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Relationship between cleft chin and some quantitative and qualitative cephalo—facial characters : a statistical study

Introduction

Some persons have a distinct depression, dimple, fissure or cleft on the lower margin of the chin in the median sagittal plane. Such chins are also termed bilobed chins. The trait shows a great deal of variability in its mode of expressivity, from dimple to Y-shaped furrow. Recent studies of Malhotra and Sarkar (1975) based on family data, and Guha (1975) based on family and twin data, have shown beyond doubt that the trait is inherited as a autosomal, diallelic incompletely dominant. Mckusick (1968) lists this as a good dominant (item No. 1166). The trait is independent of age but reveals sex differences (Malhotra 1971, Malhotra *et al.*, 1971, Singh and Malhotra 1971). Recently Bhanu and Malhotra (1972) reviewed results of all surveys in India in which the cleft chin was recorded and observed wide variations in gene frequencies for the gene *cl*.

During the last one million years the morphology of the *proto hominids* and *hominids* face has undergone substantial changes. The changes in the lower jaw are most striking. One of the most characteristic feature to have appeared in the facial morphology is the development of Chin. Further the appearance of cleft in the chin of some individuals is a unique feature of *Homo Sapiens*. Although the antiquity of this trait is yet to be established, it appears that it is of recent origin. The exact evolutionary significance, in terms of fitness, is yet to be worked out. Intuitively it seems, however, that the cleft may afford certain advantage in the mechanical aspects involved in mastication.

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The present paper is the outcome of a larger programme initiated in 1970 by KCM to answer some of the issues raised above. In this paper an attempt has been made to explore the possibility of dependence between cleft chin and some of the quantitative and qualitative characters of the face.

METHODS AND MATERIALS

The chin of each subject was examined and the presence or absence of cleft was noted. On the same subjects seven metrical characters of the face were recorded. They are : head length (H. L.), head breadth (H. B). upper facial height (U. F. H.), nasal height (N. H.), nasal breadth (N. B.), bizygomatic breadth (BZB), and bigonial breadth (BIG). The qualitative characters observed are : supra-orbital ridges, prognathism, chin prominence and chin shape or form, and ear lobe attachment. A total of 2713 males, age 20-60 years studied for metrical characters while for qualitative traits 570 males, age 9-60 years, were examined. The subjects belonged to 22 endogamous Dhangar (Shepherd) castes from Maharashtra. The groupwise breakdown of the sample is shown in Table 1. Details of sampling design were suggested by Dr. T. V. Hanurav and Dr. R. Chakraberty. The measurements and observations were made after Martin And Saller (1956).

RESULTS

Analysis of Quantitative Characters

The results are incorporated in Table 2. Test for homogeneity revealed that the incidence of cleft chin is heterogeneous among the groups (χ^2 22=54.7, P>0.01). The incidence of cleft chin individuals varied from 14.65 per cent to 45.92 per cent with a mean 39.34 per cent. Out of the seven metric characters investigated four have shown strong dependence on cleft chin. Mean H. B. for cleft chinned individuals is higher and the difference is significant (t=2.84, P>0.01). The same is true in the case of BZB with t=3.06, P>.01. On the other hand in the case of UFH and NH the mean values for the cleft chinned individuals are lower with 't' values 5.31, P>.001, and 4.82, P>.001 respectively. It may be noted that although the mean H. L. for cleft chinned individuals is smaller and BIG and NB are higher, the differences, however, are not significant.

Analysis of Qualitative Characters

The results are set out in Tables 3 and 4. Test for homogeneity showed, as in the case of metric characters, that here also the incidence of cleft chin is heterogeneous among the groups, the range of variation of this trait is between 16. 30 per cent to 47.97 per cent, with a series average 28.85 per cent. Out of the 5 qualitative characters considered, supra-

orbital ridges, chin prominence, and chin shape show striking association with the cleft chin (for χ^2 values see Table 4). On the other hand sub-nasal prognathism and ear lobe attachment seems to be independent of cleft chin.

Discussion

From the analysis three important inferences can be drawn, viz. (1) for all the measurements involving breadths (i.e. in the horizontal plane) there is a strong tendency for the higher values to be associated with cleft chin, (2) in the case of measurements involving heights (i.e., in the vertical plane) the lower values markedly tend to be associated with cleft chin, and (3) both chin prominence (prominent and medium) and chin shape (square) show strong association with this trait. In terms of cephalo-facial morphology it means that short and wide faces with strong built square chins are more often associated with the cleft chin compared to long, narrow faces with negative, oval or round chins. Lack of association between cleft chin and sub-nasal prognathism is of great interest. The *Proto-hominids*, and perhaps the early *hominids*, who have had usually prognathus jaws lacked this trait as is evidenced from the living apes. The development of strong chin is very much associated with the reduction of prognathism. In the modern populations of the world, strong chins are highly associated with orthognathous faces. If this observed association is any guide, we can venture to predict that populations with marked prognathism such as Negroes, and Proto-Australoids would have lower incidence of cleft chin compared to orthognathous populations such as Caucasoids and Mongoloids. Unfortunately not much data is available on this trait. The limited data in hand, however, supports our surmise that the Proto-Australoid groups from Kerala, show an incidence of about 7 per cent (range 4 per cent to 10 per cent) while most of the Caucasoid and Mongoloid groups studied record over 15 per cent (range 6 per cent to 39 percent) : (for details see Bhanu and Malhotra 1972 and Malhotra and Sarkar 1975).

The results of this study when viewed in terms of general correlation between various facial and head measurements, assumes further significance. Majumder and Rao (1960) found that the correlation between HB, and BZB was fairly high (approximately in all cases .5 but in the case of these breadths and NB weak correlation was observed, The results then get strong support from the findings of these authors. Rao and Majumdar also found high correlation between these breadths and minimum frontal breadth. We can thus safely predict that the wide foreheads will have higher frequency of cleft chin.

Although firm conclusions can not be drawn from this limited investigation, it, however, strongly suggests ;

(1) the cleft chin must have appeared in the human evolutionary history only after the development of positive chins and substantial reduction in the prognathism,
(2) the presence or absence of cleft chin is highly correlated with certain metric and qualitative cephalo-facial chracters, and
(3) the presence or absence of cleft chin may afford certain selective advantage or disadvantage.

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NOTE

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TABLE I

Frequencies of Cleft-Chin in various Endogamous groups

	Quantitative characters		Present	Qualitative characters		Present
Populations	N	n	%	N	n	%
Ahir	273	84	30.77	327	99	30.28
Dange	157	23	14.65	195	35	17.94
Gandhari-Dhengar	80	25	31.25	112	33	29.46
Halmat	11	4	36.36	14	5	35.71
Hande	60	21	35.00	90	35	38.89
Hatkar	499	154	30.86	678	200	29.50
Hattikankan	29	10	34.48	35	11	31.43
Kanade	55	12	21.82	92	23	25.00
Kharik	133	36	27.07	168	43	25.60
Khutekar	401	131	32.67	516	167	32.36
Kurmar	92	26	28.26	104	29	27.88
Ladshe	98	45	45.92	123	59	47.97
Mendhe	119	33	27.73	184	53	28.80
Sangar	81	19	23.46	89	19	21.35
Shegar	71	23	32.39	143	46	32.17
Telangi	61	10	16.39	92	15	16.30
Thellari	110	24	21.82	116	24	20.69
Unnikankan	57	21	36.84	69	22	31.88
Varhade	58	19	32.76	77	21	27.27
Zende	126	43	34.13	156	51	32.69
Zade	70	11	15.71	78	14	17.95
Gadhri-Nikhar	67	20	29.85	107	24	22.43
Bandgar	5	2	40.00	5	2	40.00
Total	2713	796	29.34	3570	1030	28.85

TABLE 2

Mean standard deviation and t-values for quantitative characters

Character	Cleft-chin	N	Mean	S. D.	t-value	Remarks
Head Length	Present	793	18.2932	0.7391	1.1770	N. S.
	Absent	1910	18.3301	0.7497		
Head Breadth	Present	790	14.4325	0.6630	2.8434	*
	Absent	1912	14.3536	0.6403		
Bizygomatic Breadth	Present	788	13.3023	0.6113	3.0600	*
	Absent	1914	13.2242	0.5828		
Bigonial Breadth	Present	794	10.3227	0.6483	1.2754	N. S.
	Absent	1915	10.2881	0.6310		
Upper Facial Height	Present	768	6.1697	0.4297	5.3149	**
	Absent	1810	6.2687	0.4406		
Nasal Height	Present	795	4.8101	0.4782	4.8262	**
	Absent	1915	4.8788	0.3888		
Nasal Breadth	Present	796	3.5815	0.3144	0.6159	N. S.
	Absent	1915	3.5734	0.3078		

N. S =Non significant, *=Significant at 1% level of significance, **=Significant at .01 level of significance.

TABLE 3

Frequency distribution of Cleft Chin (Pooled data) in various categories

Supra-orbital ridges			
Imperceptible	536	1185	1621
Trace	232	587	319
Medium	63	149	212
Pronounced	11	30	41
Continuous	221	459	680
Total	963	2410	3373

(Contd.)

(Contd.)

prognathism sub-nasal			
Slight	741	1724	2465
Medium	262	711	973
Marked	15	51	66
Total	1018	2486	3504
Chin			
Prominent	442	1166	1608
Medium	574	1152	1726
Receding	11	218	228
Total	1127	2536	8563
Chin form or shape			
Oval	263	1039	1608
Round	133	613	746
Square	631	880	1511
Total	1027	2532	3559
Ear-lobe : Right			
Attached	447	1052	1499
Intermediate	453	1138	1591
Free	122	322	444
Total	1022	2512	3534
Ear-lobe : Left			
Attached	447	1057	1504
Intermediate	453	1140	1593
Free	122	314	436
Total	1022	2511	3533

P=Present ; A=Absent

TABLE 4

χ^2—Values for qualitative characters

Characters	χ^2	d. f.	
Supra-orbital ridges	153.2000	4	
Prognathism (Sub-nasal)	4.6293	2	N. S.
Chin	82.3297	2	
Chin form or Shape	214.2767	2	
Ear-lobe : R	1.1948	2	N. S.
Ear-lobe : L	0.8361	2	N. S.

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