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Anthropometric Variation and Population Structure of The Nicobarese Islanders

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INTRODUCTION

Andaman and Nicobar Islands (A & N Islands) lie between the Bay of Bengal to the West and the Andaman Sea to the East form a long archipelago parallel to the coastline of Thailand and Myanmar. Claudius Ptolemaeus (2nd century) first mapped A & N Islands, possibly the earliest reference to these islands. Since then many travellers (Fahien – 6th century; Marcopolo – 13th century and Nicolo Conti – 15th century) visited A & N Islands enroute to Burma/China/Malaysia and their description about islands topography; geology; climate; natural environment and aborigine culture had drawn attention of several administrators and travellers, subsequently all over the world. Mouat (1863), Portman (1899), Man (1889), and Kloss (1902) have well documented the natural history of islands; aborigines traditional norms; behaviour, language, culture etc. Radcliff-Brown (1948) first trained anthropologist studied the meaning and function of the beliefs; customs; rites and ceremonies of the Andaman Islanders. Palaeo anthropological studies indicate that cultural antiquity of the tribes date back 2000 years (Dutta, 1978) but stratigraphic sequence suggest that archipelago ranges in the age of early Miocene to Pleistocene.

Aborigines in Andaman and Nicobar Islands

The Great Andamanese and Onge are now rehabilitated at Strait Island (1969) and Little Andaman Island (1976). Owing to depopulation, the Great Andamanese now belong to four tribes viz: Jeru; Kora; Cari and Bo (Chakraborty, 1990) with a population of 36 individuals (1996). Similarly, the onge are now affiliated to 24 patrilineage such groups with a (Basu, 1990) population of 98 individuals (1996). Though friendly contacts were established with Jarawa (1974) and Sentinelese (1993) direct communication with them is a major constraint for in-depth bio-anthropological studies. Similarly, the Shompen in Great Nicobar Inland are broadly divided into Coastal and Island Shompen. Here also lack of direct communication with them is a major set back for carrying out anthropological studies.

The Nicobarese, an offshoot of Mongoloid race, (White Head, 1924) living in 12 Nicobar islands are linguistically separated (6 groups) and geographically divided (3 groups). The Car Nicobarese and Nicobarese in Chowra have a common dialect; while people of Teresa and Bompuka have another dialect whereas people of Katchal, Kamorta, Nancowry and Trinket together speak one dialect. Residents of Pulo Milo, Little Nicobar, and Kondul have one dialect while the Coastal Nicobarese living on the west coast of Great Nicobar Island speaks a different dialect. Further, the inhabited islands in Nicobar groups can be divided into northern group comprises Car Nicobar, the Central group comprises Chowra, Teressa, Bompuka, Kamorta, Trinkat, Katchal and Nancowry and the Southern group comprises Pulo Milo, Little Nicobar, Kondul and Great Nicobar. Several changes took place in their way of life from AD 1059. The Nicobarese population increased from 11,902 in 1951 to 24,686 in 1991 at an annual growth rate of 2.03% during 1951-1991 according to Barclay method (1958). The literacy rate among Nicobaese is 32% (1991). Many Nicobasrese are now working as nurses; auxiliary nurse-cum-midwife (ANM); technicians; civil and electrical engineers; teachers; administrators; presbyters and as employees in public and private sector in the Union Territory of Andaman and Nicobar islands (Prasad, 1998).

Earlier physical anthropological studies claim that the Nicobarese are heterogeneous. Ethno-history of Nicobarese population reveals that the Central and Southern Nicobar Islands are not totally isolated as presumed by many. Inter-island trade was in vogue till 19th century. Even though linguistic and territorial differences prevail among them, matrimonial alliances between islanders were reported. The Nicobarese are homogeneous according to ethno history. However studies based on morphological and

blood group data have produced conflicting results and population to which the Nicobarese are most similar remains unresolved. Keeping this in view, the present study is undertaken on Nicobarese to record phenotypic and underlying genetic anthropometric variation.

MATERIALS AND METHODS

The Anthropometric data comprises a total of 26 anthropometric measurements comprising 12 measurements on head and face; 14 measurements on body for 407 adult males aged 18 to 70 years at the time of measurement following sugges-tions of Singh and Bhasin (1989). Twelve measurements on head and face are – Head length (HL); Head breadth (HB); Minimum frontal diameter (MFD); Breadth of bizygomatic arch (BBH); Bioginal breadth (BgB); Physiognomic facial height (PFH); Physiognamic upper facial height (Pu FH); Morphological facial height (MFH); Morphological Upper/ Superior facial height (Mu FH); Nasal height (NH); Nasal breadth (NB) and Head Circumference (HC). Fourteen measurements on body include – Stature (HV); Sitting height vertex (SHV); Biacromial breadth (BAB); Bicrystal breadth (BIB); Total arm length (TAL); Hand length (HNL); Hand breadth (HNB); Foot length (FL); Foot breadth (FB); Transverse chest (TVC); Chest circumference (CC); Mid upper arm circumference (MAC); Calf circumference (CFC) and Body weight (BW). The data were collected from January 1993 to February 1995 from 20 villages/settlements which broadly come under 8 Nicobar islands (Bompuka little Andaman; Chowra; Teressa; Bompuka Nancowry; Kamorta; Pulomilo and Great Nicobar). Anthropometric data analysis was performed on computer using SPSS software (8.0). Variance analysis carried out separately for measurements on body; measurements on head and face for total individuals (407). Biological similarity within and among six Nicobarese populations was assessed by R-matrix method.

An R matrix provides estimates of genetic similarity within and among populations relative to the contemporary means of allele frequencies in a region. The weighted means of all elements of an R matrix is zero. Positive elements of the R matrix indicate populations that are more closely related than average and negative elements indicate populations that are less closely related than average. When computed from phenotypic data, the diagonal of the matrix contains the minimum estimates of the true R matrix derived under the assumption of heritabilities equal to 1. To estimate the minimum degrees of genetic divergence in Nicobarese population using anthropometric data, the minimum F_{ST} was derived following the analytical frame work of Williams – Blangero and Blangero (1989). They have shown that assuming addictive genetic model for quantative traits, minimum F_{ST} based on phenotypic data is less than or equal to the genetic F_{ST}. The mini-mum F_{ST} was calculated according to

RESULTS

Anthropometric measurements exhibited remarkable heterogeneity among Nicobarese populations. Eleven measurements on body (78.27%) and 9 measurements on head and face (75%) have shown heterogeneity as evident from F ratios (Table 1a, Table 1b). F ratio are statistically significant for body, head and face measurement except foot length (FL) hand breadth (HB); mid upper arm circumference (MAC); physiognomic facial height (PFH); Morphological upper facial height (Mu FB) and minimum frontal breadth (MFB). A close observation of individual measurements reveals that stature, bodybuild, head shape and size have shown remarkable variation among Nicobarese populations. For instance, individuals with tall stature are found to be high among Pulomilo and Coastal Nicobarese. Nearly 60% of Nicobarese in Chowra Island fall under 'Short' stature. Majority of Carnicobarese (47%) and Nancowry Nicobarese (67%) fall under medium stature. Distribution of body build reveals that Chowra and Teressa Nicobarese exhibit 'very strong' bodybuild; Carnicobarese as 'good' in bodybuild and Pulomilo Nicobarese as 'strong' in body build. With regard to head and face measurements, majority of Chowra (60%); Teressa (50%) and Pulo Milo Nicobarese (48%) belong to the category of long heads while coastal Nicobarese (40%) belong to 'medium' category and Carnicobarese to long and very long category (47% each). The Carnicobarese are mainly dolichocephalic (55%); while Chowra and Teressa belong to mesocephalic category, Coastal (75%) Nancowry (63%) and Pulomilo Nicobarese belong to hyper brachy cephalic category

$$\text{Min } F_{ST} = [\ 1/2t \sum_{i=1}^{9} W_i C_{p(ii)}] [1+1/2t \sum_{i=1}^{9} C_{p(ii)}]^{-1}$$

Table 1a: F ratio for measurements on body among Nicobarese populations

S. No.	*Measurement*	*F – ratio (d.f : 5:401)*
1	Stature (S.T)	6.248
2	Sitting height vertex (SHV)	4.900
3	Biacromial breadth (BAB)	24.038
4	Biiliac breadth (Bib)	5.474
5	Transverse chest (TC)	10.420
6	Total arm length (TAL)	3.914
7	Foot length (FL)	3.027 *
8	Foot breadth (FB)	32.538
9	Hand length (HNL)	9.367
10	Hand breadth (HNB)	0.924 *
11	Chest circumference (CC)	3.691
12	Calf circumference (CFC)	4.655
13	Mid Upper arm circumference (MAC)	3.140 *
14	Body weight (BW)	4.584

Table 1b: F-Ratio for measurements on head and face among Nicobarese populations

S. No.	*Measurement*	*F – ratio (d.f : 5:401)*
1	Head length (HL)	4.094
2	Head breadth (HB)	69.956
3	Head circumference(HC)	4.207
4	Breadth of bizygomatic arch (BBH)	9.125
5	Bigonial breadth (Bg B)	7.452
6	Physiognamic facial height (PFH)	3.111 *
7	Physiognamic upper facial height (Pu FH)	5.520
8	Morphological facial height	19.182
9	Morphological upper facial height (MFB)	0.620 *
10	Nasal height (NH)	5.061
11	Nasal breadth (NB)	8.759
12	Minimal frontal breadth (MFB)	2.415 *

*ns = not significant at 0.01 level

(Prasad, 1998). All these measurements have strong genetic components of variation therefore cause remarkable heterogeneity among Nicobarese populations. Besides several least heritable traits also show 'group heterogeneity' which are partly responsible to the effect of nutrition and physical activity (Smolej-Narancic et al., 1994).

To explore homogeneity among Nicobarese populations, we applied R-matrix separately for head and face; body; head, face and body measurements together.

R-matrix derived from body measurements are shown in Table 2 (a). In this matrix, the largest negative value is observed between CARNIC and COSNIC (-0.050806) and the lowest value is observed between CARNIC and CHWNIC (-0.025096), suggesting below average affinity between them. The positive R-matrix values indicate that populations are closely related than average that means the Nicobarese living in Central and Southern Nicobar Islands are closely related than average and are separated from Car Nicobarese. The principal diagonal of the R-matrix (r_{ii}) indicates the degree of isolation characteristic of a particular subgroup. The CHWNIC; TERNIC; NACNIC and PUMNIC with closer r_{ii} estimates are nearer to each other and are differentiated from CARNIC and COSNIC. This is clearly reflected in eigenvector plots of R matrix constructed using the first two principal eigenvectors (Fig. 1). In R-matrix derived from head and face measurements (Table 2 (b), the largest negative value is observed between CARNIC and COSNIC (-0.127254) and the lowest value is observed between CARNIC and CHWNIC (-0.016910), suggesting below-average affinity between them. The positive R matrix values indicate that Nicobarese populations in Central and Southern Nicobarese together are separated from Car Nicobarese. The principal diagonal of the R matrix (r_{ii}) indicates that CHWNIC; TERNIC; NACNIC and PUMNIC with close r_{ii} estimates are nearer to each other and are differentiated from CARNIC and COSNIC and the same is reflected in eigen vector plots of the R-matrix constructed using the first two principal eigenvectors. (Fig. 2)

R-matrix derived from 26 anthropometric measurements (Table 2c) revealed below-average affinity between CARNIC-COSNIC pair and CARNIC-CHWNIC pair. Here also, the Nicobarese living in Central and Southern Nicobar Islands are closely related than average and are separated from the Car Nicobarese. The same phenomenon was observed if head and face measurements are separated from body measurements. The eigenvector plots (Fig.3) of R matrix showed that Nicobarese in Central Nicobar islands i.e. CHWNIC: TERNIC: NACNIC and PUMNIC remain nearer to each other and are distinguished from Carnicobarese CARNIC and COSNIC. The observed F_{ST} is (0.076014+ 0.004143) suggest greater impact of genetic drift in the Nicobarese populations as a result of small population size.

Measurement on head and face and body revealed that Nicobarese in central and southern

Table 2 (a): R matrix derived from measurements on body for six Nicobarese populations

	Carnic	*Chwnic*	*Ternic*	*Nacnic*	*Pumnic*	*Cosnic*
CARNIC	0.022633*					
CHWNIC	-0.025096	0.109060*				
TERNIC	-0.035730	0.076100	0.099104*			
NACNIC	-0.043502	0.018644	0.052062	0.095725*		
PUMNIC	-0.049171	0.058431	0.065404	0.088492	0.162172*	
COSNIC	-0.050806	0.032702	0.012868	0.109722	0.159276	0.267306

Table 2(b): R matrix from head and face measurements for six Nicobarese populations

	Carnic	*Chwnic*	*Ternic*	*Nacnic*	*Pumnic*	*Cosnic*
CARNIC	0.047530*					
CHWNIC	-0.016910	0.037462*				
TERNIC	-0.043712	0.026770	0.109724*			
NACNIC	-0.109506	0.027247	0.078729	0.261702*		
PUMNIC	-0.093595	0.031134	0.073809	0.218050	0.205974*	
COSNIC	-0.127254	0.060214	0.088360	0.296155	0.247282	0.389107*

Table 2(c): R matrix derived from 26 anthropometric measurements (head, face and body together) for six Nicobarese populations.

	Carnic	*Chwnic*	*Ternic*	*Nacnic*	*Pumnic*	*Cosnic*
CARNIC	0.033603*					
CHWNIC	-0.023763	0.074793*				
TERNIC	-0.038563	0.054797	0.108979*			
NACNIC	-0.072879	0.030966	0.060890	0.169611*		
PUMNIC	-0.066353	0.040974	0.068120	0.141312	0.182167*	
COSNIC	-0.079197	0.037499	0.033123	0.188253	0.174283	0.302937*

CARNIC = Carnicobarese; CHWNIC = Nicobarese in Chowra Island; TERNIC = Nicobarese in Teressa Island; NACNIC = Nicobarese in Nancowry Island; PUMNIC = Nicobarese in Pulomilo Island; COSNIC = Nicobarese on West coast in Great Nicobar island.

Nicobar Islands are closely related than average and remain nearer to each other which infer that the Nicobarese in general are homogeneous.

DISCUSSION

Recent advances in human quantitative methodologies have resulted in a more explicit approach to genetic structure based on anthropometric traits. This approach has been applied in studies of the island of Pag, Croatia by Smolej-Narancic et al. (1994). They have used both variance and discriminant analysis separately to head and body variables in the population of the island of Pag, Croatia and observed a marked heterogeneity in Eastern, Western, and Northern region of the island (Smolej-Narancic et al., 1994). In the present study, the Nicobarese have shown heterogeneity and phenotypic variation in quantitative traits among themselves as has been evident from F- ratio, while R-matrix revealed that the Nicobarese in Central and Southern Nicobar Islands and Pulo Milo Nicobarese are homogeneous and share a common gene pool. The observed morphological heterogeneity in anthropometric traits such as longitudinal body dimensions may presumably be due to strong genetic components of variation and among the least heritable traits such as body build and circumference on head are responsive to the effects of nutrition and physical activity.

Geographically, the Chowra; Teressa; Nancowry and Pulomilo islands are situated within a radius of approximately 100 km and trade relationship existed within the Nicobarese in Central and Southern islands even before the British colonised Andaman & Nicobar Islands (1869). Admixture rate infer gene flow between islanders and according to Lasker method (1952). It varies from 0.05% in Chowra Island to 4.75% in Teressa Island. The Nicobarese stress on independent folk it varies 0.05% in Chowra Island to 4.75% in Teressa Island. Man (1889), Kloss (1902) White Head (1924) Shyam Chaudhuri (1979) and Justin (1990) described folklores of Nicobarese. Further, the inhabitants at Pulo Milo, Little Nicobar, Kondul and Great Nicobar islands were migrated from Nancowry Island to extreme south or vice-versa, while Kamorta Island was peopled by Chowra.

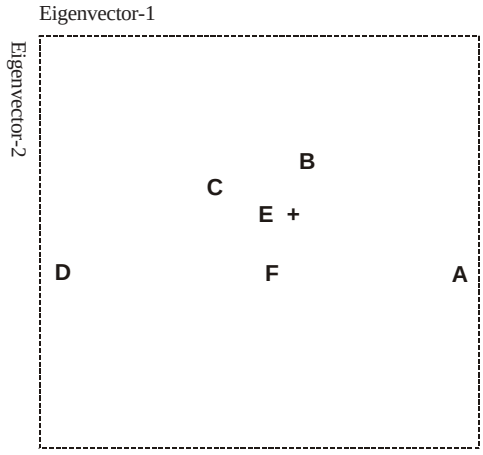

Fig. 1: Eigenvector plot for the Nicobarese

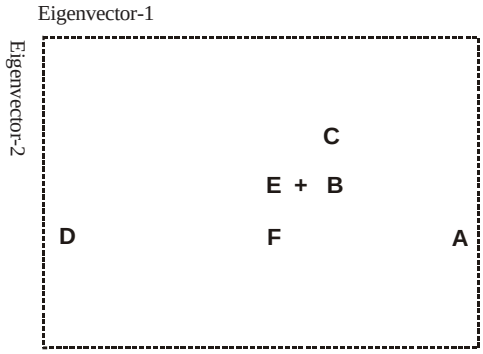

Fig. 2: Eigenvector plot for the Nicobarese

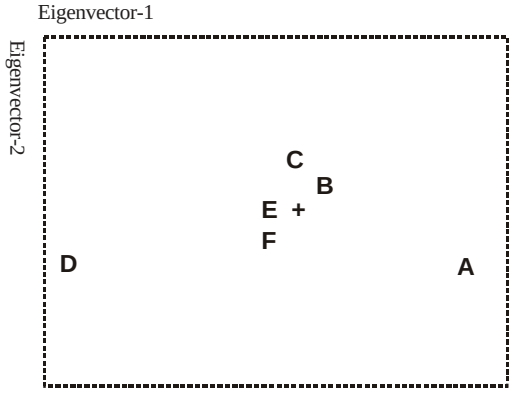

Fig. 3: Eigenvector plot for the Nicobarese

Population	Symbol
Carnic	A
Chwnic	B
Ternic	C
Nacnic	D
Pumnic	E
Cosnic	F

The anthropometric data revealed that the Nicobarese living in Central and Southern Nicobar islands share a common gene pool and to a lesser extent the Car Nicobarese. Thus, it may be concluded that the Nicobarese are 'homogeneous'.

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KEYWORDS Nicobarese. Anthropometry. R Matrix.

ABSTRACT The close resemblance of geographically and linguistically separated Niocobarese within Nicobar Islands had drawn attention of cultural anthropologists, physical anthropologists and linguistics. Studies conducted so far revealed that the Nicobarese are heterogeneous and the differences are mainly due to geographical isolation of Nicobar Islands and bio-type. The R-matrix which estimate the minimum degree of genetic divergence shows that the Nicobarese are homogeneous and this view corroborate oral tradition of Nicobarese.

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