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Population distance between Dakshina Kannada (South India) and Gujarati (North India) population using infracranial nonmetric traits

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Abstract

Infracranial nonmetric variations have been considered for determining population distance between different regions and continents, in recent times. We studied different infracranial nonmetric traits from the Dakshina Kannada (South India) region to compare with the data available from the Gujarati (North India) region. The mean measure of divergence between the two different geographic regions showed significant variation. In our study, the incidence like i) Allen's fossa of the femur, ii) plaque formation in the upper end of the femur, iii) exostosis in trochanteric fosse of femur, iv) third trochanter of femur, v) os trigonum of talus, vi) medial talar facet, vii) peroneal tubercle of calcaneus, viii) bipartite transverse foramen in the cervical vertebra, too showed significant side difference.

***Keywords*:** infracranial nonmetric variation, population divergence, geographic region, significance.

Introduction

The north and south parts of India are not only different due to their geographic, cultural and linguistic aspects, but there are racial differences between the two regions. The objective of the present study is to estimate the population distance between Dakshina Kannada (Southern part of Karnataka state, South India) and Gujarati (Southern part of Gujarat State, Surat, North India), by using infracranial nonmetric traits, to confirm the importance of these traits in the population distance. At the same time, we investigated the side-to-side difference for the traits in our (Dakshina Kannada) population. Infracranial nonmetric variations have been considered for determining population distance between different regions and continents [1, 2].

Finnegan M (1974) compared 30 infracranial traits as indicator of population distance between American white, American Negro, Coast Eskimo, Yukon Eskimo and Aleut. He concludes that the infracranial traits distances correlate very highly with the cranial trait distances [3].

In similar lines, Peneteado CV *et al.* (1986) studied the right and left side incidence of 30 non-metric infracranial variations in 2103 Brazilian dry bones [4].

Pal GP and Routal RV (1987) studied the infracranial non-metric variation in Gujarati (North India) population [5].

Recently, Dolon DA (2000) described the value of infracranial nonmetric variation in modern *Homo sapiens* [6]. He used the samples from populations originating from five major geographic regions: Australia (two populations), Africa, East Asia, Europe, and Polynesia in his study.

Deol MS and Truslove GM (1957), Truslove GM (1954), and Berry AC and Berry RJ (1967) described the genetic nature of nonmetric variation [7–9]. In particular, Berry AC and Berry RJ (1967) proposed that nonmetric variables offered a more reliable estimation of population similarity than metric variables [9]. The genetic factors are of more important than non-genetic factors in the expression of nonmetric traits [11].

Ubelaker DH and Douglas H (1974) described that the distance measures between populations are useful in anthropology for inferring residence patterns, patterns of diffusion and migration, and micro evolutionary changes through time [11]. The reliability of nonmetric traits for population distance in primates has been studied by various authors [10, 12, 13].

Finnegan M (1978) suggested that the infracranial traits might be more suitable to the non-metric analysis than cranial traits, because the infracranial traits have (i) bilateral expressions (ii) they are found on heavy bones (iii) they survive prolonged burial and subsequent excavation [14].

Material and methods

Infracranial adult bones of unknown sex and age [Femur (408), Tibia (400), Humerus (364), Hip bone (226), Scapula (318), Patella (180), Talus (210), Calcaneum (156), Atlas (160), and Third to seventh cervical vertebrae (1224)], were examined from the

specimens collected from the different regions of Southern part of Karnataka state, South India).

All the bones were fully ossified and were free of pathological changes or anomalies has been considered for 29 non-metric variants (as used by Finnegan M, 1978) [14].

The pre-auricular sulcus was not considered, as it has anatomical basis, rather than a nonmetrical trait. The above are listed in Table 1. Each bone was observed carefully and the presence or absence of each variant was noted on each side separately to record the side dimorphism. The sides were combined and compared with similar data of Pal GP and Routal RV (1987) [5].

Comparisons of the incidence of various variants for the two different Indian populations were carried out using distance statistical method by Smith CAB (as detailed by Berry AC and Berry RJ, 1967) [9]. Chi-square test (χ^2) was applied to test side difference (Table 2).

Table 1 – ***Incidence and side difference of the infracranial non-metric skeletal variables in the Dakshina Kannada population***

SL No.	Nonmetric variables	Incidence Trait observed/ No. of bones	Frequency	Side difference		χ^2 value
				Rt Trait observed/ No. of bones	*Lt Trait observed/ No. of bones*	
01.	Allen's fossa present	259/408	0.634	116/204	143/204	7.70**
02.	Poirier's facet present	279/408	0.683	136/204	143/204	0.55
03.	Plaque formation	294/408	0.720	165/204	129/204	15.78***
04.	Hypotrochanteric fossa	255/408	0.625	126/204	129/204	0.094
05.	Exostosis in trochanteric fossa	229/408	0.561	127/204	102/204	6.22*
06.	Third trochanter present	228/408	0.558	126/204	102/204	5.72*
07.	Medial tibial squatting facet	115/400	0.281	55/200	60/200	0.30
08.	Lateral tibial squatting facet	300/400	0.75	145/200	155/200	1.33
09.	Supracondyloid process present	0/0	0.0	0/0	0.0	0.0
10.	Septal aperture present	100/364	0.274	51/182	49/182	0.055
11.	Acetabular crease present	03/226	0.013	1/113	2/113	0.34
12.	Pre auricular sulcus	0/0	0.0	0/0	0/0	0.0
13.	Accessory sacral facet present	85/226	0.376	43/113	42/113	0.018
14.	Acromial articular facet present	48/318	0.150	27/159	21/159	0.88
15.	Suprascapular foramen present	24/318	0.075	12/159	12/159	0.0011
16.	Circumflex sulcus present	51/318	0.160	24/159	27/159	0.21
17.	Vastus notch present	70/180	0.388	32/90	38/90	0.84
18.	Vastus fosse present	0/180	0.0	0/90	0/90	0.0
19.	Emarginate patella	0/180	0.0	0/90	0/90	0.0
20.	Os trigonum present	97/210	0.461	32/105	65/105	20.86***
21.	Medial talar facet present	6/210	0.028	54/105	23/105	19.70***
22.	Lateral talar facet present	124/210	0.590	73/105	51/105	9.53
23.	Inferior talar articular surface single	40/210	0.190	19/105	31/105	3.78
24.	Anterior calcaneal facet double	44/156	0.282	21/78	23/78	0.126
25.	Anterior calcaneal facet absent	7/156	0.044	2/78	5/78	1.34
26.	Peroneal tubercle present	52/156	0.33	20/78	32/78	4.15*
27.	Atlas facet double	60/160	0.375	30/80	30/80	0.0
28.	Posterior bridge present	3/160	0.018	2/80	1/80	0.32
29.	Lateral bridge present	105/160	0.657	55/80	50/80	0.69
30.	Transverse foramen bipartite	132/1224	0.107	78/612	54/612	4.89*

*P<0.05 – significant, **P<0.01 – very significant, ***P<0.001 – highly significant.

Table 2 – ***Mean measure of divergence (x) between Dakshina Kannada and Gujarati population***

	Gujarati (North India)
Dakshina Kannada (South India) X (Mean)	0.42
S.D.	0.03

Present study (Dakshina Kannada) showed significant divergence (X) with Gujarati population, P<0.001.

Results

The population divergence between the Dakshina Kannada and the Gujarati population were statistically significant (p <0.001). The trait number 5 (Exostosis in trochanteric fosse), 6 (Third trochanter present), 26 (Peroneal tubercle present), 30 (Transverse foramen bipartite) showed significant side difference (p<0.05), Trait number 1 (Allen's fosse present) showed very significant side difference (p<0.01), and trait number 3 (Plaque formation), 20 (Os trigonum present), 21 (Medial talar facet present) were highly significant (p<0.001) (Table 1, Figures 1 and 2).

Discussions

The use of non-metric traits as an indicator of population distance is increasing in frequency and importance after the work carried out by Berry AC and Berry RJ (1967) [9].

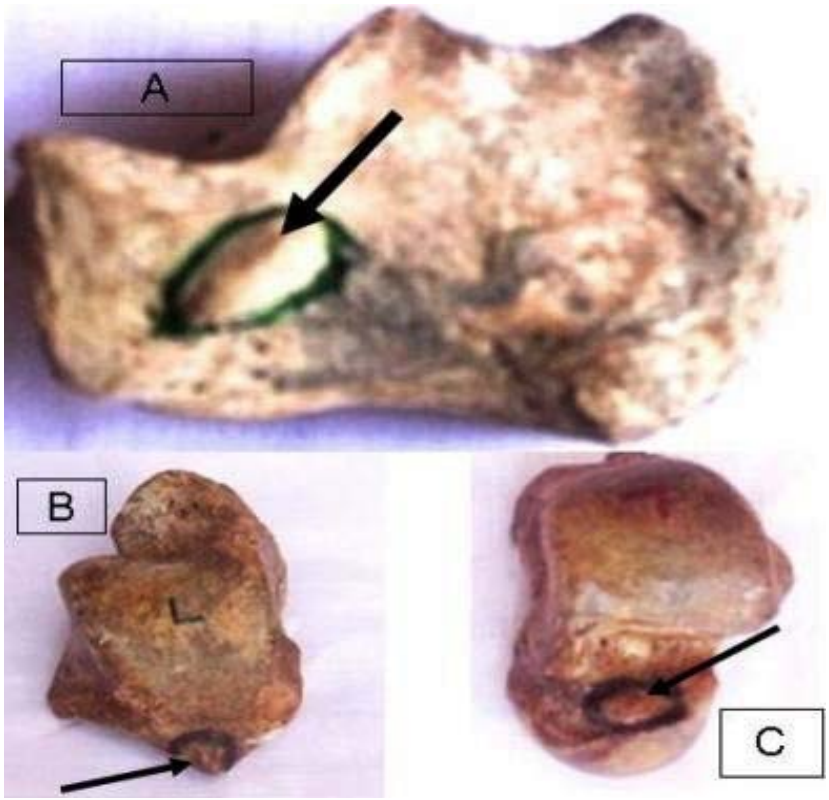

Figure 1 – ***Black arrow indicates the presence of trait: A – Peroneal tubercle; B – Os trigonum; C – Medial talar facet***

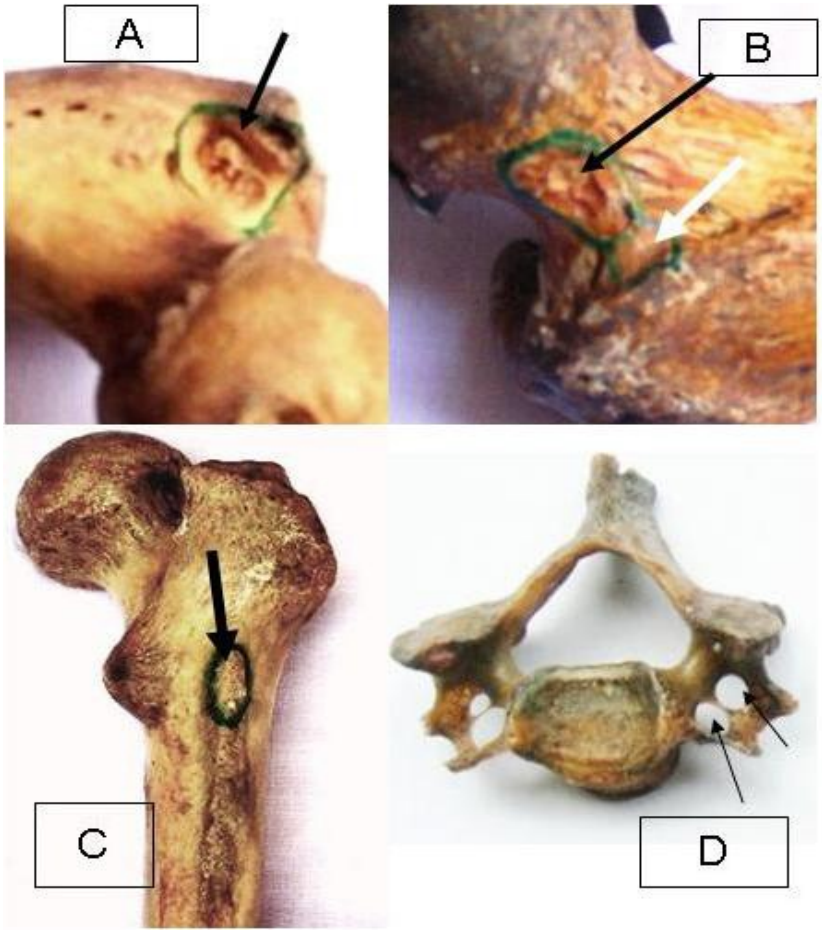

Figure 2 – ***Black and white arrows indicate the presence of trait: A – Exostosis in trochanteric fosse; B – White arrow: Allen's fosse; Black arrow: Plaque formation; C – Third trochanter; D – Transverse foramen bipartite***

Pal GP and Routal RV (1987) and Finnegan M (1978) and used the infracranial nonmetric traits for population comparison [5, 14].

Finnegan M (1978) also checked the age, sex, and side dependency for these traits and concluded that the infracranial traits may be superior to the cranial non-metric traits for population comparison [14].

Pal GP and Routal RV (1987) in their study showed that trait no. 3 (Plaque formation) and 26 (Peroneal tubercle present) were found in high frequency for Gujarati (North India) population, while trait no. 11 (Acetabular crease present), 13 (Accessory sacral facet present), 14 (Acromial articular facet present), 21 (Medial talar facet present), 24 (Anterior calcaneal facet double), 25 (Anterior calcaneal facet absent), and 29 (Lateral bridge present) showed considerable low frequency when compared with American white, Negro, Eskimo and Aleut population [5] (Table 1).

Pal GP and Routal RV (1987) showed the mean measure of divergence between Gujarati and other populations that are taken by Finnegan M (1978), were all statistically significant ($p<0.001$) [5].

In our study, i) Allen's fosse, ii) plaque formation iii) exostosis in trochanteric fosse, iv) third trochanter of femur, v) os trigonum, vi) medial talar facet, vii) peroneal tubercle, viii) bipartite transverse foramen in the cervical vertebra (Table 1, Figures 1 and 2), showed significant side difference.

The Allen's fosse was noted to be of significant side difference, both in our study and Gujarati (North India) population. The other seven traits found to be significant, only in our study. In Gujarati population only four traits showed statistically significant side differences.

Pal GP and Routal RV (1987) showed that Gujarati populations are significant population divergence with, American white, Negro, Yukon Eskimo, and Aleutian's population. Aleutians are comparatively closer to the Gujarati population and Yukon Eskimo differed the most [5].

Conclusions

In the present study, the population divergences between the two Indian populations were very significant. Above study confirms the usefulness of the infracranial nonmetric traits for population comparison and reveal the side dependency of eight traits and the significant population divergence between the two Indian populations. Further studies on various Indian populations and their comparison with other population of different geographic regions will give us an insight of the further usefulness of the infra cranial nonmetric traits.

References

[1] HOWELLS W. W., *Craniometry and Multivariate Analysis: The Jomon Population of Japan: a study by discriminant analysis of Japanese and Ainu crania*, Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, 1966, 57:1–43.

[2] JANTZ R. L., *The Redbird focus: Cranial evidence in tribal identification*, Plains Anthropologist, 1974, 19:5–13.

[3] FINNEGAN M., *Discrete non-metric variation of the post-cranial skeleton in man*, Am J Phys Anthropol, 1974, 40:135–136.

[4] PENTEADO C. V., DUARTE E., MECIANO FILHO J., STABILLE S. R., *Non-metric traits of the infracranial skeletons*, Anat Anz, 1986, 162(1):47–50.

[5] PAL G. P., ROUTAL R. V., *Infracranial non-metric variation in Gujarati skeleton*, J Anat Soc India, 1987, 36(2):101–106.

[6] DONLON D. A., *The value of infracranial nonmetric variation in studies of modern Homo sapiens: an Australian focus*, Am J Phys Anthropol, 2000, 113(3):349–368.

[7] DEOL M. S., TRUSLOVE G. M., *Genetical studies on the skeleton of the mouse. XX. Maternal physiology and variation in the skeleton of C57BL mice*, J Genetics, 1957, 55:288–312.

[8] TRUSLOVE G. M., *Genetical studies on the skeleton of the mouse. XIII. Variations in the presphenoid*, J Genetics, 1954, 52:589–602.

[9] CAROLINEBERRY A., BERRY R. J., *Epigenetic variation in the human cranium*, J Anat, 1967, 101(Pt 2):361–379.

[10] CHEVERUD J. M., BUIKSTRA J. E., *Quantitative genetics of skeletal nonmetric traits in the Rhesus macaques on Cayo Santiago. II. Phenotypic, genetic and environmental correlations between traits,* Am J Phys Anthropol, 1981, 54(1):51–58.

[11] UBELAKER D. H., *Reconstruction of demographic profiles from ossuary skeletal samples: a case study from the tidewater Potomac*, Smithsonian Contributions to Anthropology, 1974, no. 18.

[12] BERRY A. C., BERRY R. J., Epigenetic polymorphism in the primate skeleton. In: CHIARELLI A. B. (ed), *Comparative Genetics in Monkeys, Apes and Man*, Academic Press, New York, 1971, 13–42.

[13] MCGGRATH J. W., CHEVERUD J. M., BUIKSTRA J. E., *Genetic correlations between sides and heritability of asymmetry for nonmetric traits in Rhesus macaques on Cayo Santiago*, Am J Phys Anthropol, 1984, 64:401–411.

[14] FINNEGAN M., *Nonmetric variation of the infracranial skeleton*, J Anat, 1978, 125(Pt 1):23–37.

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