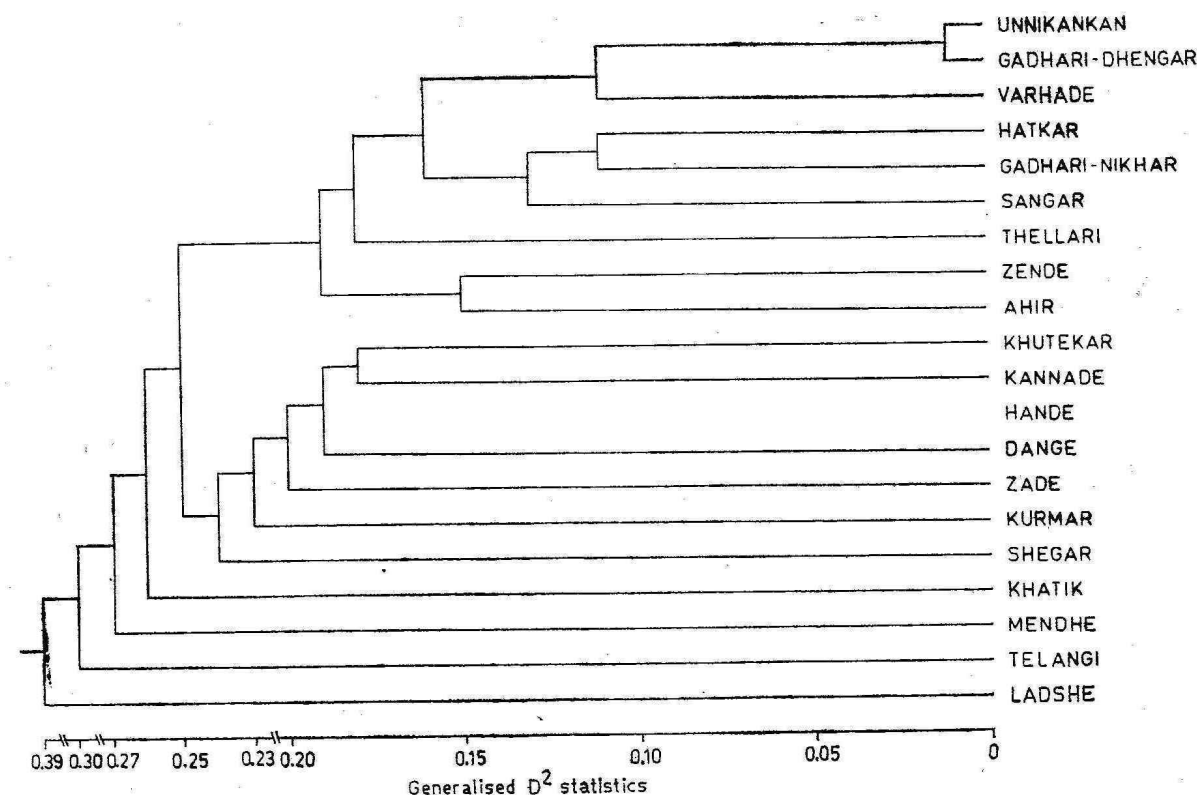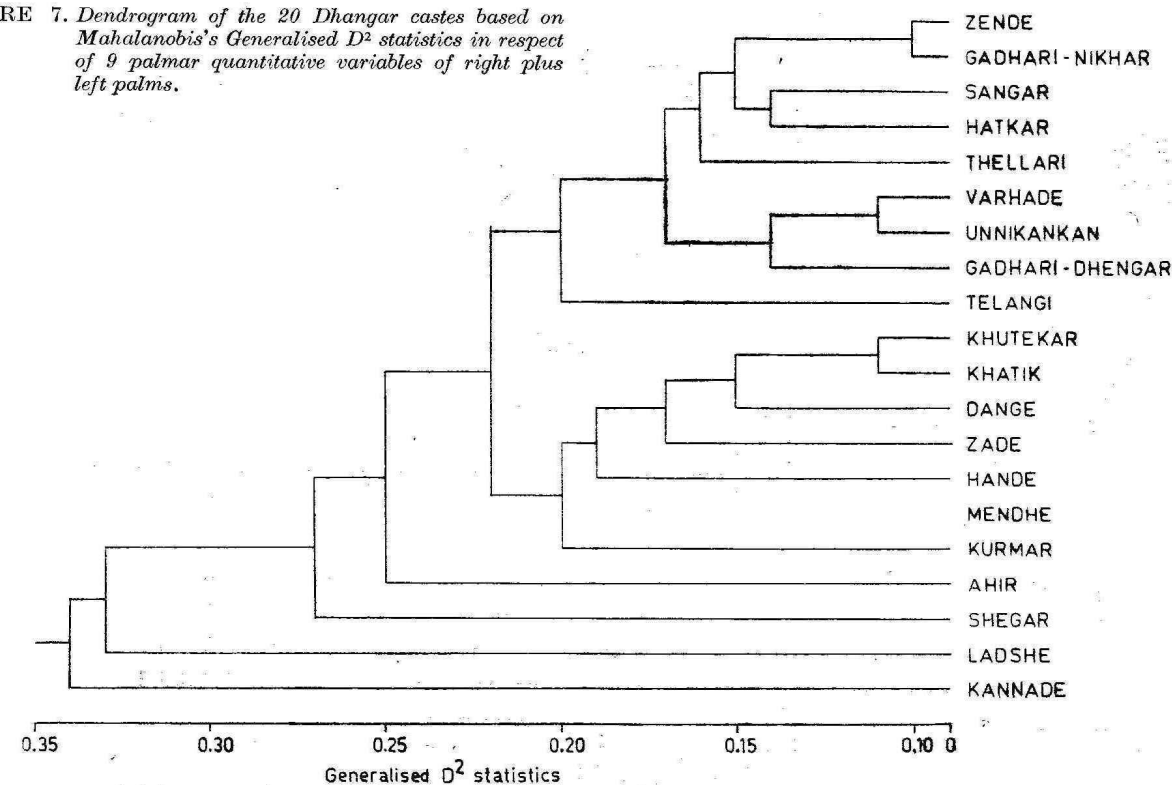

FIGURE 6. *Dendrogram of the 20 Dhangar castes based on Mahalanobis's Generalised D^2 statistics in respect of 9 palmar quantitative variables of left palm.*

FIGURE 7. *Dendrogram of the 20 Dhangar castes based on Mahalanobis's Generalised D^2 statistics in respect of 9 palmar quantitative variables of right plus left palms.*

ZENDE
GADHARI - NIKHAR
SANGAR
HATKAR
THELLARI
VARHADE
UNNIKANKAN
GADHARI - DHENGAR
TELANGI
KHUTEKAR
KHATIK
DANGE
ZADE
HANDE
MENDHE
KURMAR
AHIR
SHEGAR
LADSHE
KANNADE

0.35   0.30   0.25   0.20   0.15   0.10 0

Generalised D^2 statistics

Left column (page 22):

2. Three castes, the Kurmar, Telangi and Dange are indistinguishable from each other.
3. Another four castes, namely, the Gadhari-Dhengar, Ahir, Khatik and Ladshe are also indistinguishable from each other.
4. Similarly, the Mendhe, Khutekar and Zade are indistinguishable from each other.
5. One large cluster groups together the Gadhari-Nikhar, Zende, Unnikankan, Varhade, Hatkar and Thellari castes.

The clustering pattern, as emerged when left hand variables were considered (see *Figure 6*) is as follows:
1. Compared to right hand variables the left hand variables depict longer legs between the Dhangar groups and at least four castes, the Ladshe, Telangi, Mendhe and Khatik stand out separately from each other and the rest of the 16 Dhangar castes.
2. The remaining 16 Dhangar castes are divided into two distinct clusters. Cluster one incorporates seven castes, namely, the Shegar, Kurmar, Zade, Dange, Hande, Kannade and Khutekar, while cluster two includes nine castes, namely, the Ahir, Zende, Thellari, Sangar, Gadhari-Nikhar, Hatkar, Varhade, Gadhari-Dhengar and Unnikankan.
3. Only two pairs of castes, the Gadhari-Dhengar and Unnikankan and Hande and Kannade are indistinguishable.

The obtained dendrogram based on right plus left quantitative variables shown in Figure 7 reveals the following affinities between the Dhengar castes.
1. Four castes, Kannade, Ladshe, Shegar and Ahir stand out separately from each other as well as from the other Dhangar castes.

Second column (page 22):

2. The remaining 16 castes constitute two sub-clusters: cluster one contains 7 castes, namely, the Kurmar, Mendhe, Hande, Zade, Dange, Khatik and Khutekar, while cluster two comprises of 9 castes, namely, the Telangi, Gadhari-Dhengar, Unnikankan, Varhade, Thellari, Hatkar, Sangar, Gadhari-Nikhar and Zende.

Comparison between the Affinities based on Right and Left Palm Variables

An examination of the dendrograms (see *Figures 2 and 3*) based on right and left palms in respect of qualitative variables reveals that the relationships between various Dhangar castes, in general, are different when the traits on each palm are considered separately. For example, when the dendrogram based on right palm elements is examined it is noticed that the 20 Dhangar castes get devided into two distinct large clusters, while in the case of left hand elements the pattern is quite different. Likewise, while castes such as Ladshe, Gadhari-Nikhar, Khutekar and Kurmar in *Figure 2* cluster together, in *Figure 3*, Ladshe separates out from the other mentioned castes. Other departures are equally evident in the two dendrograms.

An inspection of the two dendrograms (*Figure 5, and 6*) based on quantitative palmar variables also reveals noteworthy differences in the pattern of relationships between the 20 Dhangar castes. To illustrate this point, it may be noted that while in the case of right hand variables, Kannade, Shegar and Hande stand out separately from the rest of the castes, in the case of left hand elements the Ladshe, Telangi, Mendhe and Khatik stand out separately.

22

Third column (page 23):

Likewise, while the Khutekar, Zade and Sangar show close affinities in the case of right hand elements, the Sangar show close affinities with the Gadhari-Nikhar and Hatkar.

It may, however, be pointed out that there are also strong similarities in the two dendrograms. For example, Dhangar castes such as the Unnikankan, Varhade, Hatkar, Thellari, Sangar, Gadhari-Nikhar and Zende in both the dendrograms are included in the same large cluster.

It can, thus, be summarized that the two palms, irrespective of qualitative or quantitative variables, while depict certain differences in the pattern of affinities between the Dhangar castes, there are also broad agreements between the two dendrograms.

Comparison between the Dendrograms based on Qualitative and Quantitative Variables

It would be of considerable interest to compare the pattern of affinities between the Dhangar castes based on two different sets of palmar variables, i.e., qualitative and quantitative.

(i) *Dendrograms based on right palm variables*

The dendrogram based on qualitative palmar variables splits the Dhangar castes into two distinct clusters (*Fig. 2*) while in the case of quantitative variables (*Fig. 5*) the pattern is more akin to a 'Staircase'. However, further examination reveals that the affinities between some Dhangar castes in both the dendrograms remain more or less the same. For example, the Varhade, Zende, Unnikankan and Thellari, as well as the Gadhari-Dhengar, Khatik, Sangar, Ahir, Kurmar, Ladshe and Khutekar display similar relationships in both the dendrograms. However, for castes like Kannade, Shegar, Hande, Telangi, Kurmar etc. the relationships in the two dendrograms are somewhat different. Broadly speaking, therefore, the concordance between the two dendrograms based on qualitative and quantitative variables is sufficiently large.

(ii) *Dendrograms based on left palm variables*

A comparison of *Figure 3 and 6* reveals that while in the case of qualitative variables the pattern is more like 'stair-case' in the case of quantitative variables the castes form two distinct clusters. Five castes, namely, the Hatkar, Varhade, Zende, Ahir and Gadhari-Nikhar reveal similar relationships in the two dendrograms. Likewise, Thellari and Unnikankan show close affinities in both the dendrograms. Among the prominent differences it is noticed that while in the case of qualitative variables, the Gadhari-Dhengar and Hande stand out from the rest of the castes, in the case of quantitative variables there are four other castes, namely, the Ladshe, Telangi, Mendhe and Khutekar who stand out from the rest of the castes. In general, therefore, the disagreement among the two dendrograms based on left palm elements are much greater compaired to the right palm elements.

Fourth column (page 23):

(iii) *Dendrograms based on right plus left palm variables*

An inspection of *Figures 4 and 7*, wherein are shown the clustering patterns of the Dhangar castes based on qualitative and quantitative palmar variables (right plus left palms), reveals the following main features:
1. The Dhangar castes cluster more neatly in the dendrogram based on D^2-statistics compared to the one based on Sanghvi's G^2.
2. Based on qualitative traits four castes, namely, the Hande, Zade, Thellari and Unnikankan cluster together in a distinct cluster, although in the dendrograms based on quantitative traits these four castes also occur in the same cluster but together with several other castes.
3. Several other castes also reveal similar relationships in the two dendrograms, viz., the Telangi, Zende, Hatkar, Khutekar and Kurmar.
4. There are, however, some noteworthy departures as well. Dhangar castes like the Unnikankan and Varhade are almost indistinguishable in the case of quantitative traits but show strong differences in respect of qualitative traits. Likewise, the Kannade and Ladshe are closer in both the dendrograms but their relationship with other Dhangar castes is quite different in the two dendrograms.
5. In general, it can, thus, be said that there is strong agreement between the two dendrograms, though some notable departures are also evident.

Palmar Dermatoglyphic Distances and the Ethnohistory of the Dhangar Caste-cluster

The various dendrograms will now be examined in some details to see if the observed inter-caste palmar dermatoglyphic relationships are meaningful in terms of the known ethnohistory of the Dhangar castes.

The archaeological evidence and ethnographical details suggest that these contemporary Dhangar castes are the result of at least more than one migration from the north-west of India which goes back 5,000 to a maximum of 10,000 years (Malhotra et al., 1978). Detection of Hb variants D and J among some of the Dhangar castes, and complete absence of sickle cell trait (Undevia et al., 1973; Kate et al., 1978).

Further ethnographic evidence shows that the Hatkar, Zende, Thellari and Dange were earlier one caste and only in recent times they separated from each other. Linguistic evidence shows that Kurmar who presently are found in eastern Maharashtra in fact migrated in recent times from southern Maharashtra; they even now continue to speak Kannade, the language spoken in southern Maharashtra and in the adjacent southern state of Karnataka. It is also linguistically well known that the Gadhari-Nikhar and Gadhari-Dhengar in fact came to north central districts of Maharashtra from northern India; both these castes even now speak a dialect of Hindi language spoken in northern India. Ahir who speak Ahirani, a mixed dialect of Gujarati and

23

Marathi, have come from north west state perhaps Gujarat and/or Rajasthan. The Khatiks, who sell goat and sheep meat, seem to have been derived largely from Khutekar, a woollen weaving cum sheep rearing caste.

In the light of the foregoing description and other details, the expectations in terms of biological affinities between the Dhangar castes are:

1. That the Dange, Hatkar, Zende and Thellari will show close affinities;
2. That the Kurmar will show affinities with the southernly distributed Dhangar castes;
3. That both the Gadhari castes will show prominent differences from the various other Dhangar castes;
4. That the Ahir will stand out separately from the castes distributed in the southern and eastern Maharashtra;
5. That in view of the rather recent separation of the Dhangar castes going back to some 250 to 500 generations of evolution and since the dermatoglyphic characters have been shown to be fairly stable, the Dhangar castes would reveal relatively low degree of differentiation in the palmar dermatoglyphic traits, and
6. That, therefore, geographic proximity, in general, will not predominate in the pattern of relationships.

The dendrograms and other results, and the congruence between observed dermatoglyphic intercaste relationships and the expected relationships based on ethnohistorical evidence will now be discussed. For the sake of brevity and clarity, the dendrograms based on qualitative and quantitative traits are considered separately and each of the above five expectations is examined.

Relationships based on Qualitative Variables

1. It is interesting to note that three Dhangar castes, the Zade, Dange and Hatkar fall within one cluster when left palm or right plus left palms are considered together; in the case of right palm, however, Zade, Thellari and Dange coexist in one cluster. Thus, except for one group in each case, the dermatoglyphic affinities go hand in hand with the expected relationships between these castes.
2. The Kurmars who were expected to show closer relationship with the southern Maharashtrian Dhangar groups, in fact, mostly cluster with eastern Maharashtrian Dhangar castes, thereby showing departure from the expectation.
3. It is noteworthy that the expectation that the two Gadnari-Dhengar castes, now found distributed in north-central Maharashtra, would show weak affinities with the other Dhangar castes, is justified in case of Gadhari-Dhengar but not the Gadhari-Nikhar, with respect to right, left and right plus left palmar elements. The latter caste in fact shows more affinities with the Dhangar castes found in eastern and central Maharashtra.
4. The Ahirs do not stand out separately as expected, but show strong affinities with the Hatkars.

5. 24.4% of inter-Dhangar caste pairs showed significant differences at 5% levels and below in respect of qualitative palmar variables based on univariate analysis (Karmakar, 1984 unpublished Ph. D. Thesis), indicating thereby, as expected, that the palmar dermatoglyphic differentiation among the Dhangar castes is at a rather moderate level.
6. As expected, in general, the Dhangar castes do not reveal patterning in affinities based on geographic proximity.

Relationships based on Quantitative Variables

An examination of the three dendrograms given in Figures 5, 6 and 7 based on quantitative variables reveals the following in respect of the expectations detailed above:

1. It is highly noteworthy that the Hatkar, Thellari and Zende cluster together irrespective of the side of the palm or right plus left palm variables. However, contrary to our expectations, Dange do not show close affinities with the three castes mentioned above.
2. The Kurmars, as expected, do share close affinities with a few of the Dhangar castes inhabiting southern districts of Maharashtra like Shegar, Mendhe, Khatik and Telangi when variables of right or left palms are considered separately. However, when right plus left palm elements are considered the Kurmars show more closer affinities with the Dhangar castes of eastern Maharashtra (like Ladshe and Kannade) and north-central Maharashtra (like Gadhari-Nikhar and Khutekar).
3. The two Gadhari castes who have migrated into north-central Maharashtra in recent historical times do display close affinities when variables on left palm and right plus left palms are considered. But, the relationship is contrary to the expectations when elements of right palm are considered.
4. The Ahir Dhangars do separate out from the rest of the Dhangar castes when palmar variables of right plus left palms are considered. However, in the case of right or left palmar variables the separation is not so distinct.
5. It was found that 26.05% of all possible intercaste Dhangar pairs show significant differences at 5% levels and below in respect of quantitative palmar variables (Karmakar, 1984, Ph. D. Thesis). They do establish the fact that the palmar dermatoglyphic differentiation among the Dhangar castes is at rather low levels.
6. The relationships depicted by the Dhangar castes based on quantitative variables clearly demonstrate that these are, in general, not based on geographic proximity.

To sum up the above findings it is quite clear that the observed relationships between the Dhangar castes, irrespective of qualitative or quantitative palmar variables, by and large confirm the pattern of relationships based on ethnohistorical evidence.

Comparison between Palmar Dermatoglyphic Distances and Distances based on Anthropometry, Genetic Traits and Finger Dermatoglyphics

A great deal of interest has been generated in recent years regarding (a) the usefulness of dermatoglyphic traits in understanding the relationships between various populations, and (b) population relationships obtained from dermatoglyphic data and how these relate to those obtained from other data, such as anthropometric, genetic traits etc. The second issue will be taken up first. A number of investigations in the recent past have included dermatoglyphic data with other biologic data, such as anthropometric and genetic, to evaluate the population relationships obtained from dermatoglyphic data and how these relate to those obtained from other form of data. A majority of the investigators found that the dermatoglyphics seem to reveal relationships less clearly, and produce a set of relationships differing from other sets of data (see among others Chai, 1972; Neel et al., 1974; Friedlaender, 1975; Rothhammer et al., 1979). However, quite a few others did find close congruence between dermatoglyphic and other biologic data (see among others Rothhammer et al., 1977; Malhotra, 1978; Jantz et al., 1982). At least part of the differences observed in the above studies are due clearly to the choice of dermatoglyphic variables (see Jantz and Chopra, 1976; Jantz, 1979). It is, therefore, of considerable interest to compare the relationships between Dhangar castes as obtained from palmar dermatoglyphic data and other biologic data such as anthropometry, genetic markers and finger dermatoglyphics.

Malhotra et al. (n.d. MSS) studied the relationship between the Dhangar castes based on 18 anthropometric measurements. These authors used Morton's (1973) Bioessay of Kinship. The constructed dendrogram is shown in Figure 8. A comparison between this dendrogram and the dendrograms described earlier based on palmar dermatoglyphic variables, clearly indicate a number of differences. The separation of the Dhangar castes in the case of anthropometric characters is clearly influenced by geographic proximity. Thus all the five castes without any exception (Kannade, Ladshe, Zade, Kurmar and Varhad) inhabiting eastern Maharashtra cluster together; the castes distributed in north-central districts of Maharashtra (Ahir, Thellari, Gadhari-Dhengar, Khutekar and Gadhari-Nikhar) cluster together, and the castes found in southern districts of Maharashtra (Hande, Zende, Sangar, Shegar and Mendhe) cluster together. The separation of the Dhangar castes based on palmar variables in fact, as noted earlier, was not governed primarily by geographic proximity.

Malhotra et al. (1978b) studied the relationships between the Dhangar castes based on eleven loci (A_1 A_2 B_0, MN, Le(a), Le(b), p, Rh, and Hp). However, since these common loci were available for only 14 Dhangar castes, the other castes could not be considered. The genetic distances were computed by the authors using Nei's (1972) distance measure. Since all the Dhangar castes could not be included in this analysis a meaningful comparison, however, cannot be attempted. Nevertheless, despite these limitations a few points are worth noting. The clustering pattern obtained in the case of genetic traits is clearly not based on geographic proximity
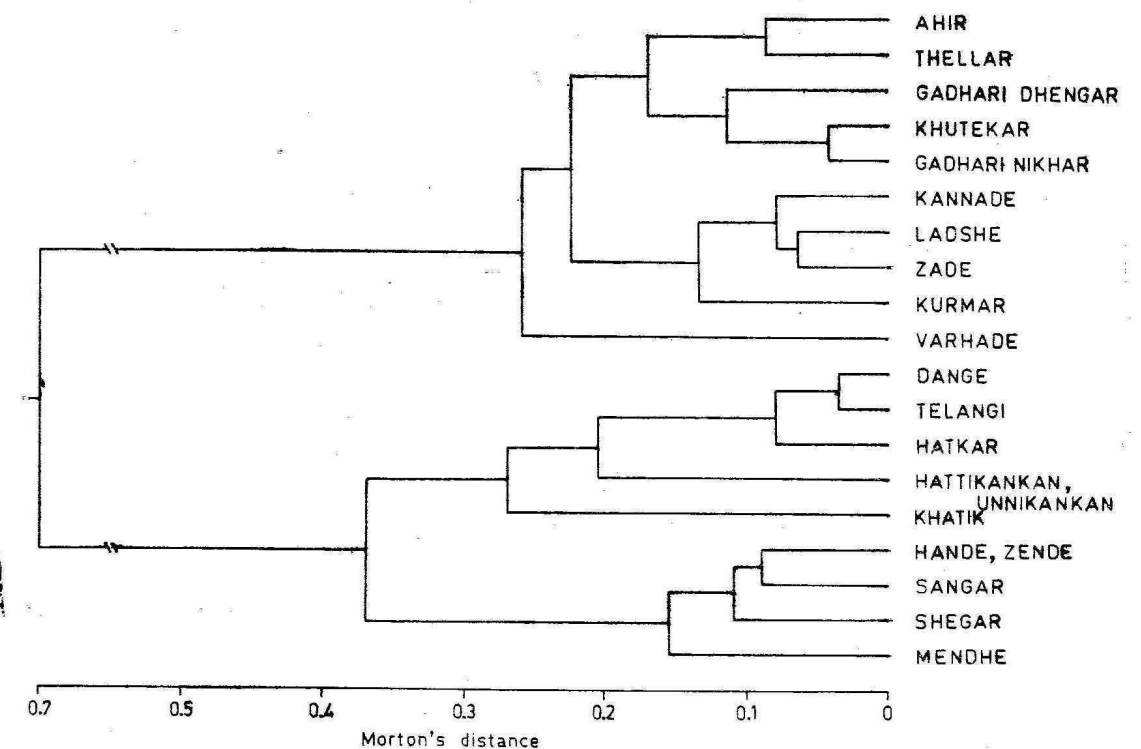

FIUGRE 8. Dendrogram based on anthropometric characters (after Malhotra, et al., n. d., MSS).

of the Dhangar castes (see *Figure 9*). Thus, as expected, the Kurmar now found distributed in eastern Maharashtra cluster with the southern Maharashtrian Dhangar castes. This was expected. Similarly, as expected, the Dange and Hatkar show close similarities.

In general, therefore, the pattern of distribution between the Dhangar castes based on genetic traits and palmar dermatoglyphic variables shows strong congruence. Further, Malhotra et al. (1978b) showed

that the genetic differentiation among the Dhangar castes is rather small; average DST is approximately 0.01. Similar moderate level of differences, as noted earlier, were obtained in respect of intercaste variation using palmar dermatoglyphic variables.

Malhotra et al. (1980a) also studied the finger dermatoglyphic traits among the Dhangar castes. Based on total finger ridge count, absolute finger ridge count and finger pattern intensity index, these authors generated Mahalanobis's D^2 distances
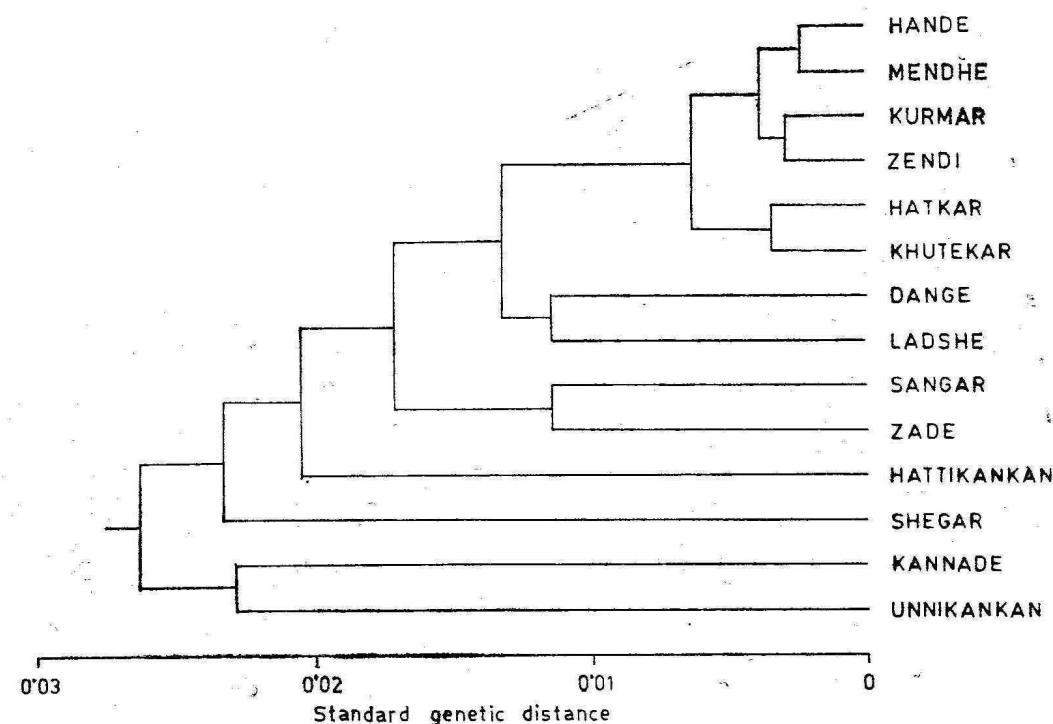
FIGURE 9. *Dendrogram of the 14 Dhangar castes of Maharastra based on Genetic markers (after Malhotra et al. 1978).*
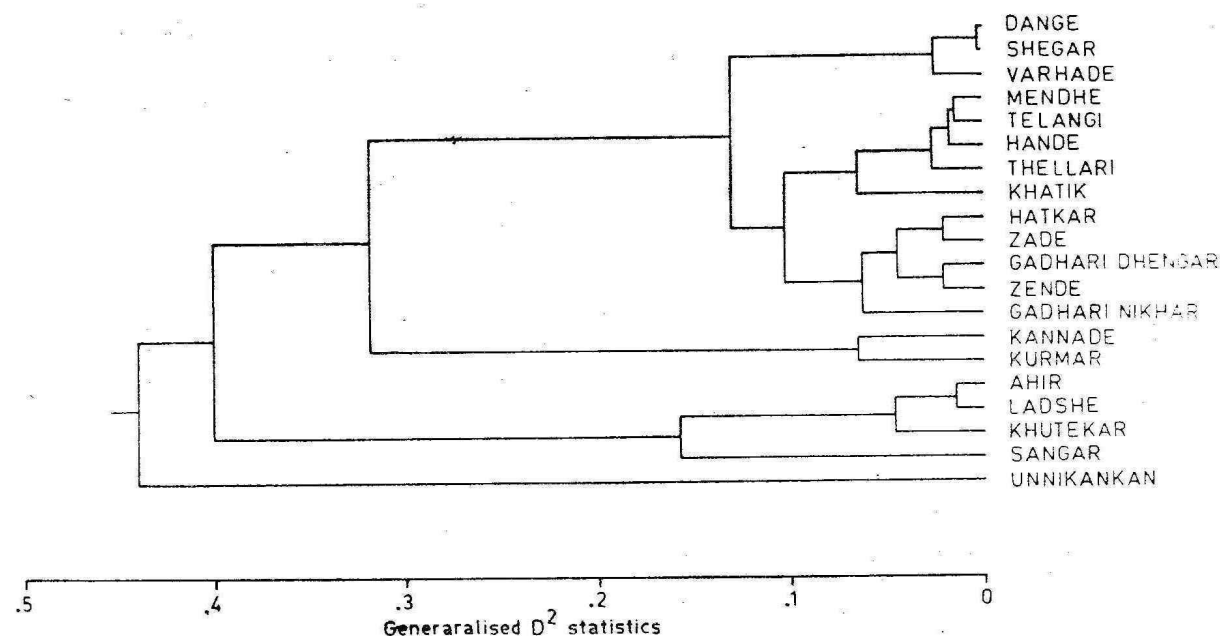
FIGURE 10. *Dendrogram of the 20 Dhangar castes based on finger pattern intensity, total and absolute finger ridge counts.*

among the Dhangar castes. The obtained dendrogram is shown in *Figure 10*.

The most noteworthy point emerging from the dendrogram based on digital quantitative traits is that the differentiation of the Dhangar castes, in general, is not based on geographic proximity of the castes and in fact the obtained relationships, generally speaking, show noteworthy departures from the known relationships between the Dhangar castes. The similar findings — 'the absence of clear-cut clinal configuration', are observed by Malhotra (1979) in respect of qualitative finger dermatoglyphics among the Dhangar castes.

The facts observed in the above studies, show that, palmar dermatoglyphic variables compared to other sets of biologic data are more confirmatory to the known ethnohistorical relationships of the Dhangars. The similar results are obtained by Reddy et al. (1987) in respect of palmar quantitative traits among the marine fishermen of Puri, India.

CONCLUSION

The obtained pattern of relationships between the 20 Dhangar castes for both qualitative and quantitative palmar variables, confirmo the expected pattern of relationships based on the known ethnohistorical evidence. Different sets of biological data, such as palmar variables, finger variables, anthropometric characters and genetic traits show marked inter-variable set differences. Among the different sets of biologic variables considered in the present work, anthropometric characters show a pattern of differentiation based on geographic proximity while in the case of other sets of data the pattern of relationships, in general, is not influenced by the geographical proximity. Of the various sets of data considered here the best congruence between the known ethnohistory of the Dhangar castes is reflected by the palmar dermatoglyphics irrespective of qualitative or quantitative variables. The relationships based on finger dermatoglyphics show marked deviations from the expected interrelationships between the Dhangar castes. This is in confirmity with several other investigations which used finger ridge counts and found similar departures. The palmar dermatoglyphic dendrograms show, in general, properties similar to the genetic dendrograms as observed earlier by Jantz (1975).

In conclusion it can be said that palmar characters in particular do help in understanding the relationships between different groups both at major racial level and at sub-regional levels of biological differentiation.

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