POPULATION GENETICS OF THE MISHMIS OF ARUNACHAL PRADESH (ABSTRACT)

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The main aim of the physical anthropology is to understand the process of human evolution and the nature and extent of human variations at both micro and macro-levels. Till the middle of the 20th century, the physical anthropologists were mostly engaged in the taxonomic researches. Since the middle of the 20th century, along with the advent of the science of genetics, the physical anthropologists have diverted their attention to understand the genetic basis of human variations and the processes of microevolution (Washburn, 1953; Laughlin, 1960). In doing so, physical anthropologist have used genetic markers, dermatoglyphic and anthropometric data with a view to understand the phylogenetic position of human populations. The differences and similarities between populations with a major racial group in respect of genetic and anthropometric traits are considered the ongoing process of evolution. On the other hand, the ongoing process of human evolution is subject to a number of evolutionary forces like mutation, natural selection, genetic drift and gene flow, which act differently in different populations. Understanding of the operation of these evolutionary forces in human populations is of great importance to the evolutionists, biologists and physical anthropologists. Thus, a large number of studies have been carried out in the evolutionary mechanism operating in different human populations. In such studies, different demographic, morphological and genetics traits have been used extensively by many scholars (Crawford, 1973; Harrison, 1977).

With this end in view we have undertaken a study on population genetics among the Mishmis of Arunachal Pradesh with the following objectives:

1. To describe the demographic structure of the Mishmi population taking into consideration all the three Mishmi groups, namely, the Idus (Chulikata Mishmi), the Taraons (Digaru Mishmi) and the Kamans (Miju Mishmi).

2. To describe the genetic composition and morphological characteristics of each of the subgroups.
3. To find out how evolutionary forces like selection, drift are operating in all the subgroups of the Mishmi population.
4. To assess the phylogenetic position of the Mishmi in relation to other neighbouring populations of Northeastern region of India.

MATERIALS AND METHODS

Study area and population

The data for the present study were collected from the three subgroups of the Mishmi population, namely, the Idu Mishmi of the Lower Dibang Valley district, the Digaru Mishmi and the Miju Mishmi of the Lohit district of Arunachal Pradesh. Simple random sampling technique was applied for selection of the villages for conducting fieldwork for the present study. Villages comprising more than 500 Mishmi individuals representing each subgroup are listed accordingly. According to this sampling method, a list of 10 Idu Mishmi villages were first prepared based on the information collected from the Statistical Handbook of the Lower Dibang Valley district. The data for the Idu Mishmi was collected from the Mayo village (10% of the listed villages), which had 562 Idu Individuals. The data for the Digaru Mishmi and the Miju Mishmi were collected from Tafragam (14% approx. of the listed villages) and Danglat (14% approx of the listed villages). By lottery method one village for each subgroup was drawn for the present study. No random sampling was applied for selection of subjects/informants from each of the selected villages due to operational difficulties in the field.

The Mishmi is a schedule tribe of Arunachal Pradesh which is divided into three endogamous subgroups viz. Idu Mishmi, also known as Chulikata; Digaru Mishmi, locally

known as Taraon; and the Miju Mishmi known as Kaman. The Idus inhabit the Dibang Valley district. The Digarus and the Miju are settled in Lohit district of Arunachal Pradesh.

All the three Mishmi dialects have an affinity to each other in spite of their dialectical variations (Grewal, 1997). These dialects belong to tibeto-burman family of speeches. The Mishmi are dived into clans and larger clans are again subdivided into sub-clans. The Mishmis follows clan exogamy. Traditionally, Mishmis believe in animism. The main economic resources of the Mishmi are land, forest and water. They are primarily farmers and practice jhum, terrace and wet form of cultivation. Monogamy is the norm of marriage. It is, however, permissible for a man to marry more than one woman if he can afford it.

According to J. P. Mills (1952), the Chulikata Mishmi (Idu), was the first to come from Burma. They were followed by the ancestors of the Digaru Mishmi, a little over 500 years ago and have lived as close neighbours of the Chulikata for a long time. The Miju, who came last, seem to stand a little apart.

In the present study we have collected data on demography, anthropometry, four genetic marker viz. ABO and Rh blood groups, PTC (Phenylthiocarmamide) taste blindness and colour blindness, dermatoglyphics and morphological and behavioral traits on these three Mishmi populations. The demographic data was collected through in depth interview with each of the married woman or head of the household using the fertility schedules as suggested by WHO (1964, 1968). For anthropometric data the methods and techniques of taking measurements as suggested by the International Biological Programme (IBP) given by Weiner and Lourie (1981) were followed. Standard techniques as suggested by Lowler and Lowler (1959 and Bhatia (1979) were followed for the serological data. Data on colour blindness was followed by using Ishihara chart (1962). The serial dilution method suggested by Harris and Kalmus (1949), was followed to collect data on PTC taste sensitivity. Ink printing method as suggested by Cummins and Midlo

(1961) was followed to collect digital and palmar prints. Morphological data was collected following the method given by Minami (1952).

Findings of the present study

Demographic Characteristics

1. The sex ratio among the Digaru, Miju and Idu Mishmi are 1:1.04, 1:1.08, and 1:1.10 respectively. It shows that in all these three Mishmi subgroups, the number of females is higher than that of males
2. It is seen that in the Digaru Mishmi, nearly 19.51 % of males and 17.07 % of females belong to the age group 0-14 years; nearly 23.96 % and 28.98 % is males and females, belonging to the reproductive age group 15-49years. In the post- reproductive age groups i.e., 50+ years, 5.59 % and 4.88% are males and females respectively.

   In the Miju Mishmi, nearly 17.89 % of males and 17.89 % of females belong to the age group 0-14 years; nearly 24.19 % and 29.13 % is males and females, belonging to the reproductive age group 15-49years. In the post- reproductive age groups i.e., 50+ years, 5.96 % and 4.94% are males and females respectively.

   In the Idu Mishmi, nearly 19.39 % of males and 18.50 % of females belong to the age group 0-14 years; nearly 24.20 % and 30.43 % is males and females belonging to the reproductive age group ie. 15-49years. In the post-reproductive age groups i.e., 50+ years, 3.91 % and 3.56 % are males and females respectively.
3. The population pyramids show the distribution of the three Mishmi populations by age groups. In all the Mishmi populations, the base is broader and shrunk as we move to higher age groups. So, according to the Sundberg's classification of population, all the Mishmi subgroups are of Progressive type.

4. The mean age at marriage for males and females in Digaru Mishmi is 25.84±0.25years and 20.73±0.25years; in Miju Mishmi, 25.56±0.48years and 19.86±0.26years; and in Idu Mishmi, 25.56±0.45years and 20.07±0.23years.

5. The mean age at first child birth in case of male and female Digaru Mishmi is found to be 26.87±0.33years and 21.40±0.22years; in the Miju Mishmi, 27.86±0.40years and 22.09±0.17years; and in the Idu Mishmi, 27.88±0.37years and 22.17±0.15years respectively. So, the mean age at first child birth, taking both males and females together, is 24 years in Digaru, 25years in Miju and 25years in Idu Mishmi respectively.

6. Following the method, suggested by Glass (1956), we have taken 24years as a generation length for the Digaru Mishmi and 25 years for both the Miju and the Idu Mishmi.

7. In Digaru Mishmi not a single case of multiple marriage was found in the first generation i.e., up to 24years of age in both the sexes. In the second generation i.e., 25-48 years, 6.52% of males and 5.09% of females have changed their mates. In the third generation i.e., 48+years, 31.58% of males and 11.43% of females have married more than once. In Miju Mishmi also not a single case of multiple marriages is found in the first generation i.e., up to 25years. In the second generation i.e., 26-50 years, 11.56% of males and 6.52% of females; and in the third generation i.e., 50+years, 26.32% of males and 6.67% of females have married more than once. Not a single case of multiple marriage is found in the first generation of the Idu Mishmi. In the second generation, 4.17% of males only and in the third generation, 12.50% of males and 5.00% 0f females have married more than once. So, it shows that in all the Mishmi subgroups, males have greater tendency to change their mates than their female counterparts.

8. Completed fertility size among the Digaru Mishmi is 6.12, Miju Mishmi is 6.48 and the Idu Mishmi is 4.86. The average number of surviving offspring per mother, aged 45+years, for the Digaru, Miju and the Idu Mishmi are 4.19, 4.13 and 4.03 respectively.

9. The child-woman ratio is found to be highest in the Digaru Mishmi i.e., 43.07, followed by the Idu Mishmi having 37.43. The Miju Mishmi has lowest child-women ratio, i.e. 27.49.
10. The average live-birth per mother among the Digaru, Miju and the Idu Mishmi are 4.01, 4.64 and 3.86 respectively.
11. Figure 7 shows that the age specific fertility rate by age class among the Digaru, Miju and Idu Mishmi women. It is seen that the age-specific fertility rate of the Digaru Mishmi women increases from the mothers aged 15-19years to 20-24years. The age- specific fertility rate in this period increases from 0.2623 to 1.1136 and thereafter it steeply decreases from 1.1046 in age group 25-29years to 0.1277 in age group 45+years. The total fertility rate (T.F.R.) in this population is found to be 4.4508, which seems to be moderate. Table 7 shows that the age-specific fertility rate of the Miju Mishmi women increases from the mothers, aged 15-19years, to aged 25-29years with the increase of fertility rate in this period from 0.0385 to 1.6148, and thereafter it steeply decreases from 1.1456 in age group 30-34years to 0.1667 in age group 45+years. However, the total fertility rate (T.F.R.) in this population is found to be 4.0205. Figure7 shows that the age-specific fertility rate of the Idu Mishmi women increases from the mothers, aged 15-49 years to 25-49years, from 0.0250 to 1.2523 and thereafter it steeply decreases from 0.9286 in age group 30-34years to 0.0000 in age group 45+years. However, the total fertility rate (T.F.R.) in this population is found to be 3.9423.
12. The overall mortality rate among the Digaru, Miju and the Idu Mishmi are 22.77%, 23.37%, and 10.80% respectively.
13. The overall child mortality rate (i.e., those died before 15years of age) among the Digaru Mishmi is found to be 21.12%, where, 10.56% died before completing one year of age, 5.12% died between 1 and 4 years, 3.30% died between 5 and 9 years and 2.14% died between 10 and 14 years.

The overall child mortality rate among the Miju Mishmi is 21.74 %, where, 13.22% died before completing one year of age, 6.16% died between 1 and 4 years, 1.09% died between 5 and 9 years and 1.27% died between 10 and 14 years.

The overall child mortality rate among the Idu Mishmi is 8.29%, where, 6.28% died before completing one year, 0.50% died between 1 and 4 years, 0.50% died between 5 and 9 years and 1% died between 10 and 14 years.

Probably this is the reason for shrinking of the base of the pyramid for all the Mishmi subgroups.

14. Among all the three Mishmi populations, the breeding size, effective population size, coefficient of breeding isolation and variance due to drift have been calculated on the basis of all these demographic information.

15a. It is seen that out of the total population of 697 individuals, only 267 i.e., 38.31%, actually constitute the breeding size among the Digaru Mishmi. In Miju Mishmi and the Idu Mishmi these are 36.16% and 33.27% respectively.

15b.The effective population size among the Digaru Mishmi is 214. It means that 30.70% of the total population size and 80.15% of the breeding size constitute the effective population size. The effective population size among the Miju Mishmi is 111, which mean that 18.91% of the total population size and 52.36% of the breeding size constitute the effective population size. The effective population size among the Idu Mishmi is 161. It means 28.65% of the total population and 86.10% of the breeding size constitute the effective population size.

15c.According to the formula given by Wright (1940), the variance due to random genetic drift in a population per generation, in absence of migration, selection and mutation, has been calculated among the Digaru, Miju and the Idu Mishmi. It is found that among the Digaru Mishmi, the variance due to random genetic drift per generation is 0.001168 with an *initial* gene frequency of 0.5 .In Miju Mishmi it is 0.001126 with an initial gene frequency of 0.5

and among the Idu Mishmi, the variance due to random genetic drift per generation is 0.000776 with an initial gene frequency of 0.5.

16. One of the most powerful evolutionary forces is selection, which brings about changes in the genetic make up of the population. The total selection intensity among all the three Mishmi populations has been estimated by using the Crow's (1958) formula and also by the modified formula of Johnston and Kensinger (1971).

17a. According to Crow's formula, among the Digaru Mishmi, the total selection intensity (I) is 0.3479 and its fertility component (I_f) and mortality component ($I_{m)}$ are 0.0902 and 0.3472 respectively, among the Miju Mishmi, the total selection intensity (I) is 0.4516 and its fertility component (I_f) and mortality component (I_m) are 0.1613 and 0.4090 respectively. In the Idu Mishmi, the total selection intensity (I) is 0.2067 and its fertility component (I_f) and mortality component (I_m) are 0.1003 and 0.1191 respectively.

17b. According to Johnston and Kensinger's modified formula, the total selection intensity (I) for the Digaru, Miju and the Idu Mishmi are 0.4252, 0.4950 and 0.2535, and the embryonic components (I_{me}) are 0.1162, 0.0652 and 0.0553 respectively.

Anthropometry

1. Altogether 13 anthropometric measurements have been taken on the adult Mishmi males as well as females, aged between 20 years and 60 years. The detail results of all these measurements and the indices have been given in the respective tables. On the basis of these anthropometric measurements it is found that the Digaru Mishmi males are short statured, dolichocephals, platyrrhine with broad chest and very broad face. The females show similarity to the males but are of below medium stature. The Miju Mishmi males are short statured, mesocephals, platyrrhine with medium chest and very broad face. The females are below medium statured, mesocephals, mesorrhine with broad chest and very broad face. Both

the sexes of the Idu Mishmi are short statured, mesocephals, platyrrhine with very broad face. Idu females posses broad chest whereas the males have medium.

2. On the basis of anthropometric measurements the distance among the populations have been calculated, following the method given by Nei *et al.* (1983). The dendrogram shows that in respect of Anthropometric characters, the Miju Mishmi remains quite apart from remaining populations compared. However, Miju Mishmi shows closeness with the Dirang Monpa and Tawang Monpa. In respect of these anthropometric traits, Digaru Mishmi also stands apart from rest of the Mongoloid populations compared except the Kalaktang Monpa, Khampti, Gallong, Miju Mishmi, Dirang Monpa and Tawang Monpa. The dendrogram further shows that the Idu males are closer to the Tangsa.

Genetic markers

In the present study we have used four genetic markers viz. ABO and Rh blood groups, PTC taste blindness and colour blindness.

1. It is seen that among the Digaru Mishmi, the frequencies of A, B, AB and O blood groups are 31.28%, 13.27%, 2.37% and 53.08% respectively. The gene frequency of p, q and r are 0.1858, 0.0817 and 0.7325 respectively. Among the Miju Mishmi, the frequency of A, B, AB and O blood groups are 27.18%, 20.87%, 5.83% and 46.12% respectively. The gene frequency of p, q and r are 0.1813, 0.1435 and 0.6752 respectively. Among the Idu Mishmi the frequencies of A, B, AB and O blood groups are 25.25%, 23.91%, 1.01% and 49.83% respectively. The gene frequency of p, q and r are 0.1427, 0.1348 and 0.7225 respectively. Both the d/σ and χ^2 values indicate that these populations are not in genetic equilibrium.
2. The frequencies of Rh^+ and Rh^- individuals among the Digaru Mishmi are 99.53% and 0.47%, and the D and d genes are 0.932 and 0.068 respectively. The frequencies of Rh^+ and Rh^- individuals among the Miju Mishmi are 94.66% and 5.34%, and the D and d genes are 0.769

and 0.231 respectively. Among the Idu Mishmi the frequency of Rh^+ and Rh^- individuals are 96.30% and 3.70% and the D and d genes are 0.808 and 0.192 respectively. The χ^2value indicates that the population is in equilibrium.

3. The frequency of tasters and non-tasters in the Digaru Mishmi population are found to be 54.50% and 45.50%, and that of T and t genes are 0.325 and 0.675 respectively. The frequency of tasters and non-tasters in the Miju Mishmi are found to be 48.06% and 51.94%, and that of T and t genes are 0.279 and 0.721 respectively. Among the Idu Mishmi, the frequencies of tasters and non-tasters are 61.28% and 38.72%, and the T and t are 0.378 and 0.622 respectively.
4. It is observed that among all the three Mishmi populations, not a single individual is found to be colour blind.
5. On the basis of ABO blood groups, about 28.72%, 38.05% and 35.99% of all matings are found to be incompatible among the Digaru, Miju and the Idu Mishmi respectively.
6. Since the frequency of Rh^- gene is less than 1% in the Digaru Mishmi, the incompatible matings, in respect of Rh system, cannot be of any significance in this population.
7. It may be postulated that selection finds an ample opportunity to play its role through ABO incompatibility.
8. As per suggestions of Glass (1956), the intergeneration differences in respect of both ABO blood groups and PTC taste blindness have been worked out among the Digaru, Miju and Idu Mishmi respectively and no significant difference between generations is noticeable. So, genetic drift in these populations might have occurred more than three generations ago.
9. Inter-population differences have been worked out in respect of ABO blood group, Rh blood group and PTC taste blindness. It is observed that in respect of ABO blood group the inter-population differences, when tested by χ^2, are found to be statistically significant [χ^2

(between all populations) = 20.0843, d. f. = 6, $P<0.05$; χ^2 (between Digaru and Miju) =8.2084, d. f. = 3, $P<0.05$; χ^2 (between Miju and Idu) =10.4721, d. f. =3, $P<0.05$; χ^2 (between Digaru and Idu) =10.4771, d. f. =3, $P<0.05$].

In respect of Rh blood group, inter-population differences are found to be statistically significant (χ^2 =8.2960, d. f. =2, $P<0.05$). Again, when compared between the populations, it found that the differences between Digaru and Miju, and between Digaru and Idu are statistically significant [χ^2 (between Digaru Mishmi and Miju Mishmi) =8.8302, d. f. = 1, $P<0.05$, χ^2 (between Digaru Mishmi and Idu Mishmi) =5.5793, d. f. =1, $P<0.05$, χ^2 (between Miju Mishmi and Idu Mishmi) =0.7785, d. f. =1, $P>0.05$].

In respect of PTC taste blindness, the χ^2 value (χ^2 =8.7191, d. f. =2, $P<0.05$) shows that there is significant difference among the three Mishmi populations. Again, when compared between the two populations, significant difference observed between Miju Mishmi and Idu Mishmi (χ^2 =8.6233, d. f. =1, $P<0.05$).

10. Taking into consideration of the ABO blood group and PTC taste blindness, the three Mishmi subgroups have been compared with 20 other Mongoloid populations of Assam and Arunachal Pradesh. The dendrogram shows that the three Mishmi subgroups i.e., the Idu, Digaru and the Miju Mishmi stand very close to each other. In respect of these genetic markers the Idu Mishmi is also very close to the Chutia and the Ahom who are the neighbouring populations.

Dermatoglyphics

1. Combining both the hands together, it is observed that among the Digaru Mishmi, the frequencies of whorl, loop and arch are 45.71%, 51.15% and 3.14% in males, and 44.58%, 51.21% and 4.21% in females respectively. Among the Miju Mishmi, the frequencies of

whorl, loop and arch are 51.76%, 46.18% and 2.06% in males, and 47.86%, 47.86% and 4.27% in females respectively. The frequencies of whorl, loop and arch found to be 57.40%, 40.26% and 2.34% in the Idu males, and 49.44%, 46.45% and 4.10% in females respectively.

2. It is seen that there is significant difference, in respect of dermatoglyphic trait, among the three Mishmi populations. When compared between the populations, significant differences between Digaru and Miju as well as Digaru and Idu Mishmi were also observed.
3. Among the Digaru Mishmi, the Furuhata's index, Dankmeijer's index and Pattern intensity index are found to be 89.38, 6.87 and 14.26 in males and 87.04, 9.43 and 14.04 in females respectively. These indices are found to be 112.10, 3.98 and 14.97 in Miju Mishmi males and 100.00, 8.92 and 14.36 in females, whereas, in the Idu Mishmi males, these indices are found to be 142.58, 4.07 and 15.51; and 106.43, 8.29 and 14.53 in females respectively.
4. Combining both the hands together, the frequencies of mainline formulae, 11-9-7, 9-7-5 and 7-5-5 are found to be 16.19%, 32.86% and 2.38% in the Digaru Mishmi, males and 10.75%, 26.64% and 1.40% in females respectively. The frequencies of these formulae are 15.20%, 30.39% and 16.67% in the Miju Mishmi males and 11.65%, 27.67% and 29.61% in females respectively. In the Idu Mishmi, these are found to be 7.79%, 21.43% and 27.27% in males and 7.64%, 17.71% and 32.99% in females respectively.
5. Among the Digaru Mishmi, the axial triradii t appears in highest frequency i.e. 68.10% in males and 50% in females. It is followed by t′, t″, tt′ and tt″. It is seen that tt″ is absent in the males and axial triradii t is missing in 0.47% of females. Among the Miju Mishmi, the axial triradii t appears in highest frequency i.e. 53.45% and 54.85% in both hands of males and females respectively. It is followed by t′, t″, tt′, tt″ and t′t″. It is seen that tt″ is absent in females. Among the Idu Mishmi, the axial triradii t′ is highest in both hands of males (49.68%) and females (68.40%). It is followed by t, t″ and tt′. It is observed that tt′t″ is found only in males (0.65%).

6. The occurrence of ulnar termination of 'c' line is common in both hands of both sexes among all the three Mishmi subgroups.
7. The mean atd angle with its ± s. e. in right and left hands of the Digaru Mishmi males is 44.06±0.43 and 44.25±0.50 and in females 46.60±0.71 and 46.02±0.54 respectively. Among the Miju Mishmi males they are 43.45±0.56 and 43.07±0.50, and in females 44.70±0.45 and 44.99±0.44 respectively. In the Idu Mishmi, the mean atd angle with its ± s. e. in right and left hands of males is 45.28±0.40 and 45.64±0.37 whereas in females they are 46.12±0.38 and 46.98±0.41 respectively.
8. Two dendrograms have been drawn on the basis of finger pattern and pattern intensity index for males and females separately. The dendrogram for male shows that in respect of the above mentioned traits Digaru Mishmi stands closer to Mishing, Khamiyang and Ahom. The Miju Mishmi remains quit apart from the Digaru Mishmi and Idu Mishmi. However, it is seen that Miju Mishmi is closer to the Tangsa and Lalung. The Idu Mishmi males are closer to the Aka and Tawang Monpa. However, the dendrogram constructed on the basis of finger pattern and pattern intensity index shows different relationship among the Mongoloid populations of Assam and Arunachal Pradesh than that of the anthropometric traits and genetic markers.

   The dendrogram for female shows that the Idu Mishmi female is closer to the Nishi; the Miju Mishmi is found to be closer to the Wancho and Khampti, and Digaru Mishmi is closer to the Gallong. Other Mongoloid tribes of Assam and Arunachal Pradesh, however, stand separated in respect of finger pattern and pattern intensity index.

Morphological and Behavioural traits

Arm-folding

1. The frequencies of L>R and R>L in the Digaru Mishmi are 68.25% and 31.75% , in the Miju Mishmi, 68.93% and 31.07% and in the Idu Mishmi , 59.60% and 40.40% respectively.

2. In respect of this morphological trait, significant differences among the three Mishmi subgroups is observed.

Hand-clasping

1. The frequencies of L>R and R>L are found to be 57.82% and 42.18% in the Digaru Mishmi,61.65% and 38.35% in the Miju Mishmi and 61.28% and 38.72% in the Idu Mishmi respectively.
2. In respect of this trait, no significant difference is found among the three Mishmi subgroups.

Tongue-rolling

1. It is observed that 36.97% of all Digaru Mishmi individuals can roll their tongue while 63.03% cannot do so. In Miju Mishmi, 39.32% can roll their tongue while 60.68% cannot and in the Miju Mishmi, 18.18% of all the individuals can roll their tongue while 81.82% cannot do so.
2. In respect of tongue-rolling significant difference, was observed among all the three Mishmi subgroups.

Tongue-folding

1. It is observed that 18.01% of all the Digaru Mishmi individuals can fold their tongue, while 81.99% cannot do so. In the Miju Mishmi, 16.50% of all individuals can fold their tongue while 83.50% cannot and in the Idu Mishmi, 17.51% of can fold their tongue and 82.49% cannot.
2. No significant difference, in respect of tongue-folding was observed among the three Mishmi subgroups.

Relative length of first and second toe

1. In the Digaru Mishmi, the frequencies of I>II (T), II>I (F) and I=II (O) are 42.65%, 30.81% and 26.54% ; in the Miju Mishmi, 34.95%, 42.23% and 22.82% ; and in he Idu Mishmi, they are 48.48%, 27.27% and 24.24% respectively.

2. No significant differences are observed in respect of this morphological trait, among the three Mishmi subgroups.

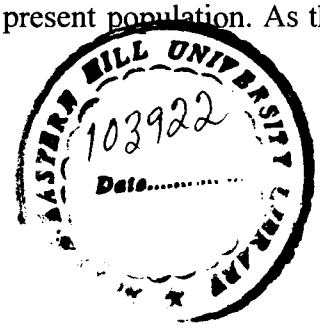
Earlobe attachment

1. In the Digaru Mishmi the frequency of free earlobe is 55.92% and attached is 44.08%, in the Miju Mishmi, 53.40% and 46.60% and in the Idu Mishmi, they are 62.63% and 37.37% respectively. It is further seen that there is no significant differences, in respect of earlobe attachment, among the three Mishmi populations.

CONCLUDING REMARKS

In the present study we have taken demography, anthropometry, four genetic markers viz. ABO, Rh blood groups, PTC (phenylthiocarbamide) taste blindness and colour blindness, dermatoglyphics and morphological traits with a view to understand the genetic composition of the Mishmi subgroups as well as their genetic relationship with other neighbouring mongoloid populations. In view of the present findings on the Mishmis of Arunachal Pradesh, it is necessary to look into three important aspects. The first aspect is related to inter-sub group variation within the Mishmi populations. The second is concerned with the relationship of all the Mishmi subgroups with other neighbouring mongoloid populations, and the third is related to the possible role of evolutionary forces like selection and genetic drift in all the Mishmi subgroups.

In the present study, the Mishmi shows some resemblance to each other than other populations compared. In respect of the genetic markers i.e. ABO and the Rh blood group and PTC taste sensitivity these three subgroups of Mishmi are by and large similar. But, the traits like anthropometry and dermatoglyphics show that they stand quite apart from each other. The reason can be when each of the subgroups of the Mishmi came to the present place, only a section of the population must have migrated which may not have represented the population. The same group survived through the time to form the present population. As the three Mishmi



populations maintained isolation for several generations, in the process of time they must have a separate population culturally, as well as genetically.

REFERENCES

Bhatia, H.M. 1977. *Procedures in blood banking and Immunohaematology.* Bombay: Blood Group Reference Centre.

Crawford, M.H.1973. The use of genetic markers of the blood in the study of evolution of population. In: *Methods and Theories of Anthropological Genetics*, M.H. Crawford and P.L. Workman (Eds), pp. 19-38. Albuquerque: University of New Maxico Press.

Crow, J.F. 1958. Some possibilities for measuring selection intensities in man. *Hum. Biol.* 30:1-13.

Cummins, H. and C. Midlo. 1961. *Finger prints, Palms and Soles: An Introduction to Dermatoglyphics.* New York: Dover Publication Inc.

Glass, B. 1956. On the evidence of random genetic drift in human populations. *Am. J. Phys. Anthrop.* 14: 541-555.

Grewal, D.S. 1997. *Tribes of Arunachal Pradesh: Identity, Culture and language.* New Delhi: South Asia Publication.

Harrison, G.A. 1977. Introduction, structure and function in the biology of human population. In: *Population Structure and Human Variation*, G.A Harrison (Ed), pp. 1-9. Cambridge: Cambridge University Press.

Harris, H. and K. Kalmus. 1949. The measurement of taste sensitivity to PTC. *Ann. Eugen.* (Lond.) 15: 24-31.

Ishihara, S. 1972. *Tests for Colour Blindness.* Tokyo: Kannehara Shuppan Co. Ltd.

Johnston, F.F. and K.M. Kensinger. 1971. Fertility and mortality differentials and their implications for micro-evolutionary change among the Cashinahua. *Hum. Biol.* 43: 356-364.

Laughlin, W.S. 1960. Aspects of current physical anthropology. *South West J. Anthrop.* 16: 75-92.

Lawler, S.D. and L.J. Lawler. 1951. *Human Blood Groups and Inheritance.* London: William Heinemann Ltd.

Mills, J.P. 1952. The Mishmis. *J. Royal Anthrop. Institute.* Vol.82.

Minami, K. 1952. The digital formula in Japanese featus. II – Study on the relative lengths between the first and second toes. *Folia. Ant. Jap.* 24: 295.

Socio-economic Review of Lower Dibang Valley District. 2002. Roing: District Statistical Office, Lower Dibang Valley District.

Washburn, S.L. 1953. The strategy of physical anthropology. In: *Anthropology Today*, A.L. Kroeber (Ed), Chicago: University of Chicago Press.

Weiner, J.S. and J.A. Lourie. 1981. *Practical Human Biology.* London: Academic Press.

World Health Organisation. 1964. *Research in population genetics of primitive groups.* WHO Tech. Rep. Ser. No. 279, Geneva: WHO.

World Health Organisation. 1968. *Research in human population genetics.* WHO Tech. Report Ser. No. 387, Geneva: WHO.

POPULATION GENETICS OF THE MISHMIS OF ARUNACHAL PRADESH

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DECEMBER, 2008

I, Dolly Gogoi, hereby declare that the subject matter of the thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, that the thesis has not been submitted by me for any research degree in any other University/Institute.

This is being submitted to the North-Eastern Hill University for the **Degree of Doctor of Philosophy in Anthropology.**

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CHAPTER - I
INTRODUCTION

Population genetics is neither so new nor so formidable a discipline as is often supposed. Many of its most important theories were worked out in the period between 1908 and 1932, but the findings of those years did not become generally known until much later. The actual studies of natural populations began to appear in the late thirties and new results to unfold from then on.

Population genetics is concerned with gene and genotype frequencies, the factors that tend to keep them constant, and the factors that tend to change them in population. Population genetics is the study of the allele frequency distribution and change under the influence of the four evolutionary forces: natural selection, genetic drift, mutation and gene flow. It also takes account of population subdivision and population structure in space. Thus, according to Vogel and Motulsky (1986), "population genetics deals with the behavior of gene in large groups, and is concerned with the evolutionary forces of drift, migration, mutation, and selection in human populations". The observable variation or similarities in gene frequencies in human populations "are the product of the forces of evolution, acting not one at a time but simultaneously" (Crawford, 1973).

Population genetics is intimately bound up with the study of evolution and natural selection, and is often regarded as the theoretical cornerstone of modern Darwinism. This is because natural selection is one of the most important factors that can affect a population's genetic composition. Natural selection occurs when some variants in a population out-reproduce other variants, as a result of being better adopted to the environment, or fitter. By studying formal models of gene frequency change, population geneticist, therefore, hope to shed light on the evolutionary process and to permit the consequences of different evolutionary hypotheses to be explored in a quantitatively precise way.

Corresponding to evolution, as "process and result", are two principal themes that recur in evolutionary studies. The first is that of phylogenetics inference, which aims to determine the evolutionary history and genetic relatedness among a group of organisms. The second theme of

evolutionary studies is that of mechanism, which is primarily within the purview of population genetics. The domain of population genetics is the genetic composition of natural population, past and present. Research in population genetics is directed towards problems whose resolution is essential for a just appreciation of the evolution process.

The operation of various evolutionary forces mentioned above is undoubtedly responsible for the changes in the genetic composition of a population. The degree of an individual's ability to adapt to his or her environment can be measured in terms of reproductive performances/differential fertility and mortality. "The relative frequencies of homozygotes and heterozygotes for certain growth genes and for gene located in the same chromosomes would be altered; some genetic factors which were previously eliminated because of their harmfulness might become neutral or even favourable after some generations, genetic constitution of the whole species may be change" (Dobzhansky, 1951). "This is the dynamic process that has been occurred in the past, occurs today, and will continue to occur as long as inheritable variation and differing reproductive abilities exist. Under these circumstances, the genetic composition of a population can never remain constant" (Volpe, 1985).

Knowledge of population genetics provides a basis for better understanding of human evolution and prediction of future trends in the biological evolution of mankind in the face of various environmental changes. Since the human population is much better described than any other species and much better records are available, there are many advantages to studying the population genetics of man.

Work in human population genetics may conveniently divides into two broad classes: description of population and their genetic composition and studies designed to understand the causes for changes in the human gene pool.

One aspect is the widespread tendency to prefer marriages within the same subgroups, which in the long run, leads to genetic differences between such subgroups. Measures of

"population distance" have been developed to assess such differences. Populations are influenced by migration of individuals between subpopulations. Migration counteracts the effect of isolation.

In the present study, we shall deal with the population genetics of the Mishmis, which includes both genetic and demographics structures. Harrison and Boyce (1972) define genetic structure as "the way genes are organized into genotypes in human population and the extent which individuals share a common gene pool, which shows the degree of biological relatedness among the members". They define demographic structure as "Patterns of fertility and mortality, emigration and immigration and the effects of these on age and sex composition". The relationship between genetic and demographic structures is very well known and needs no further elaboration.

Population genetical studies are gaining interest in physical anthropology, and studies on racial history are no more at the centre stage. Even the expert groups of the World Health Organization (1964 and 1968) have suggested that population genetical research among the primitive communities of the world should be taken up urgently in the view of fact that the culture of most of such groups is gradually disintegrating due to increasing contact with civilization, and such disintegration will have far reaching biological consequences. The isolated populations in the contemporary world, may reveal many important facts, concerning the mechanisms and processes of human evolution.

With this end in view we have undertaken a study on population genetics among the Mishmis of Arunachal Pradesh with the following objectives:

1. To describe the demographic structure of the Mishmi population taking into consideration all the three Mishmi subgroups, namely, the Idus (Chulikata Mishmi), the Taraons (Digaru Mishmi) and the Kamans (Miju Mishmi).

2. To describe the genetic composition and morphological characteristics of each of the subgroups.
3. To find out how evolutionary forces like selection and drift are operating in all the subgroups of the Mishmi population.
4. To assess the phylogenetic position of the Mishmi in relation to other neighbouring populations of Northeastern region of India.

LAND AND PEOPLE

The land

Arunachal Pradesh is located in the North-eastern part of India. Arunachal is in the trans Himalayan region between the latitude of 26° 28′ N and 29° 33′ N and longitude of 91° 31′E and 97° 30′E with nearly 84,000 Sq. Km. in area and is the largest state area-wise in the North-East. It stretches from the snow-capped mountains in the North to the plains of Brahmaputra valley in the south. Arunachal Pradesh is the home of many tribes and considered to be one of the most splendid variegated and multi-lingual tribal areas of the world. There are about 22 major tribes and 100 sub-tribes speaking over 50 main dialects. These tribal have a glorious heritage of arts and crafts, enchanting folk songs and costumes and the people are simple, friendly, hospitable and cooperative.

Anthropologically, the tribes belong to Indo-Mongoloid racial group. Each tribe can be broadly identified by some distinct physical feature and genetic traits. Most of the tribes are short to below medium in their heights.

The Lohit District is situated on the North eastern extremity of Arunachal Pradesh. It lies approximately between 95°15′ and 97°24′East longitudes and 27°33′ to 29°22′ North latitudes. It is bounded by China and part of Dibang Valley District in the North, Changlang District to the

Figure 1
Map of Arunachal Pradesh

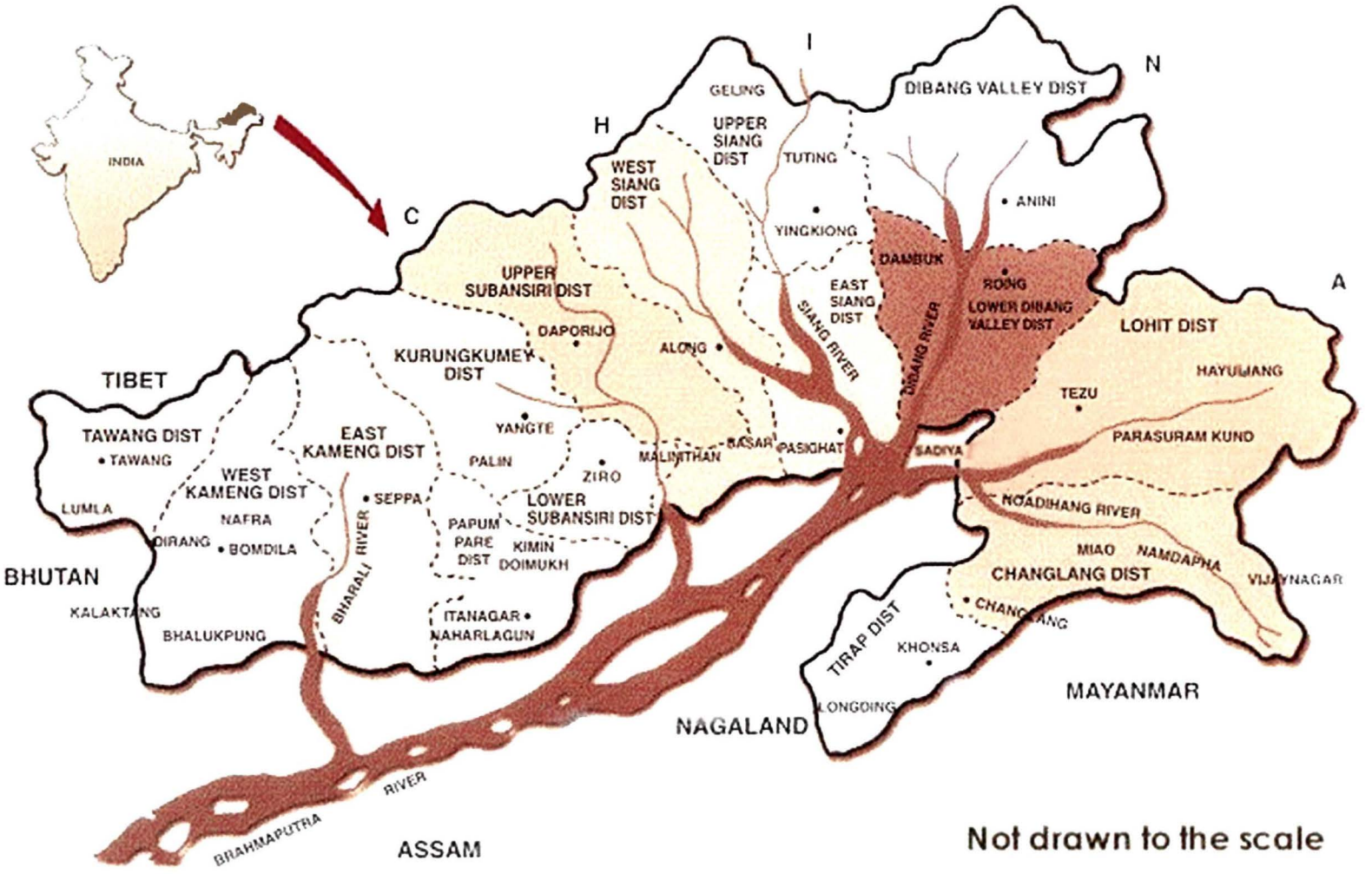
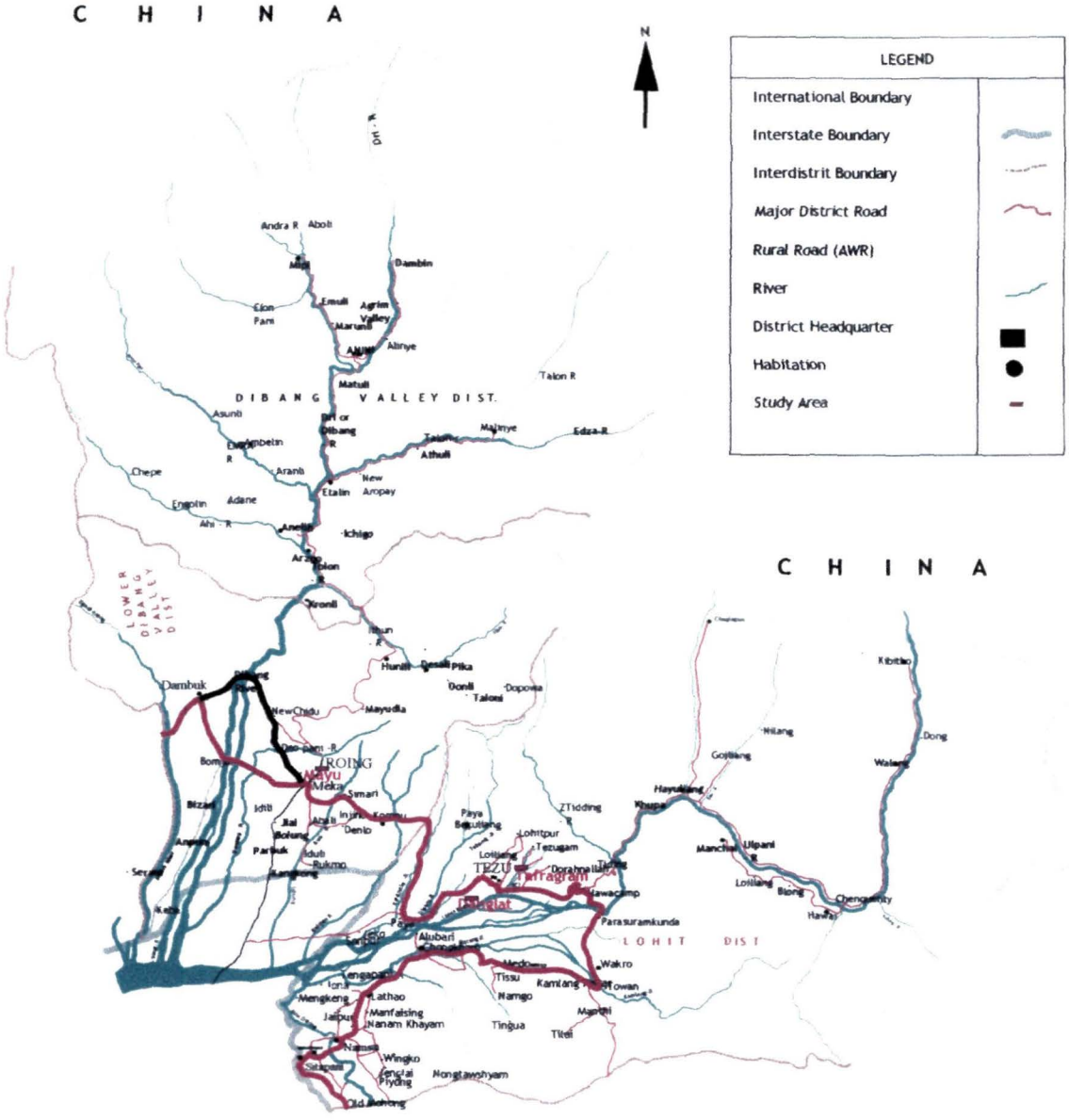


FIGURE- 2
MAP OF LOHIT DISTRICT & DIBANG VALLEY DISTRICT



South, China and Myanmar to the East and Assam State and part of Dibang Valley District to the West. The name of the district is derived from the river Lohit that flows through the district. The district headquarters of the Lohit District is at Tezu (Statistical Handbook of Lohit District.1998).

Lower Dibang valley district is located in the eastern part of Arunachal Pradesh. Its main land extends between latitudes 37°33'N and 24°30'N and the longitudes 95°15'E and 97°30'E. The district is bounded on the north by Dibang Valley District, on the east by Lohit District, on the west by east and Upper Siang District of Arunachal Pradesh and on the south by Assam (Socio-economic review of Lower Dibang Valley District, 2002).

The People

The Mishmis are recognized as a scheduled tribe of Arunachal Pradesh. The Mishmi is divided into three endogamous subgroups viz. Idu Mishmi, also known as Chulikata; Digaru Mishmi, locally known as Taraon; and the Miju Mishmi, known as Kaman. The Idus inhabit the Dibang Valley district. The Digarus are on the bank of the Lohit River from Hayulinang downwards till it reaches the foothills region and in the Dalai valley. The Miju Mishmi occupies the valleys of the upper Lohit, the Kamlang and the Lati. All Mishmi are settled in Dibang valley and Lohit districts of Arunachal Pradesh.

All the three Mishmi dialects have an affinity to each other in spite of their dialectical variations (Grewal, 1997). These dialects belong to Tibeto-Burman family of speeches. The Mishmis are divided into clans and larger clans are again subdivided into subclans. The Mishmi follows clan exogamy. They are patrilineal and practice polygamy. Traditionally, Mishmis believe in animism. According to J. P. Mills (1952), the Chulikata Mishmi (Idu), found in the north and west of the Lohit district, were the first to come from Burma. They were followed by the ancestors of the Digaru Mishmi, a little over 500 years ago in small batches over the passes,

following the courses of Dibang and its tributaries, and have lived as close neighbours of the Chulikata for a long time. The Miju, who came last, preserved the tradition of having migrated from the direction of 'Hakamtilong' or the Kachin country seem to stand a little apart.

The main economic resources of the Mishmi are land, forest and water. They are primarily farmers and practise jhum, terrace and wet forms of cultivation.

The Digaru Mishmis are popularly known as Taraon. They inhabit the area stretching from Hayuliang in the east to the Digaru river in the west. The community is concentrated in the Hayuliang, Tafragam, Changlagam and Goiliang circles of the Lohit districts.

The Miju Mishmi calls themselves as Kaman. Their territory includes the upper Lohit and Deu valleys, the area to the east of Hayuliang, Billong and Tilai valleys and the southern part of the Lohit district. Some of them settled in and around Tezu.

The Idus live in the Dibang Valley District. The area inhabited by the Idus is a vast and formidable mountains terrain extending from the Indo-Tibetan Border on the north to near the confluence of the Lohit and Dibang rivers on the south. They are divided into eight sections, each section named after the river along which they are settled.

Religious beliefs and practices

They believed in numerous spirits having great powers to rule over human beings. According to these beliefs, there are mainly two kinds of spirits, malevolent and benevolent spirit. The Mishmis have therefore, evolved a system of magico-religions rites and practices to dispel the evil spirits by appeasement. The relation of the spirits with the high God is not well defined, but they are thought to be subservient to him. Propitiation of the spirits who dominate the world of man is the most significant aspect of the Mishmi religion and their festivals.

The different groups of the Mishmis have different names for the supreme god. They believe that the supreme god is beyond all human propitiations and, therefore, no sacrifices or

offerings are made to him. But his name is invariably invoked on all sacrificial and ritualistic occasions. The Mishmis have other gods also who control the sun, the moon and stars, the rain, fire and the wind etc. These gods are worshipped and appeased so that they may evade their wrath, which manifests itself in the natural calamities, such as earthquake, fire, epidemics storms, crop failure etc. The extension of their religions belief is expressed in the form of nature worship as well.

The Mishmis celebrate a number of festivals. Tamla-du by Digaru Mishmi, Wanshang and Taka-thung by Miju Mishmi and Reh by Idu Mishmi are the major festivals celebrated within the year.

The clans

The Mishmi society is divided into a number of exogamous clans and the larger clans are again divided into sub-clans. The members of a clans trace their descent from one single ancestor. The society has, however, no clear-cut class distinction, nor it is headed by chiefs. The social life of the Mishmis is considerably influenced by the clan-division. Mills observed that the 'clan are almost invariably named after places, but some clans appear to have derived their names from rivers along which they are settled. Generally, the pattern of village settlement is based on the distribution of the clans, but the tradition of one-clan to one-village system is not always operative. The Idus, for instance are migratory in their habits. With the growth of population, a section of people may migrate to a region where cultivable land is available. Persons from other clans may also join them, and thus form a new village of different clans. Moreover, the exogamous character of the Clans has also helped this conglomeration.

Marriage

Monogamy is the norm of marriage. It is, however, permissible for a man to marry more than one woman if he can afford it. The procedure of marriage negotiations appears to be

common to all Mishmi groups. Usually, when a boy falls in love with a girl, he first obtains a mediator to find out whether a proposal of marriage has any chance of finding favour with her parents. The parents of the girl then consult their relations and the other villagers with the consent of the girl they then proceed to fix the marriage price through the mediator. As soon as the price is definitely fixed, the match is finally arranged. The bride-pride is essential for marriage, and its amount varies according to circumstances. Generally, well-to-do families may claim up to five Mithuns, while poorer families often actually pay only one or two.

The date for taking away the bride is fixed after the marriage price has been paid to the bride's parents. On the appointed day, the bridegroom, along with the mediator and some of his co-villagers proceeds to the bride's village. The parents of the bridegroom generally do not accompany of the party. Presents such as pigs, rice-beer, and three or four loads of dried fish, are taken along with the party for the bride's relations. The bridegroom's party is feasted on their arrival by the bride's people, and there follows a great deal of fun and merry-making.

When a man takes a second wife, she means an additional helpful hand for him. On the death of the husband, a son may inherit any widow who is not his actual mother. In case there is no son, she goes to the brother of the deceased.

A man cannot marry a girl of his own clan, that is, when his father and the girl's father happen to be descendants from a common ancestor in the male line. A man also cannot marry a girl; she is within the 13^{th} degree in the descent from the maternal grandfather in the male line. Such a marriage is considered incestuous, and also thought to have an evil effect on the clans to which the parties belong. Amongst the Idus, cross cousin or parallel cousin marriage is considered immoral and unnatural. It is just as bad as marrying one's own sister.

It is customary for the Mishmis to return the bride price if the wife dies without any issue. The bride-price for a wife is generally paid in *Mithuns* (an animal of the bovine species). The father-in-law returns the bride-price not in the shape of *Mithuns* but articles equal in value, such

as silver ornaments, brass gongs, bear skin bags, utensils and other such things. The return of wealth, as it is called, is paid not at one time but in instalments

It should be noted that normally a Mishmi girl is not married against her will. A marriage is settled with the consent of parents. If a wife dies soon after marriage without any issue, the widower is allowed to marry her younger sister. If she has no such sister one of her cousin sisters is given in marriage to him, for which he is required to pay a nominal bride price. On the other hand, if the husband dies, his younger brother may inherit the widow as his wife. Besides the sororate and levirate form of marriages, there may be other form of marriage practiced by the people, for instance, in the event of father's death, a son may inherit a childless step-mother.

Death

The Idus bury and do not burn their dead. When someone dies, the relatives are informed as soon as possible, and the body is usually kept in the house for two to three days, till all the relatives living at a distance have arrived to join the mourning. Usually, the relatives bring some gifts to the offered in the name of the deceased.

The burial takes place in the afternoon. The priest first touches the body, and then asks the relatives to take it out of the house.

Dress and Ornaments

The dress and ornaments of each of the Mishmi tribe are unique in themselves, and they distinguish them from one another.

The Mishmi dress is remarkable for 'the wealth and beauty of its weaving designs. They make most of it themselves, partly from wood, partly from cotton and sometimes of nettle fibre.' The male dress consists of a sleeveless coat of black or maroon colour with ornamental borders and a strip of waistcloth with an embroidered flap in the front. The head-dress is 'a carefully woven cane hat' The women wear black skirts, sometimes with coloured stripes, reaching above

the ankle, a beautifully embroidered bodice and a shawl. The women also wear a colourful piece of cloth over the skirt. The Mishmi women are skilled weavers. Their sense of colour and design is admirable. They are extremely fond of ornaments, which are well designed and made of silver.

The dress of the Idus is 'colourful and picturesque. They have a special attraction for black, red, yellow and dark green colours that they utilize for bags and women's skirts. Usually they prefer to weave in black, with patterns done in red, white and yellow colours. A woollen coat imported from Tibet, with stripes of different colours and cross marks on it, is often worn by both sexes. In all weather the men wear hats which are woven in cane, and are so strongly made as to be sword-proof.

The dress of the women consists of a loose-fitting bodice, and a striped or coloured cloth fastened round the waist, which extends to the knees.

A distinguishing trait about the Mishmis is 'the way they do their hair. The Idus are called by the plains people as Chulikata, meaning 'cropped hair' cut their hair front of head just above the ears.

Food and Drink

The basic diet consisting mainly of cereals, millets, vegetables and meat is much the same for all the three sub-tribes of the Mishmi. Millet and maize are more commonly taken, and they are supplemented by sweet potatoes, arum or kachu. A large variety of wild leafy vegetables, roots, tubers and different types of fruits as well as pumpkins, brinjals, gingers, onion, mustard leaves, chilies, the flowers of plantain, Mushroom and bamboo shoots are also included in the diet.

The staple cereal food of the Mishmi is rice and millet. A meal usually consists of boiled cereal, either rice or millet and some boiled green leaves seasoned with chilies and salt. Tobacco is grown in all the areas of the Lohit Valley. The Mishmis, men and women, are devoted to

tobacco. The Kamans and Taraons have always been addicted to opium, but the Idus of Dibang Valley have never taken to it.

For their meat supply, they rear cows, pigs, *Mithuns* and chickens, which are sacrificed on social and religious occasions. They regard themselves as having lineal relation with the tiger, and therefore to eat their flesh is taboo. All kinds of meat are absolutely forbidden to the women, because it is believed that it renders them barren. A woman can, however, eat small birds, fish and wild rats with impounity.

Rice-beer is the traditional drink of the Mishmi. It is prepared either from rice or millet.

Tea, milk and milk products are recent additions to their diet, making an entry after contact with the people living in the plains developed.

CHAPTER - II
REVIEW OF LITERATURE

DEMOGRAPHY

Several studies on demographic structure have been published by many scholars among the non-Indians, tribal as well as non-tribal populations (Lasker, 1952; Eaton and Mayer, 1953; Roberts. 1956; Cavalli-Sforza *et al.*, 1966; etc.).

It is generally known that demographic variables, like fertility and mortality, etc., are the fundamental events of natural selection, which brings about changes in gene frequencies in a population. Thus many studies have suggested that fertility and mortality components are directly responsible for the rate and direction of human evolution (Wright, 1943; Cavalli-Sforza *et al.*, 1966; etc.).

Roberts (1956) has published his article on the Dinka of southern Sudan taking into consideration many demographic parameters with a view to finding out various evolutionary forces that acting on this population and their magnitudes. He presented the demographic structure of the Dinka, which is characterized by a fairly high sex ratio, moderate fertility and mortality. The rate of genetic drift in this population is found to be important. He has suggested that the smaller the social unit, the greater is the frequency of marriages among outside units. Sutter (1963) has worked on the relationship between human population genetics and demography. Bonne (1963) has made a study on demographic aspects of the Samaritans in order to estimate the effect of random drift for determining the biological characteristics of this population. Kuchemann *et al.* (1967) have carried out a population genetic study, based on demographic parameters in a Oxfordshire village. They have suggested that evolutionary forces such as selection, mutation, drift and gene flow determine the genetic structure of a population size, fertility, mortality and mating patterns. Sulzano *et al.* (1967) have made a further demographic-genetic study on the Xavante Indian of Brazil. Roberts and Bear (1980) studied the measures of genetic changes in an evolving population. Sulzano and Jacques (1979) have studied

the four Brazilian Indians, taking into consideration demographic and genetic parameters. They have made an attempt to relate the demographic findings with the genetic results with a view to understanding the micro-evolutionary process. Relethford (1986) has reported that the effect of population size on marital migration distance. He has suggested that small population draws mates from relatively local gene pools, whereas larger populations draw mates from relatively larger gene pools.

In India, several studies have been carried out on population genetics, taking into considerations demographic parameters.

Basu (1969) argues that the study of isolated breeding populations has important evolutionary implications. But before taking a population for a genetical study, the limit of breeding community, such as social, economic, religious geographical, etc., should be taken into consideration. He had worked among the Pahira population of Ajodhya and Dalma hills and has reported that this population as such is not one endogamous group, but it is composed of three sub-endogamous units among which the impact of many evolutionary forces varies.

Ghosh (1976) has reported that the Kota of Nilgiri hills is characterized by a low rate of fertility and a high rate of infant mortality. In the Kota, the frequency of consanguineous marriages is high and thereby it shows the high coefficient of inbreeding. The coefficient of breeding isolation indicates that the genetic drift plays an important role in bringing about differentiation in this population. Selection is also found to operate with a moderate intensity.

Deka (1980) has reported selection potentials among the Sonowal Kachari of Upper Assam.

Pandey *et al.* (2000) studied on the foetal wastage and infant mortality in four endogamous populations of Purnia District, Bihar. The study reveals that nutritional status of mothers, social and environmental factors, age of mothers, literacy rate and fertility rate plays an important role in foetal wastage and infant mortality. Paul Majumdar (2001) studied some

aspects of fertility of the Mahatos of Midnapore, West Bengal. It is found that the Mahato women show lower mean age at marriage than India's perspective. Majumdar found that fertility is inversely related with the educational, occupational status of the couples of the Mahato people. Fertility is also found to be higher in joint families than nuclear families.

Veleti (2001) have studied the family structure and its effective influence on fertility. The study reveals that the average fertility of the women is more in the nuclear family structure than in the extended family structure.

Bhasin and Nag (2002) studied demographic profile of the people of Jammu and Kashmir and estimates trends and differentials in fertility. They reported that fertility behaviour and gender inequality have a strong relationship. The various population groups of the state show differential fertility as a result of their development profiles.

Rao *et al.* (2006) has made a study on selection intensity among the Khonds of Andhra Pradesh. They observed that the selection intensity of the Khonds is similar to the Sugalis but is found to be lower than the some other tribes (Raj Gond, Pardhan, Hill Kolam, Manne Kolam etc.) of Andhra Pradesh. They also reported that the Khond is passing through better demographic transition.

Turning to the Northeastern region, Barua (1983) has presented the demographic structure of the Hajongs of West Garo Hills district in Meghalaya. In comparison with other tribal populations in other parts of the country, the Hajongs seems to have a higher fertility rate with a lower rate of mortality. He has reported that selection is operating with a moderate intensity among the Hajong.

Deka (1989) has found that the Jaintia of Saphai village in the Jaintai Hills district of Meghalaya have a fairly high rate of fertility with a low rate of infant mortality and selection acts with moderate intensity.

Khongsdier (1995) studied on prenatal and postnatal mortality in the War Khasi of Meghalaya. It is found that the infant and juvenile mortality rates are quite moderate in comparison with other population particularly with populations in the northeastern region of the country. He reported that religions have played its role in regulating the prenatal and postnatal mortality rates in the War Khasi.

A study undertaken by Sengupta and Chakravarty (1995) on family type, fertility and mortality among the Ahoms of Assam shows that the nuclear family registers a higher total fertility rate as well as foetal wastages over the joint family. It also reveals that the urban Ahom couples exhibit relatively lower average birth rates compared to their rural counterparts.

Limbu (1996) studied genetic structure of Semsa in the light of Founder Principle (Mayr, 1963). He found that the population genetic structure of the present day Semsa must have evolved from the genetic structure of the original splinter group.

Khongsdier and Ghosh (1996) have suggested, on the basis of a population genetic study among the War Khasi of Meghalaya, that the demographic structure of a population should be taken into consideration before making any population genetical study since many of the populations in this country are not, in genetical sense, "Mendelian Populations", but comprising of several demes.

A study on few aspects of fertility of the Garo women of Pochimbosti, Garo village in Sibasagar, Assam was carried out by Ahmed Das and Saikia (1999). Their study shows that the Garo women exhibit comparatively lower fertility than many other communities of Northeast India.

Ahmed Das and Barua (1999) have made a demographic study among the Manipuri Meities of Borkula Hanhchara village of Sibasagar District. They have reported a declining trend in fertility rate of the Meitei population. Pregnancy wastage and infant mortality rate are also low in this population which may be attributed to their better socio-economic condition.

Sengupta and Dutta (2000) studied on the factors influencing fertility among the Mishings of Assam. The study reveals that several biological, socio-cultural and ecological factors have a strong bearing on human reproduction.

Sengupta and Kalita (2001) have reported that the shift towards later age at marriage in the Sonowal Kachari of Assam might be one of the reasons for lower fertility in them.

Ahmed Das and Deori (2001) studied demographic profile of the Deori village of Lohit district, Arunachal Pradesh. Their study shows that the Deori women of the nuclear families exhibit higher number of birth rate than the women of joint families.

Ahmed Das and Konwar (2002) have reported that pregnancy wastage of the Oraon women of Tingkhon Tea Estate, Dibrugarh, Assam, is comparatively higher than that of some other communities of Assam, whereas fertility rate is lower in them.

A study undertaken by Sengupta and Purnungla (2005) among the Ao Nagas of Nagaland shows that low pregnancy wastages and pre-reproductive mortality usually results in lower fertility rate.

Varte and Varte (2006) have made a study on natural selection among the Hmar of Mizoram, India. They concluded that the higher values of mortality components and index opportunity for selection among the rural Hmar population of Mizoram than that of their urban counterparts may be due to less equipped medical facilities, poor socio-economic conditions and many other factors which can effect the total selection intensity i.e., due to rural-urban residence of population as there are no physical and environmental variations among themselves.

Imtisenla (2007) carried out study on a genetical-demographic study among the Khasis of Meghalaya. She has reported that in view of the marriage pattern, genetic drift and selection intensity, the Khasis are characterized by genetic variation within the population. Such variation is mainly due to admixture and natural selection.

In fact, there are plenty of papers in bio-demography, which deal with one or the other genetic aspects of demography. In this brief review of literature, we have tried to highlight some of the facts of bio-demography.

ANTHROPOMETRY

In order to ascertain affinities among the population groups of India, several anthropometric studies have been published since the pioneering studies of Thurston (1909) and Waddell (1901). Thurston's study among the South Indian caste and tribes has provided a lot of ethnographic information from cultural and social anthropological points of view, while Waddell's study was based on the anthropometric data from the Brahmaputra Valley.

In the beginning of the 20th century, anthropometric data among the different populations of India had been collected with a view to classifying the Indian population into racial, sub-racial groups (Risley, 1915; Guha, 1935 and others). Sarkar (1935-36) observed among the hill males and plains males, the sections of the same tribe of Rajmahal hills in central India, that the plains males are taller, having longer and broader head, more total facial height and narrower nose than the hill males.

Later on, a number of anthropometric surveys were gradually shifted to inter-regional framework (Mahalnobis *et al.*, 1949; Karve and Dandekar, 1951; Karve and Malhotra, 1968; Majumdar and Rao, 1960 and others). These studies have indicated that there is no consideration pattern. Mahalnobis *et al.* (1949) have suggested that same castes of comparable social rank tend to cluster together; whereas Majumdar and Rao (1960) have shown that there is a closer resemblance between casts group within the same region.

Singh (1975) has shown that weight, arm girth and skinfold measurement were significantly lower among Tamilians of Ooty than those in Madras city. He has pointed out that these differences are due to greater physical activity of the people living in the hilly areas of

Ooty. Biswas and Bhattacharya (1966) have indicated that height, sitting height and weight are consistently more in urban than in rural areas. Heurotte (1966) has suggested that socio-economic conditions have an effect on weight, height, cephalic index and length of eye. Singh and Purkait (2006) have made a cephalometric study among sub caste groups Dangi and Ahirwar of Khurai Block of Madhya Pradesh. They have observed that individual becomes more and more sexually dimorphic with increasing age among both Dangis and Ahirwars. Sexual difference is better projected as one attains adulthood.

In the Northeastern region, several anthropometric surveys have also been carried out (Waddell, 1901; Hutton, 1921; Guha, 1935; Macfarlane and Sarkar, 1941; Das, 1978; and many others). These studies were mostly done for the purpose of doing racial classifications.

Guha and Basu (1931) published a report on the human relics recovered by the Naga Hills expedition for the abolition of human sacrifice (during 1926-1927). They found two racial types among the Naga Crania, which were termed, group I and group II. The latter was identified to be Australoid and the former as Mongoloid.

Das (1960b) studied somatic variations among the hills and plains Garo of Meghalaya and Assam border. He reported that the plains Garos are significantly taller than their counterparts in the hill. Their face and nose are longer and narrower. Both have long and narrow head, but the head of the plains Garos shows a tendency to become rounder.

Phookan (1969) studied the anthropometric characters of the Dimasa Kachari of Assam. He revealed that the Sonowals are taller than the Dimasas. Phookan identified two other Kachari tribes- the Jharua and the Thengal, which are very much akin to the Sonowal and live in contiguous areas. They also show more or less similar deviation fron the Dimasa.

Studies on climatic correlations of anthropometric variables have also been summarized by Steegman (1975).

A comparison between the hill Karbis (Mikir) and plain Karbis reveals certain differences in physical characteristics comparable to that observed among the Garos (Deb, 1979). The plain Karbis are taller; they have shorter and broader head; their face is longer and broader; the mean value of nasal index is lower. However, except for face, the differences are not statistically significant.

A study by Singh (1986) reveals that the plain Kabuis are significantly taller than the hill Kabuis. Their head is significantly longer, broader and rounder (cephalic index); the nose is also longer, broader but narrower (nasal index) and the face is longer than the hill section.

Markendy (2000), while studying the anthropometric characters and nutritional status among the Khynriam of Meghalaya, has reported that the Khynriam population is not a homogenous group, when compared with other populations of Meghalaya.

A study by Kuotsu (2003) reveals that Khynriams of East Khasi Hills district are closer to the neighbouring populations of Assam, in respect of some anthropometric traits.

GENETIC MARKERS

SEROLOGY

ABO blood groups

The study of ABO blood groups is generally adopted by many physical anthropologists. "It is polymorphic in most populations of the world, and there are vast differences in the frequencies of A, B, and O genes between the various populations" (Basu *et al.*, 1980).

Reddy *et al.* (1995), in their study on the distribution pattern of the ABO and Rh (D) blood groups in the Sugali tribe of Andhra Pradesh, has reported that the genetic constitution of Sugalis is quite different from most tribal populations of Andhra Pradesh and in fact preponderance of the blood group B over group A in two different samples of this tribe place them closer to caste populations of the state. They also suggest a non-autochthonous origin of the

tribe. Gangadhar and Rajasekhara Reddy (2001) have reported that in respect of ABO blood groups a high frequency of O blood group is observed among the Adikarnatakas of Karnataka.

Jai Prabhakar *et al.* (2005), while studying ABO and Rh (D) blood groups among the Vishwakarmas of Hosahundi village of Mysore District, Karnataka, has reported that in ABO blood group system, the frequency of O blood group is highest, followed by B blood group. Gangadhar and Ronibala Devi (2006) carried out a study on distribution of the ABO and Rh (D) blood groups among the Kaniyas of Karnataka and found a high frequency of allele B among them.

In the Northeastern region also, several studies on ABO blood group have been published (Basu, 1938; Macfarlane and Sarkar, 1941; Miki *et al.*, 1960; Das, 1958; Sengupta and Dutta, 1980; etc).

Mitra (1936) has observed that in respect of ABO blood groups there is a good deal of similarity between the Angami and Lushai and the people of South China. Bhattacharjee (1954) has found significant differences among the Abor populations.

Das (1968a) has found that among the Khasi, there is a high percentage of both A and B genes. He has suggested that a thorough survey on blood groups of the populations of this region is necessary before arriving into any conclusion.

Kumar (1975) observed that the frequency of A allele is higher than that of B allele among the Gallong of Arunachal Pradesh. Same trend was reported in most of the populations of Arunachal Pradesh such as Minyong, Padam, Pasi, Pangi (Bhattacharya, 1954), Adi (Kar, 1975), and Dirang and Khalaktang Monpa (Duarah, 1990).

Sarkar *et al.* (1995) studied the distribution of ABO blood groups in Changlang, Arunachal Pradesh. They reported that A is higher than B among the Longchang and other tribals (i.e. Jugli, Morang, Singpho, Nocte, Tutsa etc.) while among the Muklom both A and B show equal occurrences. They also reported that there is no intergroup difference in respect of ABO

blood groups among different tribes inhabiting Changlang district of North Eastern Indian state of Arunachal Pradesh.

Jalal Ahmed *et al.* (1997) has conducted a genetic study on the Lyngam of Meghalaya. They has suggested that in respect of the ABO blood group Lyngam seems to be a distinctly different population and with all probability not either a sub population of the Khasi or of the Garo.

Borthakur *et al.* (1997a) has observed that in respect of ABO blood group, though The Dalu of Meghalaya shows some resemblance with some Mongoloid groups, it is a distinctly different population and do not resemble any of the Mongoloid populations of Meghalaya and Manipur.

Khongsdier and Murry (1999) have observed that in respect ABO blood groups, the Dibongiya Deuri of Assam are more related to the Koch and Ahom than to the Tengapaniya and Chutia of the same ethic group.

Phukan Gogoi and Sengupta (1999), while studying the blood groups among the Munda and Oraon tea garden labourers of Assam, found that the Munda and the Oraon differ from most of the tribal populations of the region.

A genetic study carried out among the Garos of Meghalaya by Nchang (2006) shows that the population is in genetic equilibrium in respect of ABO blood group system and shows a closer resemblance to the Tibeto-Burman linguistic family.

Marbaniang (2007) while studying among the Khynriam of Meghalaya, has reported that this population shows a close resemblance to the other Tibeto-Burman populations excepting the Bodo and Rabha with regard to ABO blood group system.

Rh factor : Reddy *et al.* (1995) has suggested that in respect of the ABO and Rh (D) blood groups, the Sugali tribe of Andhra Pradesh is a non-autochthonous. Gangadhar and Rajasekhara

Reddy (2001) have reported a very high frequency of Rh (D) among the Adikarnatakas of Karnataka.

Jai Prabhakar *et al.* (2005) while studying the distribution of ABO and Rh (D) blood groups among the Vishwakarmas of Mysore District, Karnataka, has revealed that the frequency of Rh (D) to be predominant among the studied population. Gangadhar and Ronibala Devi (2006) also reported a similar trend i.e. high frequency of Rh (D) among the Kaniyas of Karnataka.

It is theoretically known that Rh-negative genes are very rare among the Mongoloids. In his study among the four populations of the Northeastern region, i.e., the Garo, the Rabha, the Kachari and the Rajbanshi, Das (1981) has observed that out of 55 individuals, there are only 6 persons who are Rh-negative.

Jalal Ahmed *et al.* (1997) has suggested that on the basis of Rh factor the Lyngam of Meghalaya is a ethnically a distinct population.

Khonsdier and Murry (1999) has carried out a genetical study of the Dibongiya Deuri to understand the genetic differentiation within and between the Deuri groups of Assam. They have found that the various segments of the Deuri are by and large homogeneous in respect of the Rh factor.

Phukan Gogoi and Sengupta (1999) have studied the blood groups among the Munda and Oraon tea garden labourers of Assam. They found that in respect of Rh factor the Munda and the Oraon differ from most of the tribal populations of the region, who show Mongoloid ethnic strain among them.

Nchang (2006) has reported that the Rh factor among the Garos of Meghalaya is very low like other Mongoloid populations of North East India.

Marbaniang (2007) has reported that in respect of Rh factor the Khynriam of Meghalaya confirms the general prevailing trend among the Mongoloid populations of North East India, which is very low.

PTC Taste sensitivity

Taste sensitivity of Phenylthiocarbamide generally studies as a polymorphic genetic markers among different populations (Harris and Kulmus, 1949; Mohr, 1951; Das *et al.*, 1963; etc.).

Aggarwal and Sachdeva (2004) carried out a study on the taste sensitivity of Phenylthiocarbamide among the Rajputs of Kasauli, Himachal Pradesh. They observed that the Rajputs of hilly terrain show similarity in their gene pool as compared to the Rajputs of plains like those of Uttar Pradesh and also that the percentage of non-tasters is relatively high.

In the Northeastern region of the country, Das (1981), in his study among the Khasi, has reported that the frequency of non-tasters is somewhat higher in the Bhoi than any other Khasi groups. In respect of mean values of taste threshold, the Bhoi are similar to the Pnar.

Borthakur *et al.* (1997a) has conducted a genetic study on the Dalu of Meghalaya. They have observed that in respect of PTC taste sensitivity, though the Dalu resemble some Mongoloid groups, it is distinctly different population and it does not resemble any of the Mongoloid populations of Meghalaya and Manipur.

Murry *et al.* (2003), in their study on the PTC taste sensitivity among the Lotha Naga of Nagaland, has observed that the Lotha showed a much lower taster allele frequency than that of the Angami.

Nchang (2006) reported that in respect of the PTC taste sensitivity the Garos of Meghalaya shows a moderate frequency compared to other populations of North East India. Marbaniang (2007) has reported that the comparison of PTC taste blindness of the Khynriam

Khasis of Meghalaya with other populations of North East India shows a moderate frequency of the tasters as compared to non-tasters.

Colour-blindness

Colour-blindness is one of the well-established sex-linked characters in man (Gates, 1956). Variations in the frequency of colour-blindness among different ethnic groups of the world have been observed and the variation appears to be wider among the Mongoloids (Mukherjee, 1963). Studies have also shown that selection relaxation and positive selection of colour-blindness is largely influenced by socio-economic condition of the groups (Post, 1962; Pickford, 1963).

Aggarwal *et al.* (2004) has carried out a study on colour blindness among the Rajputs of Kasauli, Himachal Pradesh. They observed that the percentage of colour blind Rajput individuals is relatively high.

Singh (1982) has reported that the Tangkhul Naga has relatively higher frequency of colour-blindness than those of many hill tribes of Northeastern states of India.

Among the tribal groups of Arunachal Pradesh like Gallong (Jaswal, 1978), Padam, Minyong, Wancho, Dirang and Khalaktang Monpa, Tagin and Gallong (Choudhury and Das, 1974), the incidence of colour-blindness is low.

Khonsdier and Murry (1999) has found that the various segments of the Deuri are by and large homogeneous in respect of colour blindness. Such genetic affinities and variations are suggestive of the action of various evolutionary forces.

Murry *et al.* (2003) while studying on colour blindness among the Lotha Naga of Nagaland reinforces Post's hypothesis of 'selection relaxation' vis-à-vis colour blindness that there is more stringent selection against that gene among the tribals than among the urbanites.

Nchang (2006) reported that the frequency of colour blindness is very low among the Garos of Meghalaya, which shows a similarity with other populations of North East India.

Marbaniang (2007) has reported that in respect of colour blindness, the Khynriam of Meghalaya shows a very low frequency.

DERMATOGLYPHICS

Several studies on dermatoglyphics have been carried out among the populations of the Northeastern region (Das, 1959, 1966, 1981; Das and Das, 1965; Das, 1972; Das and Das, 1981; etc.).

Phukan Gogoi and Sengupta (1995), in their study on the finger dermatoglyphic pattern on the Boro Kacharis of Assam, has stated that the male Kachari show slightly higher mean value of total finger ridge count than their female counterparts and the sex heterogeneity is found to be significant.

Dutta Das (2000), in her study of palmar dermatoglyphics of the Nishis of Assam, has observed that in respect of this trait the Nishis are closer to all other Mongoloid populations of Arunachal Pradesh and Assam.

Barua *et al.* (2001) has made a study on finger ridge counts of the Tai Turungs, a Mongoloid population of Assam. They have observed that the Turungs show a closer resemblance with the Ahom and Khamiyang whereas they stand apart from the Aitons and the Khamptis in respect of finger ridge counts.

Sengupta and Gogoi (2002) have carried out a study on dermatoglyphics of the Mishings of Assam, India. They have observed a deviating tendency of the Mishing tribe from the neighbouring Mongoloid populations with regard to various dermatoglyphic features.

Dkhar (2007) has reported that in respect of dermatoglyphic trait, the Khynriam Khasis of Meghalaya are significantly different from most of the Mongoloid populations of North East India.

MORPHOLOGICAL AND BEHAVIOURAL TRAITS

It is generally believed that morphological and behavioural traits like earlobe attachment, relative length of 1st and 2nd toes, arm-folding, hand-clasping, tongue-rolling and tongue-folding etc are not as valuable as genetic markers from the genetic point of view. However, Salzano (1961) stated that such traits might be useful in population genetical studies for several reasons. One of such reasons is that the findings on the genetic affinity of human populations in respect of known loci are still not as clearly understand as were in case of these traits. In several cases, the findings on the genetic markers corroborate those on anthropometric and other morphological and behavioural traits (Harrison, 1977).

Of all the morphological traits, earlobe has been studied amongst most of the populations all over the country and Northeast region is no exception. Das (1967) has complied all the data on earlobe types in some populations of this region. Nath *et al.* (1995) found that in respect of ear lobe attachment the Kaibartas of Assam shows an intermediate position between population with Caucasoid affinities and Mongoloid affinities. Ghosh *et al.* (1996) found that in respect of this trait the Mizo have got lower frequency in comparison to the Ahom and Nepalee but higher than that of the Garo and Rabha.

Study on relative length of first and second toes has been undertaken in a very few populations of this region, namely, the Khasi, Rabha and Mikir (Das, 1968b, Das and Uzir, 1959, 1961). Ghosh *et al.* (1996) found that in respect of this trait the Mizo stand quite apart from those three tribal populations. However, we need more data on this morphological trait from other tribal populations of this region, to arrive at any conclusion.

Das *et al.* (1976) studied the hand-clasping among the Tangsa of Arunachal Pradesh in which he found that the frequency of L>R was higher than that of R>L. Das and Choudhury (1975), Phookan and Begum (1976) and Ghosh *et al.* (1996) found that the frequency of R>L is higher than that of L>R in the Sema Naga of Nagaland, the Gallong of Arunachal Pradesh and Mizo population of Shillong respectively.

In respect of arm-folding the frequency of L>R is higher than that of R>L in most of the populations of Northeast India viz. the Nocte and Wancho of Arunachal Pradesh (Das *et al.*, 1976), among the Nepalee of Assam (Phookan and Begum, 1976) and Mizo population of Shillong (Ghosh *et al.*, 1996).

Das *et al.* (1985) have studied tongue-rolling and tongue-folding ability among the Ahom, Deori, Chutia, Mishing and Lalung populations of Assam and reported low frequency among the Chutia, Mishing and Moran. Ghosh *et al.* (1996) reported that in respect of both tongue-rolling and tongue-folding traits the Mizo has very high frequency and stand quite apart from the other Mongoloid populations of this region.

Borthakur *et al.* (1997b) has observed that in respect of morphological and behavioural traits, the Dalu of Meghalaya is a different population.

CHAPTER - III
MATERIALS AND METHODS

In this chapter we shall discuss the materials collected for the present study and the methods that have been applied. The present study on population genetics among the Mishmi of Lohit district and Dibang valley district, Arunachal Pradesh has been carried out in three phases, between February 2004 and December 2005. In February 2004, a pilot survey was carried out. In the next field trip i.e. between September 2004 and March 2005, a detailed demographic work was done, and data on anthropometry; genetic traits viz., ABO and Rh blood groups, P.T.C. taste blindness and colour blindness; behavioural traits like arm-folding, hand-clasping, tongue-rolling and tongue-folding; morphological traits like earlobe attachment and relative length of 1st and 2nd toe and dermatoglyphics were collected from Lohit district. Again during the period between September 2005 and December 2005, the 3rd phase of field work was undertaken in Lower Dibang valley district and same type of data were collected from there. During the period between August 2007 and December 2007, last phase of field was undertaken with a view to rechecking some of the data which were collected during earlier field works and also making some demographic data up to date.

NATURE OF DATA

DEMOGRAPHY

For collection of demographic data among the Mishmi, we have taken into consideration the entire villages, i.e., a complete enumeration has been done. All households of the Mishmi were visited and surveyed.

Demographic data were collected through in depth interview with each of the married woman, or head of the household, using household and fertility schedules (given in appendix A). For collection of demographic data, we have followed the recommendation of the World Health Organization (1964, 1968), which are as follows:

Individual records

For the individuals examined, including temporary absentees, the following information was obtained:

(a) Date and place at which record was taken;

(b) Name of the informant and his/her relationship to the head of the family (mother, father, etc.,);

(c) Sex and marital status of each member of the community;

(d) Age: age of each inhabitant was recorded. Age was estimated, specially in the case of the older people with reference to some important local events. Consequently, some amount of error might have occurred in age estimation. However, these were checked and rechecked on several occasions, at the time of collecting pedigrees from various people, including relations and neighbours. For younger generation, the child's deciduous as well as permanent dentition was also considered for estimating age.

(e) Birth place:

(f) Clan: for each and every individual, both patriclan and matriclan were recorded.

(g) Mating records:

Pregnancy history of each married Mishmi woman was recorded, taking into consideration the total number of pregnancies and approximate age at each conception, outcome of each pregnancy (abortion, still birth and live birth), sex of each offspring, multiple births, number of surviving children and their age and sex and marital status, number of deceased children with age at death, etc.

ANTHROPOMETRY

Thirteen measurements were considered for present study. They are as follows: Height vertex, Sitting height, Chest girth, Head length, Head breadth, Bizygomatic breadth, Nasal

height, Nasal breadth, Weight, Least frontal breadth, Head circumference, Bigonial breadth and Mid-arm-circumference on all the subjects. Anthropometric data were collected on 211 Digaru Mishmi individuals (107 males and 104 females), 206 Miju individuals (102 males, 104 females) and 297 Idu individuals (154 males, 143 females). It may be mentioned that the instructions, given by IBP (Weiner and Lourie, 1981) were followed in the present study.

Precautions:

All subjects were asked to wear minimum clothes without any footwear, headgear, etc. Care was taken to select apparently healthy, normal and disease free individuals. Also care was taken, as far as possible, to select unrelated individuals (for example, only one adult person from one household was taken).

Anthropometric measurements:

Height vertex : It measures the vertical distance from floor to vertex.

Vertex (v) : It is the highest point on the head, when head is in eye-ear plane.

Sitting height : It measures the vertical distance from vertex to the sitting surface of the subject, when stretched i.e., when the vertical column is stretched to its maximum.

Chest girth : The girth of the chest is measured, putting the tape around the chest in horizontal position and allowing it to pass over nipples in the front and the lower scapular angle at the back.

Head length (g – op) : It is the straight distance from glabella to opisthocranion.

Glabella (g) : It is the point on the protuberance of the lower forehead above nasal root between the eyebrow ridges, intersected by mid-sagittal plane.

Opisthocranion (op) : It is the most posterior point on the posterior protuberance of the head in the mid-sagittal plane. This point is determined by measuring maximum head length.

Head breadth (eu- eu) : It is the straight distance between the two euryon points.

Euryon (eu) : It is the most laterally placed point on the sides of the head.

Bizygomatic breadth (zy- zy) : It is the straight distance between two zygion points.

Zygion (zy) : It is the most laterally placed point on the zygomatic arch.

Nasal height (n – sn) : It measures the straight distance between nasion and subnasale.

Nasion (n) : It is the point on the nasal root intersected by mid-sagittal plane.

Subnasale (sn) : The point, where the lower margin of the nasal septum meets the upper lip.

Nasal breadth (al – al) : It measures the straight distance between the two alare points.

Alare (al) : It is the most laterally placed point on the nasal wings.

Weight : Weight is taken by means of a standard spring type of weighing machine.

Least frontal breadth (ft-ft): It measures straight distance between two frontotemporal points.

Frontotemporale (ft) : It is the most anterior and inner point on the linea temporalis on the frontal bone.

Head circumference (g- op- g): It measures the maximum circumference of the head taken horizontally.

Bigonial breadth (go – go): It measures the straight distance between two gonion points.

Gonion (go) : It is the lowest posterior and most lateral point on the angle of the jaw.

Mid-arm-circumference : It measures the maximum circumference of the upper arm taken horizontally.

These definitions have been adopted from Singh and Bhasin (2004).

Techniques

The techniques of taking anthropometric measurements on the subjects, suggested by Martin (1928), Das and Deka (1992-93) and Singh and Bhasin (2003), have essentially been followed in the present study.

GENETIC MARKERS

Serology

Blood samples on 211 Digaru Mishmi individuals (107 males and 104 females), 206 Miju Mishmi individuals (102 males, 104 females) and 297 Idu Mishmi individuals (154 males, 143 females) were collected, following the standard techniques, suggested by Lawler and Lawler (1951) and Mourant (1954). Blood samples were obtained by pricking the fourth finger of the left hand of each individual with the help of a sterilized disposable needle. Before pricking, the finger is cleaned with absolute alcohol and dried. The blood sample was collected in 0.85% normal saline. Before performing the agglutination tests, the red cells were washed thrice in normal saline. For washing of red cells every time centrifugation was done 1000 r.p.m. and the supernatent was removed and finally 2 percent suspension of red cells was prepared with normal saline. Anti-A, anti-B and anti-D sera were obtained from Stangen, Hyderabad. For performing agglutination test each time a control sample was used to find potency of all anti-sera. Tests were carried out by a standard tube method.

ABO blood groups: One drop of anti-A and the same amount of anti-B sera were placed in two precipitin tubes. Then equal volume of red cell suspension was added each to anti-A and anti-B sera, already taken in tubes and left at room temperature for some time. Each tube was agitated by tapping with finger, and then results were noted accordingly.

Rh (D) blood groups: For Rh blood grouping one drop of anti-D serum was taken in a precipitin tube and one drop of packed red cell was mixed thoroughly with anti-sera. The tube was incubated for about a minute in order to activate the reaction. Agglutination confirms positive reaction i.e., Rh^+ and lack of agglutination implies negative results i.e., Rh^-.

DERMATOGLYPHICS

Finger ball (digital) and palmar dermatoglyphics:

The standard methods, as suggested by Cummins and Midlo (1961), have been followed to collect finger ball and palmar prints on 212 Digaru Mishmi individuals (105 males and 107 females), 205 Miju Mishmi individuals (102 males, 103 females) and 298 Idu Mishmi individuals (154 males, 144 females). The materials, required for taking prints, were white sheets of paper, tube of ordinary printing ink, a plate for spreading ink, pencil, soap, thin piece of cloth, cotton and rectified spirit.

The ink printing method, as suggested by Cummins and Midlo (1961), was adopted. The subjects were asked to wash their hands with soap and water in order to remove all dust, hairs, grease, etc. from hands, and in case of stubborn grease the hands were cleaned with a piece of cotton dipped in rectified spirit. The palm and fingers were allowed to dry for some time. A small quantity of ink was placed in the inking plate and spread evenly all over it with a view to making a thin film by a cotton pad (Das and Deka, 1992-93). While spreading ink by smearing on the plate, the bulging surface of the cotton pad got uniformly inked.

Digital prints : To make rolled impression, the bulb of the finger was smeared evenly by the inked cotton pad. The finger was then placed upon the paper with the nail at right angle to the plane of the paper, and it was slowly turned over until the bulb surface, which was originally facing to the left, turned to the right. In this way a clear rolled impression of the finger surface was obtained.

Palmar prints : The subject's palm was smeared with the inked cotton pad in such a way that all the ridges of the palmar surface would be properly inked. In this process the palmar surface from first bracelet area to the first phalangeal crease was properly inked and then the palm was placed on the paper. To transfer the print on the paper a little pressure was exerted on ulnar and radial borders, interdigital areas and mid palmar region.

For convenience the palmar prints were taken on the center of the sheet and the fingers on the sides. The digits were rolled from ulnar to the radial border.

Following precautions were taken in order to avoid the error in printing. Care was taken not to press the finger too hard on the paper. The plate used for spreading ink was made clean to make it free from dust, hairs or any other foreign bodies. A very thin film of ink was applied with a view to getting a clean and sharp print. The persons with deep impression or severe cuts were not included in the present sample.

MORPHOLOGICAL AND BEHAVIOURAL TRAITS

Data on arm-folding, hand-clasping, tongue-rolling, tongue-folding, relative length of 1st and 2nd toe and earlobe-attachment were taken from 211 Digaru Mishmi individuals (107 males and 104 females), 206 Miju Mishmi individuals (102 males, 104 females) and 297 Idu Mishmi individuals (154 males, 143 females) individuals.

Behavioural traits

i. Arm-folding: The individuals were asked to fold their arm in a natural way. The subjects were classified as R>L (Right over Left) or L>R (Left over Right), depending on how they folded their arms naturally. Accordingly, the observations on arm-folding were recorded.

ii. Hand-clasping: The observation on hand-clasping were also made in similar manner. The subjects were asked to clasp their hands in a natural way, and the subjects were classified

as R>L (Right over Left) or L>R (Left over Right), depending on how they clasp their hands.

iii. Tongue-rolling: The subjects were asked to roll their tongue and extend it from the mouth. Some had the ability to roll the tongue into a distinct U-shape, while others could not. The observations were recorded as +ve (positive) and –ve (negative), respectively.

iv. Tongue-folding: For tongue-folding, the subject was asked to extend the tongue and fold it without touching the lips. The observations were recorded as +ve (positive) and –ve (negative) respectively for those, who could fold and those, who couldn't.

Morphological traits

i. Relative length of 1st and 2nd toe: In the present study Minami's method (1952) was followed. He proposed the symbols T for I>II, F for II>I and O for I = II. The person under observation was asked to stand upright and observations on both feet were recorded accordingly.

ii. Earlobe-attachment: Left and right ears of all the subjects were examined. The observations were recorded in the following way: attached or free.

It may be noted that in order to avoid arbitrariness in classification of earlobe-attachment, a simple classification, as mentioned above, was adopted.

OTHER GENETICAL TRAITS

Colour blindness : The Ishihara chart (1962) was used to collect data on 211 Digaru Mishmi individuals (107 males and 104 females), 206 Miju Mishmi individuals (102 males, 104 females) and 297 Idu Mishmi individuals (154 males, 143 females) individuals i.e., 30.27%, 35.09% and 52.85% of total Digaru, Miju and Idu population respectively. The subjects were examined in adequate daylight. The book was kept open and the plates were held at a distance, approximately two and a half feet from the

subjects. The subjects were asked to read the numerals of the plate nos. 1 –25 within three seconds for each plate. In case of illiterates, the subjects were asked to trace with a clean brush the winding lines between two X's of the plates from 26 – 38.

Taste sensitivity to Phenylthiocarbamide : The serial dilution method, suggested by Harris and Kalmus (1949), was followed to collect data on PTC-Taste sensitivity. Total 211 Digaru Mishmi individuals (107 males and 104 females), 206 Miju Mishmi individuals (102 males, 104 females) and 297 Idu Mishmi individuals (154 males, 143 females) were tested (males and females), individuals i.e., 30.27%, 35.09% and 52.85% of total Digaru, Miju and Idu population respectively.

A stock solution, containing 0.13% phenylthiocarbamide (PTC), was prepared in cold boiled water. 14 identical bottles were kept serially, numbered 1 to 14 and about 40 ml of the stock solution was kept in the bottle No.1. Then from the bottle no.1, 20ml (i.e., one-half of the solution in bottle no.1) of the stock solution was taken out and poured in bottle no.2, in which 20ml of water was thoroughly mixed to make 40ml of the solution. Half of the solution in the bottle no.2 was transferred to the bottle no.3 in which 20ml of water was thoroughly mixed again to make the volume of the solution upto 40ml. The same procedure was followed until the solution no.13 was prepared. In this way a serial dilution of PTC was prepared, where the concentration of the solution in each bottle become half of the previous bottle. In the last bottle i.e., bottle no.14, plain water was kept.

The subjects were asked to wash their mouths before tasting the solutions, especially to them, who were found chewing tobacco or smoking. First of all, a few drops of plain water from the bottle no.14 were given in the mouth of the subject, and then solution nos.13, 12, 11, etc. were given in ascending order directly in the mouth of the

subject. The moment the subject got some taste, the number of the solution was noted as his/her threshold value. Sorting was done by changing the solution number, near the threshold number, repeatedly.

All precautions were taken to collect data from the unrelated individuals, still some possibilities are there that some related individuals (of course not like brother and brother; brother and sister; father and son etc.) must have been included in the present sample.

In the subsequent chapters we shall present the results of our findings on demographic, anthropometric characters, genetic, dermatoglyphics, and morphological and behavioural traits among the Mishmis.

CHAPTER - IV
DEMOGRAPHY

In this chapter we shall deal with the demographic characters of all the three Mishmi populations of Arunachal Pradesh.

Firstly, we shall deal with the demographic characters of Digaru Mishmi.

Table1. Distribution of total population by age, sex and marital status.

Age groups (in yrs)	Unmarried		Married		Widowed/ Divorced		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
0-4	47 (6.74)	40 (5.74)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	47 (6.74)	40 (5.74)
5-9	46 (6.60)	36 (5.16)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	46 (6.60)	36 (5.16)
10-14	43 (6.17)	43 (6.17)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	43 (6.17)	43 (6.17)
15-19	41 (5.88)	40 (5.74)	0 (0.00)	07 (1.00)	0 (0.00)	0 (0.00)	41 (5.88)	47 (6.74)
20-24	14 (2.01)	09 (1.29)	11 (1.58)	22 (3.16)	01 (0.14)	01 (0.14)	26 (3.73)	32 (4.59)
25-29	04 (0.57)	03 (0.43)	29 (4.16)	37 (5.31)	0 (0.00)	01 (0.14)	33 (4.73)	41 (5.88)
30-34	01 (0.14)	0 (0.00)	18 (2.58)	16 (2.29)	0 (0.00)	01 (0.14)	19 (2.72)	17 (2.44)
35-39	01 (0.14)	01 (0.14)	20 (2.87)	29 (4.16)	0 (0.00)	02 (0.29)	21 (3.01)	32 (4.59)
40-44	0 (0.00)	0 (0.000	16 (2.29)	19 (2.72)	0 (0.00)	01 (0.14)	16 (2.29)	20 (2.87)
45-49	01 (0.14)	0 (0.00)	10 (1.43)	09 (1.29)	0 (0.00)	04 (0.57)	11 (1.58)	13 (1.86)
50-54	0 (0.00)	0 (0.00)	15 (2.15)	06 (0.86)	0 (0.00)	03 (0.43)	15 (2.15)	09 (1.29)
55-59	01 (0.14)	0 (0.00)	04 (0.57)	08 (1.15)	01 (0.14)	01 (0.14)	06 (0.86)	09 (1.29)
60-64	0 (0.00)	0 (0.00)	05 (0.72)	03 (0.43)	01 (0.14)	06 (0.86)	06 (0.86)	09 (1.29)
65-69	01 (0.14)	0 (0.00)	06 (0.86)	02 (0.29)	0 (0.00)	02 (0.29)	07 (1.00)	04 (0.57)
70+	0 (0.00)	0 (0.00)	04 (0.57)	0 (0.00)	01 (0.14)	03 (0.43)	05 (0.72)	03 (0.43)
Total	200 (58.48)	172 (48.45)	138 (40.35)	158 (44.51)	04 (1.17)	25 (7.04)	342 (49.07)	355 (50.93)
Grand total	372 (53.37)		296 (42.47)		29 (4.16)		697 (100.00)	

Figures in parentheses indicates percentage

Table1 shows the distribution of total population by age, sex and marital status in the Digaru Mishmi. The total population is 697 of which 342 are males and 355 are females. It shows that in the total population, 49.07% are males and 50.93% females. The overall sex ratio is 1:1.04, which shows that number of females is slightly more than that of males, though the

overall sex ratio in this population is very near to the ideal sex ratio of 1:1. Of all males, it is found that about 58.48%, 40.35% and 1.17% are unmarried, married and widowed/divorced, respectively. In case of the females, these are 48.45%, 44.51% and 7.04% respectively. Taking males and females together, it is found that 53.37% of all individuals are unmarried, whereas 42.27% are married and 4.16% are widowed/divorced. It is seen that no individual after 34 years remains unmarried, excepting 4(0.56%) males and 1(0.14%) female. However, it is seen from Table1 that most of the marriages have taken place between 20 and 29 years of age. It holds good for both the sexes. It is found that the mean age at marriage for females is 20.73±0.25years and that for males 25.84±0.25years in this population.

Table 2. Population by age, sex and marital status (extracted from table 1).

Age group (in yrs)	Unmarried		Married		Widowed/Divorced		Total		M+F	Sex ratio
	Male	Female	Male	Female	Male	Female	Male	Female		
0-14 %	136 19.51	119 17.07	0 0.00	0 0.00	0 0.00	0 0.00	136 19.51	119 17.07	255 36.58	1:0.88
15-49 %	62 8.90	53 7.60	104 14.92	139 19.94	01 0.14	10 1.43	167 23.96	202 28.98	369 52.94	1:1.21
50+ %	02 0.29	0 0.00	34 4.88	19 2.72	03 0.43	15 2.15	39 5.59	34 4.88	73 10.47	1:0.87
Total	200	172	138	158	04	25	342	355	697	1:1.04

Table 2, extracted from Table1, shows the total population according to age group and sex. It is seen that 19.51% of males and 17.07% of females belong to the age group of 0-14years. In the reproductive age group, i.e., 15-49years, 23.96% and 28.98% are males and females respectively, whereas in the post-reproductive age group i.e., 50+years, 5.59% and 4.88% are males and females respectively.

In the reproductive age group, 8.90% and 7.60% are unmarried males and females respectively. In the same reproductive age group 0.14% of males and 1.43% of females are either

widowed or divorced. The percentage of individuals, who are widowed or divorced, are 0.43% for males and 2.15% for females in the post reproductive age group i.e., 50+years.

In this population it is seen that 36.58%, 52.94% and 10.47% of all individuals belong to the pre-reproductive age group (0-14years), reproductive age group (15-49years) and post-reproductive age group (50+years) respectively. According to Sundbarg's classification of populations, based on age group distribution, (Datta, 1972), the Digaru Mishmi seen to be of progressive type.

As mentioned earlier, the overall sex ratio in this population is 1:1.04, which shows that it is slightly tilted in favour of females. But, it is further observed that the sex ratio in the pre-reproductive age group i.e., 0-14years, is 1:0.88, which indicates that the number of males is slightly more than that of females. But in the reproductive age group i.e., 15-49years, it is seen that the sex ratio is 1:1.21. It is tilted in favour of females. So it indicates that male mortality is slightly higher than female mortality in the earlier age group. In the post-reproductive age group i.e., 50+years, the sex ratio is again tilted in favour of males, which is 1:0.87. It indicates that the average longevity is, perhaps slightly higher in males than in females.

In this population, it has been calculated that the mean age at first childbirth in case of females is 21.40±0.22years and that in case of males is 26.87±0.33years. So the mean age at first childbirth, taking both males and females together, becomes 24.13years. Thus, in the present analysis for Digaru Mishmi population, we have taken 24 years as a generation length, following the method suggested by Glass (1956). It may be noted that it is very difficult to classify any human population into generations since the generations are always overlapping.

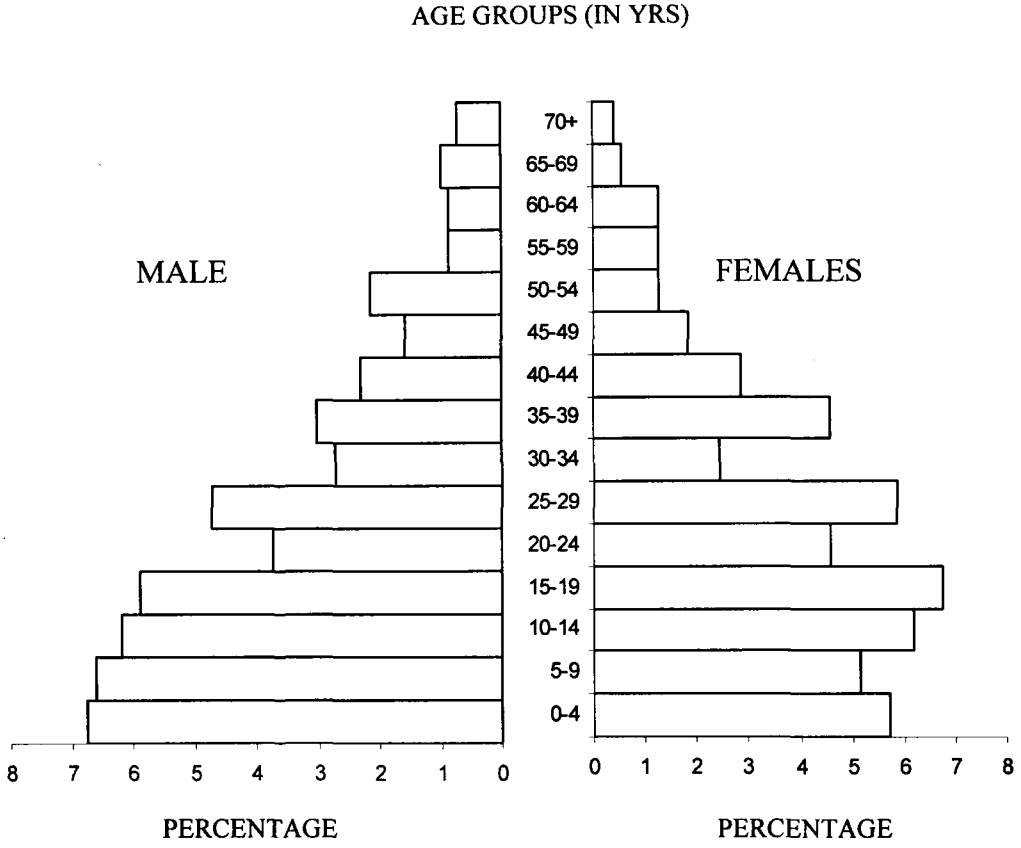


FIGURE 3. POPULATION PYRAMID (DIGARU MISHMI)

Figure 3 shows the diagramatic distribution of the Digaru population by age groups. The entire population has been classified into 15 age groups. It shows that in general the base of the pyramid is broader and shrunk as we move to higher age groups. So, the present population is progressive.

Table 3. Multiple marriages by age of spouses.

Individual married		-24years		25-48years		49+years		Total		M+F
		Male	Female	Male	Female	Male	Female	Male	Female	
Once		12	30	86	112	26	31	124	173	297
	%	100.00	100.00	93.48	94.91	68.42	88.57	87.32	94.54	91.38
More than once	Twice	0	0	04	06	08	04	12	10	22
	%	0.00	0.00	4.35	5.09	21.05	11.43	8.45	5.46	6.77
	3 times	0	0	02	0	03	0	05	0	05
	%	0.00	0.00	2.17	0.00	7.89	0.00	3.52	0.00	1.54
	4 times	0	0	0	0	01	0	01	0	01
	%	0.00	0.00	0.00	0.00	2.63	0.00	0.70	0.00	0.31
	Total	0	0	06	06	12	04	18	10	28
	%	0.00	0.00	6.52	5.09	31.58	11.43	12.68	5.46	8.62
Grand Total		12	30	92	118	38	35	142	183	325
%		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3 shows the frequency of multiple marriages by age of spouses. In the third generation i.e., upto age 24years, no individual has been found to marry more than once. In the second generation i.e., 25-48years, 4.35% and 5.09% of males and females, respectively, have married two times. In this generation, two male individuals (2.17%) have married three times. But no woman has been found to marry more than two times in this generation. In the first generation i.e., 49+years, 21.05% and 11.43% of males and females, respectively, have married two times. In this generation, 3 male individuals (7.89%) have married three times and one male individual (2.63%) has married four times. No woman has been found to marry more than two times in this generation.

Table 3 further reveals that about 8.62% of the total married (including widowed/divorced) individuals have changed their mates. It is seen that males have changed their mates more often than females (males 12.68% and females 5.46%). However, it is found that the frequency of male individuals, who married more than once, increases from lower age group to higher age groups, whereas the frequency of female individuals, who married more than once, is highest in second age group i.e., (25-48years). It is seen that 87.32% and 94.54%of the married (including widowed/divorced) males and females, respectively, have married only once, whereas nearly 8.45% of males and 5.46% of females have married twice. It is further noticed that among the Digaru Mishmi, there are 5 males (3.52%), who have married thrice and only one man (0.70%) has married more than three times.

Table 3A. Multiple marriages by age of spouses.

Individual married	-24years	25-48years	49+years	Total
Once	42	198	57	297
%	100.00	94.29	78.08	91.38
More than once	0	12	16	28
%	0.00	5.71	21.92	8.62
Total	42	210	73	325
%	100.00	100	100.00	100.00

When both sexes are pooled together, as shown in Table 3A, the frequency of individuals more than once married, increases through the lower age group to the higher age group (0.00%, 5.71% and 21.92% for the age groups ≤24years, 25-48 years and 49+years respectively). It is seen that as age progresses, both males and females incline to change their mates.

Table 3B. Multiple marriages by sex.

Individual married	Male		Female		Total (M+F)	
	No	%	No	%	No	%
Once %	124 41.75	(87.32)	173 58.25	(94.54)	297 100.00	91.38
More than once %	18 64.29	(12.68)	10 35.71	(5.46)	28 100.00	8.62
Total %	142 43.69	(100.00)	183 56.31	(100.00)	325 100.00	(100.00)

Figures in the parentheses indicate the percentage out of total male or female.

Table 3B, extracted from Table 3, shows the frequency of multiple marriages by sex. Out of 297 individuals, who have married only once, 124 of them (i.e., 41.75%) are males and 173 of them (i.e., 58.25%) females. There are 28 individuals, who have married more than once, out of which 64.29% are males and 35.71% females. In this population, there are 142 married males out of which 12.68% have married more than once, whereas there are 183 married females out of which 5.46% have married more than once. So, it indicates that the frequency of persons marrying more than once is more among the males than among the females. In respect of this, the difference between male and female is remarkable.

Table 4. Binomial test of proportion in respect of multiple marriages.

Sex	No.	No. of individuals married more than once	T_1	T_2	Inference
Male	142	18	0.0722	0.0314	Significant
		12.68			
Female	183	10			
		5.46			

Table 4 justifies the above statement. Using the binomial test of proportion, it is found that there is significant difference between male and female in respect of the frequency of changing mates (T_1=0.0722 and T_2=0.0314).

Table 5. Fertility by times of marriage.

Times of marriage	No. of married women	Total pregnancy		Total no. of live births	
		No.	Mean ±S.E.	No.	Mean ±S.E.
Once	173	626	3.62±0.18	580	3.35±0.15
More than once	10	30	3.00±0.76	26	2.60±0.60

t* (between total no. of pregnancies)= 0.7938, P>0.05, Insignificant.
t** (between total no. of livebirths)= 1.2127, P>0.05, Insignificant.

Table 5 shows the fertility performances of women by times of marriages. There are 173 women, who have married once, and 10 women, who have married more than once. In case of the women, who married only once, the mean number of pregnancy is found to be 3.62±0.18, whereas in case of women who married more than once, it is found to be 3.00±0.76. However, the difference between these two groups of women, in respect of total number of pregnancies, is not significant (t* = 0.7938, P>0.05). In case of the women, who married only once, the mean number of livebirths is 3.35±0.15, and that, in case of the women who married more than once, is 2.60±0.60. However, the t-value shows that the difference between these two groups of women, in respect of the total number of livebirths is not significant (t** = 1.2127, P>0.05).

Table 6. Completed fertility size.

No. of mothers aged 45+years	Total pregnancy	Live births			Average no. of live births per mother	Average no. of surviving offspring per mother
		Living	Dead	Total		
26	175	109	50	159	6.12	4.19

Table 6 shows the completed fertility size among the Digaru Mishmi. Only those women who are aged 45years and above and lived continuously in wedlock till attainment of 45years of age, have been taken into consideration to find out the completed fertility size. There are 26 such mothers, who have 159 livebirths. The average number of livebirths per mother is found to be

6.12, which indicates that the completed fertility is quite high among the Digaru Mishmi. The average number of surviving offspring per such mother is 4.19.

Table 7. Child-women ratio (fertility ratio).

No. of children (0-4)years	No. of women (15-49)years	Fertility ratio
87	202	43.07

Table 7 shows the child-women ratio among the Digaru Mishmi. It is another measure of fertility in which all children aged 0 to 4years and all women aged 15 to 49 years, irrespective of marital status, have been taken into consideration. It is found that there are 87 children aged 0-4years and there are 202 women aged 15-49years, irrespective of marital status, among the Digaru Mishmi. The child-women ratio (fertility ratio) is found to be 43.07, which seems to be quite moderate.

Table 8. Ever pregnant and never pregnant married women.

	Age of married women				Total
	-24yrs	25-34yrs	35-44yrs	45+yrs	
Ever pregnant	16 (8.74)	45 (24.59)	46 (25.14)	44 (24.04)	151 (82.51)
Never pregnant	14 (7.65)	11 (6.01)	4 (2.19)	3 (1.64)	32 (17.49)
Never pregnant % of all	46.67	19.64	8.00	6.38	17.49

Table 8 shows the frequency of ever-pregnant and never-pregnant women among the Digaru Mishmi. It is found that out of 183 married women, 151(i.e., 82.51%) have experienced pregnancy at least once, whereas there are 32(17.49%) women, who have never experienced any pregnancy. It is further seen that age advances the percentage of ever-pregnant women increases, and decreases after age 45+years. So, most of the never-pregnant women are in the early part of their reproductive life. However, it shows that most of the married women have experienced pregnancy before reaching the post reproductive life.

Table 9. Live births, surviving children and mortality by age of mothers.

Age group (in yrs)	No. of mother	Total no. of pregnancy	Avg. no. of pregnancy per mother	Live births*****			% Surviving	Average live births	Mortality (based on all live births)
				Living	Dead	Total			
-24	16	28*	1.75	22	01	23	95.65	1.44	4.35
%				4.70	0.72				
25-34	44	120**	2.73	100	11	111	90.09	2.52	9.91
%				21.37	7.97				
35-44	47	238***	5.06	173	41	214	80.84	4.55	19.16
%				36.96	29.71				
45+	44	285****	6.48	173	85	258	67.05	5.86	32.95
%				36.96	61.59				
Total	151	671	4.44	468	138	606	77.23	4.01	22.77
%				77.23	22.77				

* There are 4 women who are still pregnant.
** There are 9 women who are still pregnant and 1 twin pregnancy.
*** This age group includes 2 women who are still pregnant; and also includes 2 twin pregnancy.
**** This age group includes 4 twin pregnancy.
***** Since the above pregnancies have not yet been terminated, they have not been included in further analysis.

Table 9 shows the frequency of live births, surviving children and mortality by age of mothers. It is seen that there are 151 mothers, who have had altogether 671 pregnancies. These 671 pregnancies include 15, which have not yet been matured. 4 mothers of age group below 24years are still pregnant, whereas 9 mothers in the age group 25-34years and 2 mothers in the age group 35-44years are still pregnant.

It may also be noted that there are 7 mothers (one belong to the age group 25-34years. 2 belong to the age group 35-44years and 4 belong to the age group 45+years) who have delivered twins. Each of these twin births has been taken as one pregnancy.

It shows that altogether there are 671 pregnancies and the average number of pregnancy per mother varies from 1.75 in the age group upto 24years to 6.48 in the age group 45+years. So, it indicates that the average number of pregnancy per mother increases as age of the mother advances.

Table 9 further shows that altogether there are 606 livebirths, which includes 7 twin births (for each twin two live births have been calculated). Out of 606 livebirths, 468 (i.e., 77.23%) are still surviving, whereas 138 (i.e., 22.77%) have already died. The number of surviving children

varies from 67.05% in the age group 45+years to 95.65% in the age group –24years. It further shows that the average number of livebirths among the Digaru Mishmi varies from 1.44 in the age group upto 24years to 5.86 in the age group 45+years. The overall average number of livebirths per mother is found to be 4.01. It may further be noted that average number of livebirths per mother increases as age of the mother advances.

The mortality rate (irrespective of age at the time of death) varies from 4.35% in case of mothers, aged –24years, to 32.95% in case of mothers, aged 45+years. So, it is seen from Table 9 that so far as the mortality rate is concerned, it increases from the age group –24years to 45+years.

Table 10. Reproductive wastages by age of mothers.

Age groups (in yrs)	Total no. of mothers	Total pregnancy*	Reproductive wastage		
			Abortion	Still birth	Total
-24 %	16	24 3.66	01 4.17	0 0.00	01 4.17
25-34 %	44	111 16.92	01 0.90	0 0.00	01 0.90
35-44 %	47	236 35.98	18 7.63	06 2.54	24 10.17
45+ %	44	285 43.44	26 9.12	05 1.75	31 10.88
Total %	151	656**	46 7.01	11 1.68	57 8.69

* Current pregnancies are not included.
** Includes 7 Twin births.

Table 10 shows the frequency of reproductive wastages among the Digaru Mishmi. Out of 656 pregnancies, 7.01% have terminated into abortions and 1.68% into stillbirths. Combining the frequencies of abortion and stillbirth, it is found that the frequency of reproductive wastage is about 8.69% of all pregnancies. Table10 further reveals the frequency of reproductive by age of mothers. It is found that the frequency of reproductive wastage is highest (10.88%) in the highest age group i.e., 45+years. But it decreases to 10.17% in the age group 35-44years and 4.17% to age group upto 24years. This frequency is lowest in the age group 25-34years.

Table 11. Child mortality by age group.

Age of mothers (in yrs)	No. of mothers	Live births	Child mortality				Total child mortality	
			<1yr	1-4yrs	5-9yrs	10-14yrs	No.	%
-24 %	16	23 3.80	01 1.56	0 0.00	0 0.00	0 0.00	01	4.35
25-48 %	107	431 71.12	38 59.38	21 67.74	11 55.00	07 53.85	77	17.86
49+ %	28	152 25.08	25 39.06	10 32.26	09 45.00	06 46.15	50	32.89
Total %	151	606	64 10.56	31 5.12	20 3.30	13 2.14	128	21.12

χ^2 (between generations) = 2.1928, d. f. =6, P>0.05, Insignificant.

Table 11 shows the frequency of child mortality among the Digaru Mishmi. It is found that the frequency of mortality is highest (10.56%) in the age group >1year, which is followed by 1-4years (5.12%), 5-9years (3.30%) and lowest in 10-14years (2.14%). It shows that the frequency of child mortality is highest in the children below 1year.

This Table further shows that the frequency of child mortality is highest (32.89%) in case of mothers, aged 49+years. This frequency is lower (17.86%) in case of mothers, aged 25-48years and lowest (4.35%) in case of mothers, aged below 25years. The χ^2 value (χ^2 =2.1928, d. f. =1, P<0.05) that between the generations there is no significant difference in respect of child mortality in this population. However, the overall percentage of child mortality among the Digaru Mishmi is found to be 21.12% of all livebirths.

Table 12. Surviving sibship size of married women.

Total no. of mothers	No. of surviving children (N=468)										Avg. no. of surviving children per mother
	0	1	2	3	4	5	6	7	8	9	
183 %	32 17.49	26 14.21	33 18.03	37 20.22	25 13.66	20 10.93	05 2.73	05 2.73	0 0.00	0 0.00	2.56

Table 12 shows the surviving sibship size by the number of married women. There are altogether 183 married women and they have 468 surviving children. The average number of surviving children is 2.56 per mother. It is found that there are 32 mothers (i.e., 17.49% of all

married women), who have no surviving children. There are 37 mothers (20.22%), who are in majority and are having 3 surviving children. It is followed by 18.03% of all mothers, who have 2 surviving children, 14.21% 0f them have 1 surviving children. It is also observed that 2.73% of all mothers have either 6 or 7 surviving children. Rests of the mothers are having 4 to 5 surviving children.

Table 13. Age-specific fertility rate.

Age class No.	Age group (in yrs)	No. of married women	No. of live births	Age-specific fertility
1	15-19	183	48	0.2623
2	20-24	176	196	1.1136
3	25-29	153	169	1.1046
4	30-34	115	106	0.9217
5	35-39	98	61	0.6224
6	40-44	67	20	0.2985
7	45+	47	06	0.1277
Total fertility rate				4.4508

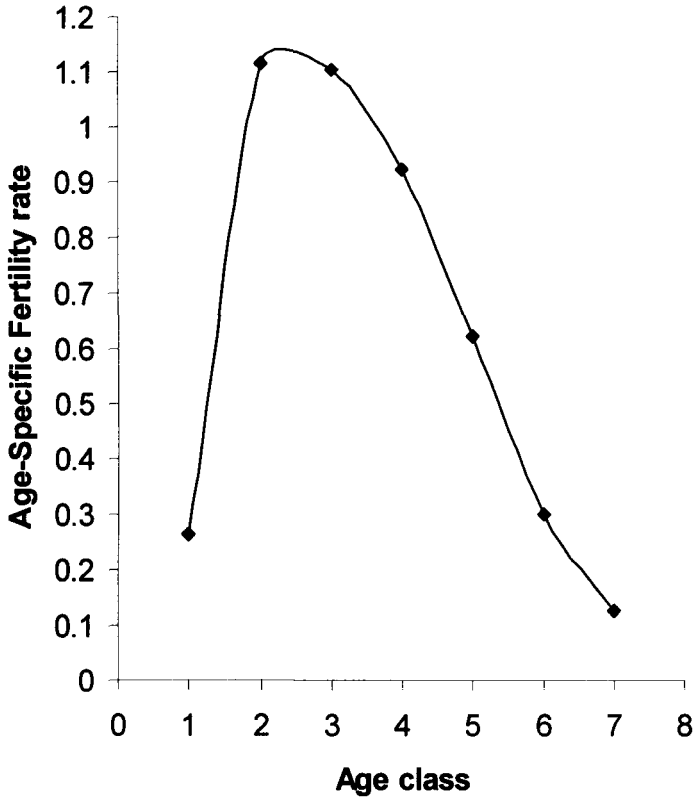


FIGURE 4. AGE-SPECIFIC FERTILITY RATE BY AGE CLASS (age groups as shown in Table13)

Table 13 shows the age-specific fertility rate of the Digaru Mishmi women. It is found that the age specific fertility rate increases from the mothers, aged 15-19years, to the mothers, age 20-24years. The age-specific fertility rate in this period increases from 0.2623 to 1.1136 and thereafter it steeply decreases from 1.1046 in age group 25-29years to 0.1277 in age group 45+years. However, the total fertility rate (T.F.R.) in this population is found to be 4.4508, which seems to be moderate. Figure 4 depicts the age-specific fertility rate among the Digaru Mishmi.

Table 14. Breeding size, effective population size, coefficient of breeding isolation and variance due to drift.

Population	Breeding size	Effective population size (N_e)	Coefficient of breeding isolation (N_{em})	Variance due to drift σ^2_{dq} (Where q =0.5)
Digaru Mishmi	267	214	0	0.001168

Table 14 gives the breeding size, effective population size, coefficient of breeding isolation and variance due to drift among the Digaru Mishmi. It is already mentioned that the total population size is 697 of which 267 individuals (i.e., 38.31%) actually constitute the breeding size in this population. It is also found that the effective population size is 214, which means 30.70% of the total population size and 80.15% of the breeding size. Wright (1938, 1940, 1943) has shown that the differentiation due to drift depends upon the product of effective population size and the migration rate (N_{em}, where N_e =effective population size, and m =migration). In the present study, it has been found that there is not a single case of marriage between Digaru Mishmi and other population. The Table 14 indicates that the coefficient of breeding isolation (N_{em}) among the Digaru Mishmi is zero, which indicates that changes due to genetic drift in this population is very great.

The variance due to random genetic drift in a population per generation, in absence of immigration, selection and mutation pressures, has been calculated according to the following formula, given by Wright (1940).

$\sigma^2_{dq} = q(1-q)/2Ne$ where, σ^2_{dq} = variance due to drift,
q = gene frequency, and
Ne = effective population size.

In the present population, it is found that the variance due to random genetic drift per generation is 0.001168 with an initial gene frequency of 0.5 (Table 14)

One of the most evolutionary forces, that brings about changes in the genetic make up of population, is natural selection. In order to estimate the total selection intensity, two statistical formulae have been applied. First one is proposed by Crow (1958), which has been subsequently modified by Johnston and Kensinger (1971) by taking into consideration the prenatal mortality.

Crow (1958) has proposed an index, which is known as an index of total selection intensity (now called index of opportunity for selection) by taking into account differential fertility and mortality. The index is separated into two components, known as the index due to fertility and the index due to mortality. Then, Crow has combined the two indices to calculate the index of opportunity for selection, which is as follows:

Proposed by Crow (1958)

$I = I_m + I_f/p_s$; $I_m = P_d/p_s$; $I_f = V_f/(X)^2$

Where, I = Index of total selection intensity,
I_m = Index of selection due to infant mortality,
I_f = Index of selection due to fertility,
X = Average livebirths per women aged 40years and above,
V_f =Variance in the number of livebirths due to fertility,
P_d = Proportion of premature deaths (deaths before 15years of age), and
P_s =Proportion of survivors ($P_s = 1-P_d$).

The above formula, proposed by Crow, have been modified by Johnston and Kensinger (1971). They have taken into consideration prenatal mortality and suggested the following formula:

$I = I_{me} + I_{me}/P_b + I_f/P_bP_s$; $I_{me} = P_{ed}/P_b$; $I_{mc} = P_d/P_s$; $I_f = V_f/(X)^2$

Where, I = Index of total selection intensity,

I_{me} = Index of selection due to embryonic mortality (i.e., prenatal mortality),

I_{mc} = Index of selection due to child mortality (i.e., mortality before 15years),

I_f = Index of selection due to fertility,

X = Mean number of livebirths per women of completed fertility (i.e., 40 years and above),

P_{ed} = Proportion of embryonic deaths (i.e., prenatal deaths),

P_b = Proportion of survivors to birth ($1 - P_{ed}$),

P_d = Proportion of child deaths (i.e., death before 15 years of age),

V_f = Variance in number of livebirths due to fertility, and

P_s = Proportion of survivors, birth to reproduction age ($1 - P_d$).

Livingstone and Spuhler (1965) have suggested that if the index of total selection intensity comes to zero, it means that there will be no change in the genetic make up of a population through selection.

Table 15. Index of total selection intensity.

According to Crow's formula (1958)	According to Johnston and Kensinger (1971)
Number of mothers aged 40yrs and above = 62 Average number of livebirths per woman aged 40yrs and above, X = 5.7581 Variance in the number of livebirths due to fertility, V_f = 2.9898 Total number of livebirths to women aged 40yrs and above = 357 Total number of premature deaths (died before the 15th yrs of life) = 92 Proportion of premature death, P_d = 0.2577 Proportion of survivors, P_s = 0.7423 Index of selection due to infant mortality, I_m = 0.3472 Index of selection due to fertility, I_f = 0.0902 Index of total selection intensity, I =0.3479	Number of mothers aged 40yrs and above = 62 Mean number of livebirths per woman of completed fertility (i.e., 40yrs and above); X = 5.7581 Variance in the number of livebirths due to fertility, V_f=2.9898 Proportion of child death (i.e., death before 15years of age) P_d =0.2577 Proportion of survivors, birth to reproductive age, P_s =0.7423 Total number of prenatal death =41 Total number of pregnancies =394 Proportion of survivors to birth, P_b = 0.8959 Proportion of embryonic death (i.e., prenatal death), P_{ed} = 0.1041 Index of selection due to fertility, I_f = 0.0902 Index of selection due to embryonic mortality (prenatal mortality), I_{me} = 0.1162 Index of selection due to child mortality (mortality before 15yrs of age), I_{mc} =0.3472 Index of total selection intensity, I = 0.4252

Table 15 shows the index of total selection intensity in the Digaru Mishmi. It has been calculated according to the formula, given by Crow (1958) as well as according to the modified formula, given by Johnston and Kensinger (1971). The results have been set out separately in the Table 15. It shows that there are 62 mothers, who are aged 40years and above. The mean number

of livebirths (X) is 5.7581 with its variance (V_f) 2.9898. Total number of livebirths to women aged 40years and above, is 357.The number of premature deaths (i.e., before 15 years of age) is 92. According to Crow's formula, the proportion of premature deaths (P_d) is found to be 0.2577 and proportion of survivors, P_s (i.e., $P_s = 1 - P_d$) is 0.7423. The index of selection due to mortality (I_m) is 0.3472 and that due to fertility (I_f) 0.0902. So, the index of total section intensity (I), according to Crow's formula, is 0.3479. It is that the selection is taking place more due to differential mortality than due to differential fertility. However, selection is operating moderately on this population.

According to Johnston and Kensinger's modified formula, it has been found that proportion of child death i.e., P_d, proportion of survivors (i.e., birth to reproductive age) P_s and the proportion of survivors to birth, P_b are 0.2577, 0.7423 and 0.8959 respectively. It is also seen that the proportion of embryonic death (i.e., abortion and still births) P_{ed} is 0.1041. The index of selection due to fertility (I_f), embryonic mortality (I_{me}) and child mortality (I_{mc}) are 0.0902, 0.1162 and 0.3472 respectively. Basing on all these indices, it is found that the total selection intensity (I) is 0.4252 in the Digaru Mishmi, which is higher then that found according to Crow's formula (1958).

Now, we shall deal with the demographic characters of Miju Mishmi.

Table 16 shows the distribution of total population by age, sex and marital status in the Miju Mishmi. The total population is 587 of which 282 are males and 305 are females. It shows that in the total population, 48.04% are males and 512.96% females. The overall sex ratio is 1:1.08, which shows that this number of females is slightly more than that of males, though the overall sex ratio in this population is very near to the ideal sex ratio of 1:1. Of all males, it is

found that about 64.18%, 34.75% and 1.06% are unmarried, married and widowed/divorced respectively.

Table.16. Distribution of total population by age, sex and marital status.

Age groups (in yrs)	Unmarried		Married		Widowed/ Divorced		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
0-4	28 (4.77)	19 (3.24)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	28 (4.09)	19 (3.24)
5-9	40 (6.81)	51 (8.69)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	40 (6.81)	51 (8.69)
10-14	37 (6.30)	35 (5.96)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	37 (6.30)	35 (5.96)
15-19	42 (7.16)	44 (7.50)	0 (0.00)	02 (0.34)	0 (0.00)	0 (0.00)	42 (7.16)	46 (7.84)
20-24	20 (3.41)	21 (3.58)	02 (0.34)	06 (1.02)	0 (0.00)	0 (0.00)	22 (3.75)	27 (4.60)
25-29	08 (1.36)	04 (0.68)	11 (1.87)	18 (3.07)	0 (0.00)	0 (0.00)	19 (3.24)	23 (3.92)
30-34	05 (0.85)	01 (0.17)	09 (1.53)	18 (3.07)	0 (0.00)	0 (0.00)	14 (2.38)	19 (3.24)
35-39	01 (0.17)	0 (0.00)	16 (2.73)	19 (3.24)	0 (0.00)	0 (0.00)	17 (2.90)	19 (3.24)
40-44	0 (0.00)	0 (0.00)	10 (1.70)	16 (2.73)	0 (0.00)	02 (0.34)	10 (1.70)	18 (3.07)
45-49	0 (0.00)	0 (0.00)	18 (3.07)	17 (2.90)	0 (0.00)	02 (0.34)	18 (3.07)	19 (3.24)
50-54	0 (0.00)	0 (0.00)	12 (2.04)	04 (0.68)	01 (0.17)	02 (0.34)	13 (2.21)	06 (1.02)
55-59	0 (0.00)	0 (0.00)	09 (1.53)	05 (0.85)	01 (0.17)	03 (0.51)	10 (1.70)	08 (1.36)
60-64	0 (0.00)	0 (0.00)	05 (0.85)	01 (0.17)	01 (0.17)	02 (0.34)	06 (1.02)	03 (0.51)
65-69	0 (0.00)	0 (0.00)	02 (0.34)	02 (0.34)	0 (0.00)	01 (0.17)	02 (0.34)	03 (0.51)
70+	0 (0.00)	0 (0.00)	04 (0.68)	02 (0.34)	0 (0.00)	07 (1.19)	04 (0.68)	09 (1.53)
Total	181 (64.65)	175 (57.38)	98 (34.75)	110 (36.07)	03 (1.06)	20 (6.56)	282 (48.04)	305 (51.96)
Grand total	356 (60.65)		208 (35.43)		23 (3.92)		587 (100.00)	

Figures in parentheses indicates percentage

In case of females, these are 57.38%, 36.07% and 6.56% respectively. Taking males and females together, it is found that 60.65% of all individuals are unmarried, whereas35.43% are married and 3.92% are widowed/divorced. It is seen that no individual after 34years remains unmarried, excepting 1 (0.17%) male. However, it is seen from the Table 16 that most of marriages have taken place between 15 and 29years of age. It holds good for both sexes. It is

found that the mean age at marriage for females is 19.86±0.27years and that for males 25.56±0.48years in this population.

Table 17. Population by age, sex and marital status (extracted from table 16).

Age group (in yrs)	Unmarried		Married		Widowed/Divorced		Total		M+F	Sex ratio
	Male	Female	Male	Female	Male	Female	Male	Female		
0-14	105	105	0	0	0	0	105	105	210	1:1
%	17.89	17.89	0.00	0.00	0.00	0.00	17.89	17.89	35.78	
15-49	76	70	66	96	0	05	142	171	313	1:1.20
%	12.95	11.92	11.24	16.35	0.00	0.85	24.19	29.13	53.32	
50+	0	0	32	14	03	15	35	29	64	1:0.83
%	0.00	0.00	5.45	2.38	0.51	2.56	5.96	4.94	10.90	
Total	181	175	98	110	03	20	282	305	587	1:1.08

Table 17, extracted from the Table16, shows the total population according to age group and sex. It is seen that 17.89% of males and 17.89% of females belong to the age group 0-14years. In the reproductive age group i.e., 15-49years, 24.19% and 29.19% are males and females respectively, whereas in the post reproductive age group i.e., 50+years, 5.96% and 4.94% are males and females respectively.

In the reproductive age group, 12.95% and 11.92% are unmarried males and females, respectively. In the same age group 0.85% of females are either widowed or divorced. The percentages of individuals, who are widowed or divorced, are 0.51% for males and 2.56% for females in the post reproductive age group i.e., 50+years. It is also found that in this population, nearly 53.32% of all individuals belong to the reproductive age group, whereas 35.78% belong to the pre-reproductive age group and 10.90% of them are in the post-reproductive age group.

In this population, it is seen that 35.78%, 53.32% and 10.90% of all individuals belong to the age group of 0-14years (pre-reproductive group), 15-49years (reproductive group) and 50+years (post-reproductive group) respectively. According to Sundbarg's classification of population, based on age group distributions, (Datta, 1972), the Miju Mishmi seem to be of progressive type.

As mentioned earlier, the overall sex ratio in this population is 1:1.08, which shows that it is slightly tilted in favour of females. It is further observed that the sex ratio in the pre-reproductive age group i.e., 0-14years, is 1:1, which is ideal sex ratio and indicates that the number of males equal to the number of females. But, in the reproductive age group i.e., 15-49 years, it is seen that the sex ratio is 1:1.20. It is tilted in favour of females. So, it indicates that male mortality is slightly higher than female mortality in the earlier age group. In the post-reproductive age group i.e., 50+years, the sex ratio is slightly tilted in favour of males, which is 1:0.83. It indicates that the average longevity is perhaps, slightly higher in males than in females.

In this population, it has been calculated that the mean age at first child birth in case of female is 22.09±0.17years and that in case of male is 27.86±0.40years. So, the mean age at first childbirth, taking both males and females together, becomes 24.98years. Thus, in the present analysis for Miju Mishmi population, we have taken 25years as a generation length, following the method, suggested by Glass (1956).

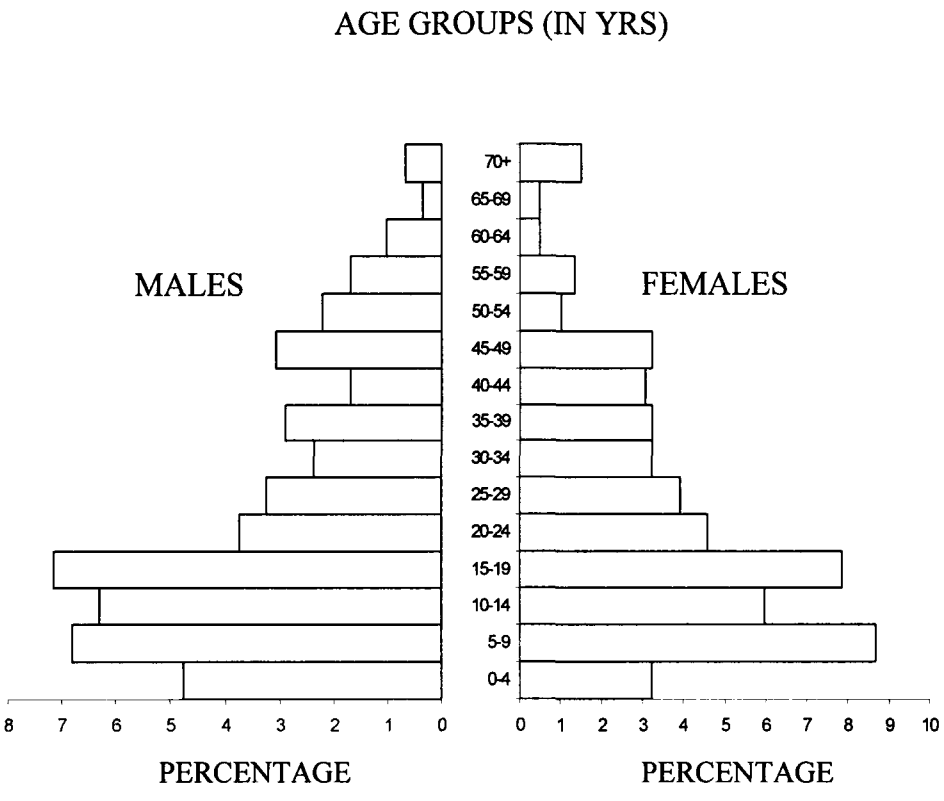


FIGURE 5. POPULATION PYRAMID (MIJU MISHMI).

Figure 5 shows the diagramatic representation of Miju population by age groups. The entire pyramid has been divided into 15 age groups. It is seen that at age group of 0-4, it is broad and slightly increases at the age group of 5-9. It is seen from the figure that the base of the pyramid is broader and gradually shrunks as the age groups increases. The present population is progressive in nature.

Table 18. Multiple marriages by age of spouses.

Individual married		-25years		26-50years		51+years		Total		M+F
		Male	Female	Male	Female	Male	Female	Male	Female	
Once		02	08	53	86	28	28	83	122	205
%		100.00	100.00	88.33	93.48	73.68	93.33	83.00	93.85	89.13
More than once	Twice	0	0	07	06	09	02	16	08	24
	%	0.00	0.00	11.67	6.52	23.68	6.67	16.00	6.15	10.43
	3 times	0	0	0	0	01	0	01	0	01
	%	0.00	0.00	0.00	0.00	2.63	0.00	1.00	0.00	0.43
	Total	0	0	07	06	10	02	17	8	25
	%	0.00	0.00	11.67	6.52	26.32	6.67	17.00	6.15	10.87
Total		02	08	60	92	38	30	100	130	230
%		100.00	100.00	100.00	100.00	99.99	100.00	100.00	100.00	

Table 18 shows the frequency of multiple marriages by age of spouses. In the third generation i.e., upto age 25years, no individual has been found to marry more than once. In the second generation, i.e., 26-50years, 11.67% and 6.52% of males and females, respectively, have married two times. But, in this generation, no individual has been found to have married more than twice. In the first generation, i.e., 51+years, 23.38% and 6.67% of males and females respectively have married two times. In this generation, one man (2.63%) has married three times. But no woman has been found to have married more than two times in this generation.

Table 18 further reveals that about 10.87% of the total married (including widowed/divorced) individuals have changed their mates. It is seen that males have changed their mates more often than females (males, 17.00%; females, 6.15%). However, it is found that the frequency of male individuals, who married more than once, increases from lower age group

to higher age group. In case of females, the order is almost similar. It is seen that 83.00% and 93.85% of married (including widowed/divorced) males and females, respectively, have married only once, whereas nearly 16.00% of males and 6.15% of females have married twice. It is further noticed that among the Miju Mishmi, there is only one male individual (1.00%), who have married thrice, whereas no woman has been found to be married more than two times.

Table 18A. Multiple marriages by age of spouses.

Individual married	-25years	26-50years	51+years	Total
Once %	10 100.00	139 91.45	56 82.35	205 89.13
More than once %	0 0.00	13 8.55	12 17.65	25 10.87
Total %	10 100.00	152 100.00	68 100.00	230 100.00

When both sexes are pooled together, as shown in the Table 18A, the frequency of individuals more than once married increases through the lower age group to the higher age group (0.00%, 8.55% and 21.92% for age groups ≤25years, 26-50years and 51+years respectively). It is seen that as age group progresses, both males and females incline to change their mates.

Table 18B. Multiple marriages by sex.

Individual married	Male		Female		Total	
	No	%	No	%	No	%
Once %	83 40.49	(83.00)	122 59.51	(93.85)	205 100.00	(89.13)
More than once %	17 68.00	(17.00)	08 32.00	(6.15)	25 100.00	(10.87)
Total %	100 43.48	(100.00)	130 56.62	(100.00)	230 100.00	(100.00)

Figures in the parentheses indicate the percentage out of total male or female.

Table 18B, extracted from Table 18, shows the frequency of multiple marriages by sex. Out of 205 individuals, who have married only once, 83 of them (40.49%) are males and 122 of them (59.51%) are females. There are 25 individuals, who have married more than once, out of

which 68.00% are males and 32.00% are females. In this population, there are100 males out of which 17.00% have married more than once, whereas there are 130 females, out of which 6.15% have married more than once. So, it indicates that the frequency of persons marrying more than once is more among the males than among the males. In respect of this, the difference between male and female is remarkable.

Table 19. Binomial test of proportion in respect of multiple marriages.

Sex	No.	No. of individuals married more than once	T_1	T_2	Inference
Male	100	17	0.1085	0.0414	Significant
		17.00			
Female	130	8			
		6.15			

Table 19 justifies the above statement. Using the binomial test of proportion, it is found that there is significant difference between male and female in respect of the frequency of changing mates (T_1=0.1085 and T_2=0.0414).

Table 20. Fertility by times of marriage.

Times of marriage	No. of married women	Total pregnancy		Total no. of live births	
		No.	Mean ±SE		Mean ±SE
Once	122	535	4.38±0.25	513	4.20±0.23
More than once	08	39	4.88±0.64	39	4.88±0.64

t* (total no. of pregnancies)=0.7277, P>0.05, Insignificant
t** (total no. of live births) = 0.9999, P>0.05, Insignificant

Table 20 shows the fertility performances of women by times of marriages. There are 122 women, who have married once, and 8 women, who have married more than once. In case of the women, who married only once, the mean number of pregnancy is found to be 4.38±0.25, whereas in case of women who married more than once, it is found to be 4.88±0.64. However, the difference between these two groups of women, in respect of total number of pregnancies, is not significant (t* =0.7277, P>0.05). In case of the women, who married only once, the mean number of live births is 4.20±0.23 and that, in case of the women, who married more than once,

is 4.88±0.64. However, the t-value shows that the difference between these two groups of women, in respect of total number of live births is not significant (t** = 0.9999, P>0.05).

Table 21. Completed fertility size.

No. of mothers aged 45+years	Total pregnancy	Live births			Average no. of live births per mother	Average no. of surviving offspring per mother
		Living	Dead	Total		
31	216	128	73	201	6.48	4.13

Table 21 shows the completed fertility size among the Miju Mishmi. Only those women who are aged 45years and above and lived continuously in wedlock till attainment of age, have been taken into consideration to find out the completed fertility size. There are 31 such mothers, who have 201 live births. The average number of live births per mother is found to be 6.97, which indicates that the completed fertility is quite high among the Miju Mishmi. The average number of surviving offspring per such mother is 4.13.

Table 22. Child-women ratio (fertility ratio).

No. of children (0-4)years	No. of women (15-49)years	Fertility ratio
47	171	27.49

Table 22 shows the child-women ratio among the Miju Mishmi. It is another measure of fertility in which all children aged 0 to 4years and all women aged 15-49years, irrespective of marital status, have been taken into consideration. It is found that there are 47 children aged 0-4years and there are 171 women aged 15-49years irrespective of marital status, among the Miju Mishmi. The child-women ratio (fertility ratio) is found to be 27.49, which seems to be quite low.

Table 23. Ever pregnant and never pregnant married women.

	Age of married women				Total
	-25yrs	26-35yrs	36-45yrs	46+yrs	
Ever pregnant	06	34	38	41	119
%	4.62	26.15	28.46	34.61	91.54
Never pregnant	05	03	02	01	11
%	3.85	2.31	1.54	0.77	8.46
Never pregnant % of all	45.45	8.11	5.00	2.38	8.46

Table 23 shows the frequency of ever pregnant and never pregnant women among the Miju Mishmi. It is found that out of 130 married women, 119 (i.e., 91.54%) have experienced pregnancy at least once, whereas there are 11 (i.e., 8.46%) women, who have never experienced any pregnancy. It is further seen that as age advances, the percentage of ever pregnant women increases. It is also seen that most of the never pregnant women are in the early part of their reproductive life. However, it shows that most of the married women have experienced pregnancy before reaching the post-reproductive life.

Table 24. Live births, surviving children and mortality by age of mothers.

Age group (in yrs)	No. of mothers	Total no. of pregnancy	Avg. no. of pregnancy per mother	Live births****			% Surviving	Average live births	Mortality (based on all live births)
				Live	Dead	Total			
-25 %	06	09	1.50	09 2.13	00 0.00	09	100.00	1.50	0.00
26-35 %	34	115*	3.38	100 23.64	06 4.65	106	94.34	3.12	5.66
36-45 %	38	169**	4.45	133 31.44	28 21.71	161	82.61	4.24	17.39
46+ %	41	294***	7.17	181 42.79	95 73.64	276	65.58	6.73	34.42
Total %	119	587	4.93	423 76.63	129 23.37	552	76.63	4.64	23.37

* There are 10 women who are still pregnant and 2 twin pregnancy.
** There are 3 women who are still pregnant.
*** These age group includes 4 twin pregnancy.
**** Since the above pregnancies have not yet been terminated, they have not been included in further analysis.

Table 24 shows the frequencies of live births, surviving children and mortality by age of mothers. It is seen that there are 119 mothers, who have had altogether 587 pregnancies. These 587 pregnancies include 13 pregnancies, which have not yet been matured. 10 mothers of age group 26-35years are still pregnant, whereas 3 mothers in the age group 36-45years are still pregnant. It may also be noted that there are 6 mothers (2 belong to the age group 26-35years, and 4 belong to age group 46+years) who have delivered twins. Each of these twin births has been taken as one pregnancy.

It shows that altogether there are 587 pregnancies and the average number of pregnancy per mother is 4.93. It is seen that the average number of pregnancy per mother varies from 1.50 in the age group upto 25years to 7.17 in the age group 46+years. So. It indicates that the average number of pregnancies per mother increases as age of the mother advances.

Table 24 further shows that altogether there are 552 live births, which includes 6 twin births (for each twin, two live births have been counted). Out of 552 live births, 423 (i.e., 76.63%) are still surviving, whereas 129 (i.e., 23.37%) have already died. The number of surviving children varies from 65.58% in the age group 46+years to 100.00% in the age group – 25years. It further shows that the average number of live births among the Miju Mishmi varies from 1.50 in the age group upto 25years to 6.73 in the age group 46+years. The overall average number of live births per mother is found to be 4.64. It may further be noted that the average number of live births per mother increases as age of the mother advances.

The mortality rate (irrespective of age at the time of death) varies from 5.66% in case of mothers aged 26-35years, to 34.42% in case of mothers, aged 46+years. So, it is seen from Table 24 that so far as the mortality rate is concerned, it increases from the age group –25years to 46+years.

Table 25. Reproductive wastage by age of mothers.

Age groups (in yrs)	Total no. of mothers	Total pregnancy*	Reproductive wastage		
			Abortion	Still birth	Total
-25yrs	06	09	0	0	0
%		1.57	0.00	0.00	0.00
26-35yrs	34	105	01	0	01
%		18.29	0.95	0.00	0.95
36-45yrs	38	166	04	01	05
%		28.92	2.41	0.60	3.01
46+yrs	41	294	13	09	22
%		51.22	4.42	3.06	7.48
Total	119	574**	18	10	28
%			3.14	1.74	4.88

* Current pregnancies are not included.

** Includes 6 Twin births.

Table 25 shows the frequency of reproductive wastage among the Miju Mishmi. Out of 574 pregnancies, 3.14% have terminated into abortions and 1.74% into stillbirths. Combining the frequencies of abortion and stillbirth together, it is found that the frequency of reproductive wastage is about 4.88% of all pregnancies. Table 25 further reveals the frequency of reproductive wastage by age group of mothers. It is found that the frequency of reproductive wastage is highest (7.48%) in the highest age group, i.e., 46+years. But it decreases to 3.01% in the age group 36-45years. This frequency (0.95%) is lowest in the age group 26-35years. Frequency of reproductive wastage is nil in the age group upto 25years.

Table 26. Child mortality by age group.

Age of mothers (in yrs)	No. of mothers	Live births	Child mortality				Total child mortality	
			<1yr	1-4yrs	5-9yrs	10-14yrs	No.	%
-25	06	09	0	0	0	0	0	0.00
%		1.63	0.00	0.00	0.00	0.00		
26-50	84	367	46	23	02	02	73	19.89
%		66.49	63.01	67.65	33.33	28.57		
51+	29	176	27	11	04	05	47	26.70
%		31.88	36.99	32.35	66.67	71.43		
Total	119	552	73	34	06	07	120	21.74
%			13.22	6.16	1.09	1.27		

χ^2 (between the generations)=5.7704, d. f. =3, P>0.05, Insignificant.

Table 26 shows the frequency of child mortality among the Miju Mishmi. It is found that the frequency of mortality is highest (i.e., 13.22%) in the age group >1year, which is followed by 1-4years (6.16%), 10-14years (1.27%) and lowest in the age group 5-9years (1.09%). It shows that the frequency of child mortality is highest in the children below 1year.

This Table further shows that the frequency of child mortality is highest (26.70%) in case of mothers, aged 51+years. This frequency is lower (19.89%) in case of mothers, aged 26-50years. The frequency of child mortality in case of mothers, aged below 26years is 0.00%. The χ^2 value (χ^2 =5.7704, d. f. =3, P>0.05) shows that between the generations there is no significant difference in respect of child mortality in this population. However, the overall percentage of child mortality among the Miju Mishmi is found to be 21.74% of all live births.

Table 27. Surviving sibship size of married women.

Total no. of mothers	No. of surviving children (N= 423)										Avg. no. of surviving children per mother
	0	1	2	3	4	5	6	7	8	9	
130	09 6.92	12 9.23	20 15.38	30 23.08	29 22.31	16 12.31	03 2.31	06 4.62	02 1.54	01 0.77	3.25

Table 27 shows the surviving sibship size by the number of married women. There are altogether 130 married women and they have 423 surviving children. The average number of surviving children is 3.25 per mother.

It is found that there are 9 mothers (i.e., 6.92% of all married women), who have no surviving children. There are 30 mothers (23.08%), who are in majority and having 3 surviving children. It is followed by 22.31% of all married women, who have 4 surviving children, 15.38% of them have 2 surviving children and 12.31% of them have 5 surviving children. 9.23% of all married women have 1 surviving child. Rest of the mothers are having 6 to 9 surviving children.

Table 28. Age-specific fertility rate.

Age class No.	Age group (in yrs)	No. of married women	No. of live births	Age-specific fertility
1	15-19	130	05	0.0385
2	20-24	128	164	1.2813
3	25-29	122	197	1.6148
4	30-34	103	118	1.1456
5	35-39	85	40	0.4706
6	40-44	66	20	0.3030
7	45+	48	08	0.1667
Total fertility rate				4.0205

Table 28 shows the age-specific fertility rate of the Miju Mishmi women. It is found that the age-specific fertility rate increases from the mothers, aged 15-19years, to the mothers, aged, 25-29years. The age-specific fertility rate in this period increases from 0.0385 to 1.6148, and thereafter it steeply decreases from 1.1456 in age group 30-34years to 0.1667 in age group 45+years. However, the total fertility rate (T.F.R.) in this population is found to be 4.0205.

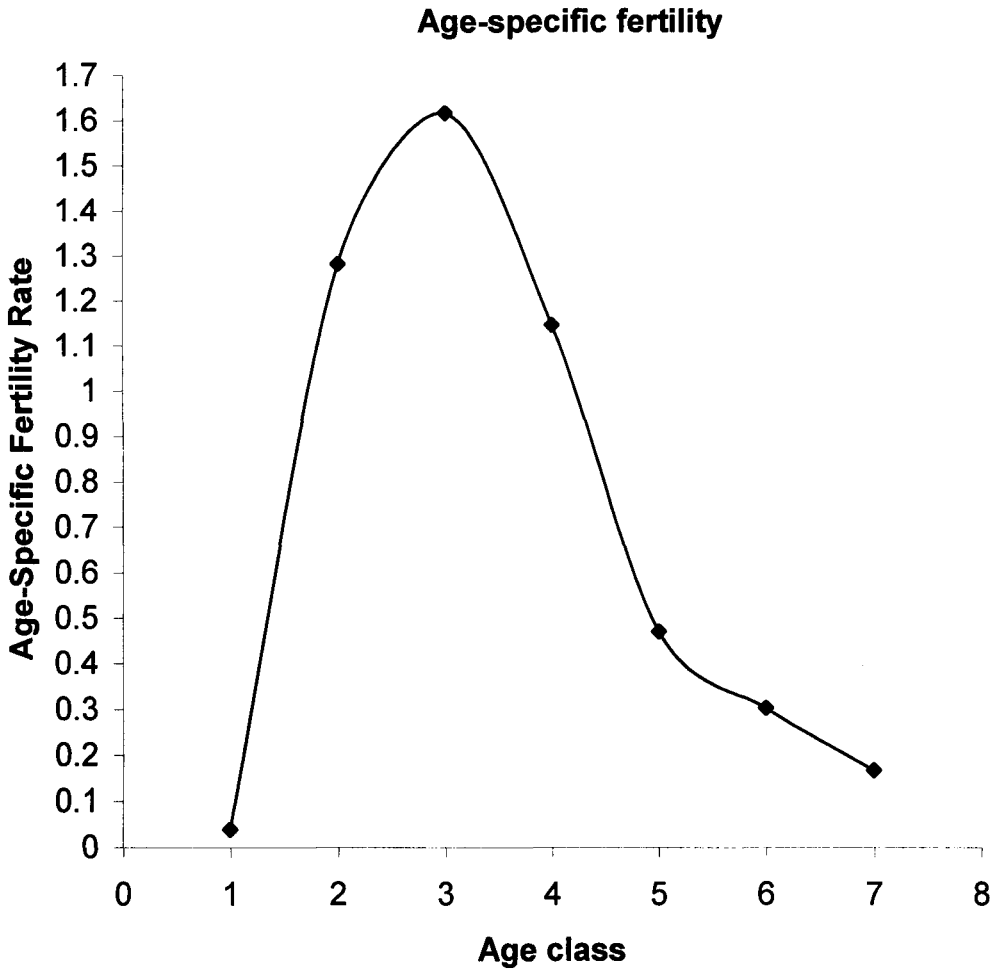


FIGURE 6. AGE-SPECIFIC FERTILITY RATE BY AGE CLASS (age groups as shown in Table28)

Table 29. Breeding size, effective population size, coefficient of breeding isolation and variance due to drift.

Population	Breeding size	Effective population size (N_e)	Coefficient of breeding isolation (N_{em})	Variance due to drift σ^2_{dq} (Where q =0.5)
Miju Mishmi	212	111	0	0.001126

Table 29 gives the breeding size, effective population size, coefficient of breeding isolation and variance due to drift among the Miju Mishmi. It is already mentioned that the total population size is 587 of which 212 individuals (i.e., 36.16%) actually constitute the breeding size in this population. it is also found that the effective population size is 111, which means

18.91% of the total population size and 52.36% of the breeding size. In the present study, it has been found that there is not a single case of marriage between Miju Mishmi and other population. The Table 29 indicates that the coefficient of breeding isolation (N_{em}) among the Miju Mishmi is zero, which indicates that changes due to genetic drift in this population is very great.

In the present population, it is found that the variance due to random genetic drift per generation is 0.001126 with an initial gene frequency of 0.5 (Table 29)

Table30. Index of total selection Intensity.

According to Crow's formula (1958)	According to Johnston and Kensinger (1971)
Number of mothers aged 40yrs and above = 63 Average number of livebirths per woman aged 40yrs and above, X=5.9048 Variance in the number of livebirths due to fertility, V_f=5.6226 Total number of livebirths to women aged 40yrs and above =372 Total number of premature deaths (died before the 15th yrs of life) =108 Proportion of premature death, P_d =0.2903 Proportion of survivors, P_s=0.7097 Index of selection due to infant mortality, I_m=0.4090 Index of selection due to fertility, I_f= 0.1613 Index of total selection intensity, I =0.4516	Number of mothers aged 40yrs and above =63 Mean number of livebirths per woman of completed fertility (i.e., 40yrs and above); X =5.9048 Variance in the number of livebirths due to fertility, V_f =5.6226 Proportion of child death (i.e., death before 15years of age) P_d =0.2903 Proportion of survivors, birth to reproductive age, P_s =0.7097 Total number of prenatal death =24 Total number of pregnancies =392 Proportion of survivors to birth, P_b =0.9388 Proportion of embryonic death (i.e., prenatal death), P_{ed} =0.0612 Index of selection due to fertility, I_f=0.1613 Index of selection due to embryonic mortality (prenatal mortality), I_{me}=0.0652 Index of selection due to child mortality (mortality before 15yrs of age), I_{mc} =0.4090 Index of total selection intensity, I =0.4950

Table 30 shows the index of total selection intensity in the Miju Mishmi. It has been calculated according to the formula, given by Crow (1958) as well as according to the modified formula, given by Johnston and Kensinger (1971). The results have been set out separately in the Table 30. It shows that there are 63 mothers, who are aged 40+years and above. The mean number of live births (X) is 5.9048 with its variance (V_f) 5.6226. Total number of live births to

women, aged 40years and above, is 372. The number of premature death (i.e., before 15years of age) is 108. According to Crow's formula, the proportion of premature deaths (P_d) is found to be 0.2903 and proportion of survivors, P_s (i.e., $P_s = 1-P_d$) is 0.7097. The index of selection due to mortality (I_m) is 0.4090 and that due to fertility (I_f) is 0.1613. So, the index of total selection intensity (I), according to Crow's formula, is 0.4516. It is seen that the selection is taking place more due to differential mortality than due to differential fertility. However, selection is operating moderately on this population.

According to Johnston and Kensinger's modified formula, it has been found that proportion of child death i.e., P_d, Proportion of survivors (i.e., birth to reproductive age) P_s and proportion of survivor to birth, P_b, are 0.2903, 0.7097 and 0.9388 respectively. It is also seen that the proportion of embryonic deaths (i.e., abortions and stillbirths) P_{ed} is 0.0612. The index of selection due to fertility (I_f), embryonic mortality (I_{me}) and child mortality (I_{mc}) are 0.1613, 0.0652 and 0.4090 respectively. Basing on all there indices, it is found that the total selection intensity (I) is 0.4950 in the Miju Mishmi, which is higher than that found according to Crow's formula (1958).

Lastly, we shall deal with the demographic characters of Idu Mishmi.

Table 31 shows the distribution of total population by age, sex and marital status in the Idu Mishmi. The total population is 562 of which 267 are males and 295 are females. It shows that in the total population, 47.51% are males and 52.49% are females. The overall sex ratio is 1:1.10, which shows that the number of females is slightly more than that of males, though the overall sex ratio in this population is very near to the ideal sex ratio of 1:1. Of all males, it is found that about 63.30%, 32.58% and 4.12% are unmarried, married and widowed/divorced, respectively. In case of the females, these are 59.32%, 31.19% and 9.49% respectively.

Table 31. Distribution of total population by age, sex and marital status.

Age groups (in yrs)	Unmarried		Married		Widowed/ Divorced		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
0-4	32 (5.69)	32 (5.69)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	32 (5.69)	32 (5.69)
5-9	44 (7.83)	40 (7.12)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	44 (7.83)	40 (7.12)
10-14	33 (5.87)	32 (5.69)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	33 (5.87)	32 (5.69)
15-19	22 (3.91)	39 (6.94)	0 (0.00)	01 (0.18)	0 (0.00)	0 (0.00)	22 (3.91)	40 (7.12)
20-24	19 (3.38)	25 (4.45)	02 (0.35)	07 (1.24)	0 (0.00)	01 (0.18)	21 (3.74)	33 (5.87)
25-29	15 (2.67)	06 (1.07)	11 (1.96)	25 (4.45)	02 (0.35)	02 (0.35)	28 (4.98)	33 (5.87)
30-34	02 (0.35)	0 (0.00)	17 (3.02)	14 (2.49)	0 (0.00)	03 (0.53)	19 (3.38)	17 (3.02)
35-39	02 (0.35)	01 (0.18)	15 (2.67)	15 (2.67)	01 (0.18)	02 (0.35)	18 (3.20)	18 (3.20)
40-44	0 (0.00)	0 (0.00)	12 (2.13)	18 (3.20)	0 (0.00)	01 (0.18)	12 (2.13)	19 (3.38)
45-49	0 (0.00)	0 (0.00)	16 (2.85)	07 (1.24)	0 (0.00)	04 (0.71)	16 (2.85)	11 (1.96)
50-54	0 (0.00)	0 (0.00)	09 (1.60)	02 (0.35)	0 (0.00)	07 (1.24)	09 (1.60)	09 (1.60)
55-59	0 (0.00)	0 (0.00)	04 (0.71)	01 (0.18)	04 (0.71)	03 (0.53)	08 (1.42)	04 (0.71)
60-64	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.18)	02 (0.35)	03 (0.53)	02 (0.35)	04 (0.71)
65-69	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.18)	01 (0.18)	02 (0.35)	01 (0.18)	03 (0.53)
70+	0 (0.00)	0 (0.00)	01 (0.18)	0 (0.00)	01 (0.18)	0 (0.00)	02 (0.35)	0 (0.00)
Total	169 (63.30)	175 (59.32)	87 (32.58)	92 (31.19)	11 (4.12)	28 (9.49)	267 (47.51)	295 (52.49)
Grand total	344 (61.21)		179 (31.85)		39 (6.94)		562 (100.00)	

Figures in parentheses indicates percentage

Taking males and females together, it is found that 61.12% of all individuals are unmarried, whereas 31.85% are married and 6.94% are widowed/divorced. It is seen that no individuals after age of 35years remains unmarried excepting 2 (0.35%) males and 1 (0.18%)

female. However, it is seen from Table 31 that most of marriages have taken place between 20 and 29years of age. It holds good for both sexes. It is found that the mean age at marriage for female is 20.07±0.23years and that for male is 25.56±0.23years in this population.

Table 32. Population by age, sex and marital status (extracted from table 31).

Age group (in yrs)	Unmarried		Married		Widowed/Divorced		Total		M+F	Sex ratio
	Male	Female	Male	Female	Male	Female	Male	Female		
0-14	109	104	0	0	0	0	109	104	213	1:0.95
%	19.39	18.50	0.00	0.00	0.00	0.00	19.39	18.50	37.90	
15-49	60	71	73	87	03	13	136	171	307	1:1.26
%	10.68	12.63	12.99	15.48	0.53	2.31	24.20	30.43	54.63	
50+	0	0	14	05	08	15	22	20	42	1:0.91
%	0.00	0.00	2.49	0.89	1.42	2.67	3.91	3.56	7.47	
Total	169	175	87	92	11	28	267	295	562	1:1.10

Table 32, extracted from Table 31, shows the total population according to age group and sex. It is seen that 19.39% of males and 18.50% of females belong to the age group of 0-14years. In the reproductive age group, i.e., 15-49years, 24.20% and 30.43% are males and females respectively, whereas in the post reproductive age group, i.e., 50+years, 3.91% and 3.56% are males and females respectively.

In the reproductive age group, 10.68% and 12.63% are unmarried males and females respectively. In the same reproductive age group 0.53% of males and 2.31% of females are either widowed or divorced. The percentage of individuals, who are widowed or divorced, are 1.42% for males and 2.67% for females in the post reproductive age group i.e., 50+years.

In this population, it is seen that 37.90%, 54.63% and 7.47% of all individuals belong to the pre-reproductive age group (0-14years), reproductive age group (15-49years) and post reproductive age group (50+years) respectively. According to Sundbarg's classification of population, based on age group distribution, (Datta, 1972), the Idu Mishmi seem to be of progressive type.

As mentioned earlier, the overall sex ratio in this population is 1:1.10, which shows that it

is slightly tilted in favour of females. But, it is further observed that the sex ratio in the pre-reproductive age group i.e., 0-14years, is 1:0.95, which indicates that the number of males is slightly more than that of females. But, in the reproductive age group i.e., 15-49years, it is seen that the sex ratio is 1:1:26. It is tilted in favour of females. So, it indicates that male mortality is slightly higher than female mortality in the earlier age group. In the post reproductive age group i.e. 50+ years, the sex ratio is again slightly tilted in favor of males, which is 1:0:91. It indicates that the average longevity is perhaps slightly higher in males than in females.

In this population, it has been calculated that the mean age of first childbirth in case of females is 22.17±0.15 years and that in case of males 27.88±0.37 years. So the mean age at first childbirth, taking both males and females together, becomes 25.03 years. Thus in the present analysis, for Idu Mishmi population, we have taken 25 years as a generation length, following the method, suggested by Glass (1956).

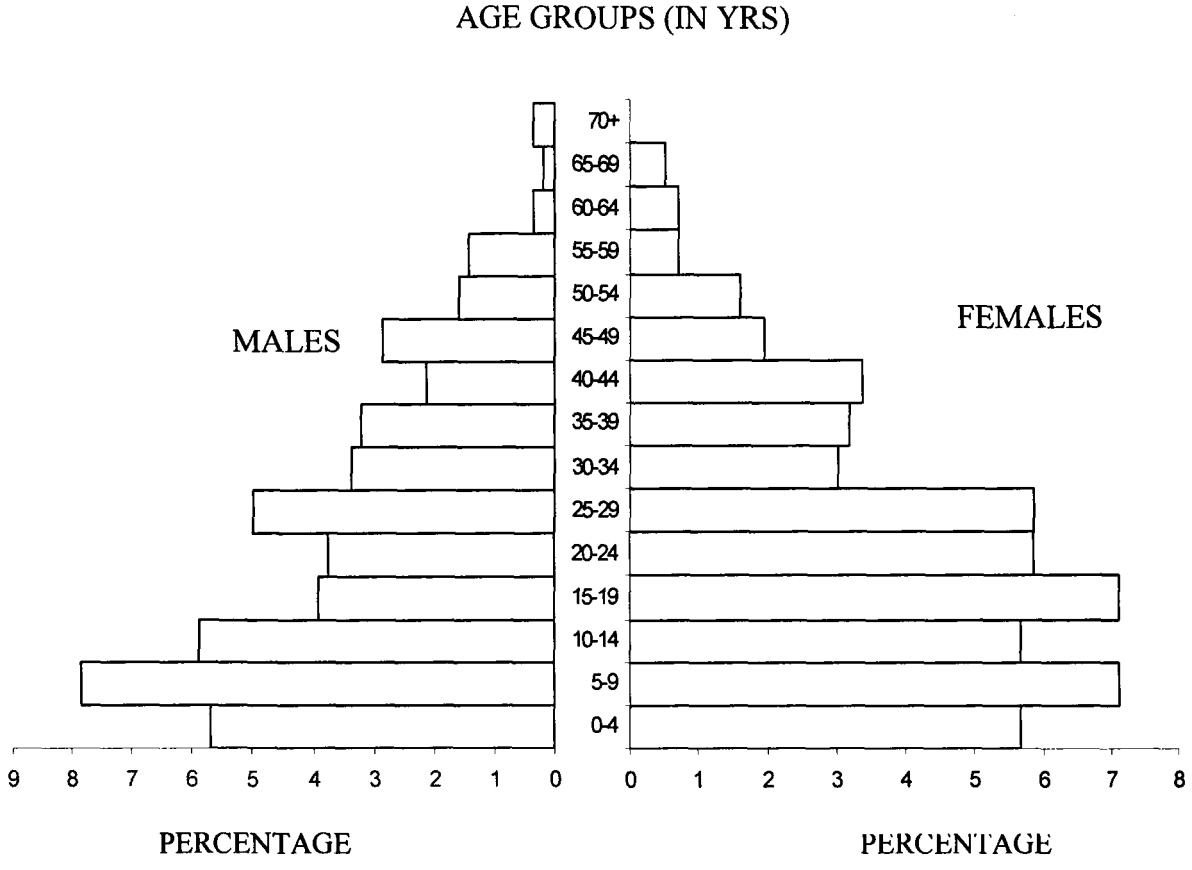


FIGURE 7. POPULATION PYRAMID (IDU MISHMI).

Figure 7 shows the diagramatic representation of the Idu population by age groups. The entire population have been divided into 15 age groups. It is seen that in general the base of the pyramid is broader and gradually shrunks as we move onto higher age groups. The population is progressive.

Table 33. Multiple marriages by age of spouses.

Individual married		-25years		26-50years		51+years		Total		M+F
		Male	Female	Male	Female	Male	Female	Male	Female	
Once		02	09	69	91	21	19	92	119	211
%		100.00	100.00	95.83	100.00	87.50	95.00	93.88	99.17	96.79
More than once	Twice	0	0	03	0	02	01	05	01	06
	%	0.00	0.00	4.17	0.00	8.33	5.00	5.10	0.83	2.75
	3 times	0	0	0	0	01	0	01	0	01
	%	0.00	0.00	0.00	0.00	4.17	0.00	1.02	0.00	0.46
	Total	0	0	03	0	03	01	06	01	07
	%	0.00	0.00	4.17	0.00	12.50	5.00	6.12	0.83	3.21
Grand Total		02	09	72	91	24	20	98	120	218
%		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 33 shows the frequency of multiple marriages by age of spouses. In the third generation i.e.upto 25 years, no individual has been found to have married more than once. In the second generation i.e., upto 25-50 years, 4.17% of males have married two times. No woman in this generation found to have married more than once. But no individual has found to have married more than two times. In the first generation, i.e.51+ years, 8.33 % and 5.00% of males and females respectively, have married two times. In this generation, 4.17% of males have married more than two times in this generation.

Table 33 further reveals that about 93.88% and 99.17% of the total married (including widowed/ divorced) males and females respectively have married only once, whereas nearly 5.10% of males and 0.83% of females have married twice. It is further noticed that among the Idu Mishmi, there is only one male (1.02%), who have married twice and no woman have been found to married three times.

Table 33A. Multiple marriages by age of spouses.

Individual married	-25years	26-50years	51+years	Total
Once	11	160	40	211
%	100.00	98.16	90.91	96.79
More than once	0	03	04	07
%	0.00	1.84	9.09	3.21
Total	11	163	44	218
%	100.00	100.00	100.00	100.00

When both sexes are pooled together, as shown in Table 33A,the frequency of individuals more than once married increases through the lower age group to the higher age group (0.00%, 1.84% and 9.09%) for the age group ≤25 years, 26-50years and 51+years respectively. It is seen that as age group progresses, both males and females incline to change their mates.

Table 33B. Multiple marriages by sex.

Individual married	Male		Female		Total	
	No	%	No	%	No	%
Once	92	(93.88)	119	(99.17)	211	(96.79)
%	43.60		56.40		100.00	
More than once	06	(6.12)	01	(0.83)	07	(3.21)
%	85.71		14.29		100.00	
Total	98	(100.00)	120	(100.00)	218	(100.00)
%	44.95		55.05		100.00	

Figures in the parentheses indicate the percentage out of total male or female.

Table 33B, extracted from Table 33, shows the frequency of multiple marriages by sex. Out of 211 individuals who have married only once, 92 of them (43.60%) are males and 119 of them (56.40%) are females. There are 7 individuals, who have married more than once, out of which 85.71% are males and 14.29% are females. In this population, there are 98 males out of which 6.12% have married more than once, whereas there are 120 married females, out of which 0.83% have married more than once. So, it indicates that the frequency of persons marrying more than once is more among males than among females. In respect of this, the difference between male and female is remarkable.

Table 34. Binomial test of proportion in respect of multiple marriages.

Sex	No.	No. of individuals married more than once	T_1	T_2	Inference
Male	98	6	0.0529	0.0240	Significant
		6.12			
Female	120	1			
		0.83			

Table 34 justifies the above statement. Using the binomial test of proportion, it is found that there is significant difference between male and female in respect of the frequency of changing mates (T_1=0.0529 and T_2=0.0240).

Table 35. Fertility by times of marriage.

Times of marriage	No. of married women	Total pregnancy		Total no. of live births	
		No.	Mean ±SE	No.	Mean ±SE
Once	118	412	3.46±0.21	394	3.31±0.21
More than once	01	4	4	4	4

t* (total no. of pregnancies)= 2.5714, P<0.05, Significant.
t** (total no. of live births)= 3.2857, P<0.05, Significant.

Table 35 shows the fertility performances of women by times of marriages. There are 119 women, who have married once, and one woman, who have married more than once. In case of the women who married only once, the mean number of pregnancy is found to be 3.46±0.21, where as in case of the women who married more than once, it is found to be 4.00±0.00. However, the difference between these two groups, in respect of total number of pregnancies, is significant (t* = 2.5714, P<0.05). In case of the women, who married only once, the mean number of live births is 3.31±0.21. The t-value shows that the difference between these two groups of women, in respect of total number of live births, is significant (t** = 3.2857, P<0.05).

Table 36. Completed fertility size.

No. of mothers aged 45+years	Total pregnancy	Live births			Average no. of live births per mother	Average no. of surviving offspring per mother
		Living	Dead	Total		
28	143	113	23	136	4.86	4.03

Table 36 shows the completed fertility size among the Idu Mishmi. Only those women who are aged 45years and above and lived continuously in wedlock till attainment of 45years of age, have been taken into consideration to find out the completed fertility size. There are 28 such mothers, who have 136 livebirths. The average number of livebirths per mother is found to be 4.86, which indicates that the completed fertility is moderate among the Idu Mishmi. The average number of surviving offspring per such mother is 4.03.

Table 37. Child-women ratio (fertility ratio).

No. of children (0-4)years	No. of women (15-49)years	Fertility ratio
64	171	37.43

Table 37 shows the child-women ratio among the Idu Mishmi. It is another measure of fertility in which all children aged 0 to 4 years and all women aged 15 to 49 years irrespective of marital status, have been taken into consideration. It is found that there are 64 children aged 0 to 4 years and there are 171 women aged 15-49 years irrespective of marital status, among the Idu Mishmi. The child woman ratio (fertility ratio) is found to be 37.43.

Table 38. Ever pregnant and never pregnant married women.

	Age of married women				Total
	-25yrs	26-35yrs	36-45yrs	46+yrs	
Ever pregnant %	05 4.17	39 32.50	32 28.33	27 23.33	103 85.83
Never pregnant %	05 4.17	07 5.83	02 1.67	03 2.5	17 14.17
Never pregnant % of all	50.00	15.22	5.88	10.00	14.17

Table 38 shows the frequency of ever pregnant and never pregnant married women among the Idu Mishmi. It is found that out of 120 married women, 103 (i.e., 85.83%) have experience pregnancy at least once, whereas there are 32 (i.e., 14.17%) women, who have never experienced any pregnancy. It is further seen that in the earliest age group i.e. upto 25 years the percentage of ever pregnant married women is only 4.17% and becomes highest i.e. 32.50% in

the next age group i.e. 26-35 years. After that it gradually decreases with the increase of age group. So, most of the ever pregnant women are in the early part of their reproductive life. However, it shows that most of the married women have experienced pregnancy before reaching the post reproductive life.

Table 39. Live births, surviving children and mortality by age of mothers.

Age group (in years)	No. of mothers	Total no. of pregnancy	Avg. no. of pregnancy per mother	Live births***			% Surviving	Average live births	Mortality (based on all live births)
				Living	Dead	Total			
-25	05	06	1.20	06	00	06	100.00	1.20	0.00
%				1.69	0.00				
26-35	39	115*	2.95	94	05	99	94.95	2.54	5.05
%				26.48	11.63				
36-45	32	171**	5.34	144	15	159	90.57	4.97	9.43
%				40.56	34.88				
46+	27	139	5.15	111	23	134	82.84	4.96	17.16
%				31.27	53.49				
Total	103	431	4.18	355	43	398	89.19	3.86	10.80
%				89.20	10.80				

* There are 14 women who are still pregnant and one twin pregnancy.
** There are 1 woman who are still pregnant and 2 twin pregnancy.
*** Since the above pregnancies have not yet been terminated, they have not been included in further analysis.

Table 39 shows the frequency of live births, surviving children and mortality by age of mothers. It is seen that there are 103 mothers, who have had altogether 431 pregnancies. These 431 pregnancies include 15 pregnancies, which have not yet been matured. Fourteen mothers of age group 25-36 are still pregnant, whereas one mother in the age- group 36-45 years is still pregnant. It may also be noted that there are 3 mothers (one belong to the age group 25-36 years and 2 belong to the age group 36-45 years) who have delivered twins. Each of these twin births has been taken as one pregnancy. It shows that altogether there are 431 pregnancies and the average number of pregnancy per mother is 4.18. It is seen that the average number of pregnancy per mother varies from 1.20 in the age group upto 25 years to 5.15 in the age group 46+ years. So, it indicates that the average number of pregnancy per mother increases as age of the mother advances.

Table 39 further shows that altogether there are 398 live births, which includes three twin births (for each twin 2 live births have been counted). Out of 398 live births, 355 (i.e., 89.20%) are still surviving, whereas 43 (i.e., 10.80%) have already died. The number of surviving children varies from 82.84% in the age group 46+ years to 100 % in the age group -25years. It further shows that the average number of livebirths among the Idu Mishmi varies from 1.20 % in the age group upto 25years to 4.96 % in the age group 46+ years. The overall average number of livebirths per mother is found to be 3.86. It may further be noted that the average number of livebirths per mother increases as age of the mother advances and decreases after the age of 49+ years. The mortality rate (irrespective of age at the time of death) varies from 0.00% in case of mothers, aged -25 years to 17.16 in case of mothers, aged 46+years.

So, it is seen from Table 39 that so far as the mortality rate is concerned, it increases from age group -25years to 46+ years.

Table 40. Reproductive wastage by age of mothers.

Age groups (in yrs)	Total no. of mothers	Total pregnancy*	Reproductive wastage		
			Abortion	Still birth	Total
-25 %	05	06	0 0.00	0 0.00	0 0.00
26-35 %	39	101	0 0.00	03 2.97	03 2.97
36-45 %	32	170	10 5.88	03 1.76	13 7.65
46+ %	27	139	05 3.60	0 0.00	05 3.60
Total %	103	416**	15 3.60	06 1.44	21 5.05

* Current pregnancies are not included.

** Includes 3 Twin births.

Table 40 shows the frequency of reproductive wastage among the Idu Mishmi. Out of 416 pregnancies, 3.60 % have terminated into abortions and 1.44 % into stillbirths. Combining the frequencies of abortions and stillbirths together, it is found that the frequency of reproductive wastage is about 5.05 % of all pregnancies. Table 40 further reveals the frequency of reproductive wastage by age group of mothers. It is found that the frequency of reproductive

wastage is highest (7.64%) in the age group 36-45 years, followed by 3.60% in the age group 46+ years and 2.97% in the age group 26-35 years.

Table 41. Child mortality by age group.

Age of mothers (in yrs)	No. of mothers	Live births	Child mortality				Total child mortality	
			<1yr	1-4yrs	5-9yrs	10-14yrs	No.	%
-25 %	05	06 1.51	0 0.00	0 0.00	0 0.00	0 0.00	0	0.00
26-50 %	81	304 76.38	18 72.00	01 50.00	02 100.00	01 25.00	22	7.24
51+ %	17	88 22.11	07 28.00	01 50.00	00 0.00	03 75.00	11	12.50
Total %	103	398	25 6.28	02 0.50	02 0.50	04 1.00	33	8.29

χ^2 (between the generation)=4.6950, d. f. =3, P>0.05, Insignificant.

Table 41 shows the frequency of child mortality among the Idu Mishmi. It is found that the frequency of mortality is highest (6.25%) in the age group >1 year, which is followed by 10 - 14 years (1.00%). The frequency of child mortality in the age group 1-4 years and 5-9 years is 0.50% each. It shows that the frequency of child mortality is highest in the children below 1 year.

This Table further shows that the frequency of child mortality is highest (12.50%) in case of the mothers aged 51+years, followed by 7.24% in case of mothers aged 26-50years and 0.00% in case of mothers aged, -25years. It is seen that between the generations there is no significant difference in respect of child mortality in this population (χ^2=4.6950, d. f. =3, P>0.05). However, the overall percentage of child mortality among the Idu Mishmi is found to be 8.29% of all live births.

Table 42. Surviving sibship size of married women.

Total no. of mothers	No. of surviving children (N=355)										Avg. no. of surviving children per mother
	0	1	2	3	4	5	6	7	8	9	
120	17 14.17	12 10.00	22 18.33	21 17.5	22 18.33	15 12.5	05 4.17	05 4.17	01 0.83	0 0.00	2.96

Table 42 shows the surviving sibship size by the number of married women. There are altogether 120 married women and they have 355 surviving children. The average number of surviving children is 2.96 per mother.

It is found that there are 17 mothers (i.e., 14.17% of all married women), who have no surviving children. There are 22 mothers (18.33%), who are in majority and are having 2 surviving children. There are also equal number mother (18.33%), who are having 4 surviving children. It is followed by 17.50% of all mothers who have 3 surviving children, 12.50% of them have 5 surviving children and 10.00% of them have 1 surviving child. Rests of the mother are having 6 to 8 surviving children.

Table 43. Age-specific fertility rate.

Age class No.	Age group (in yrs)	No. of married women	No. of live births	Age-specific fertility
1	15-19	120	03	0.0250
2	20-24	119	145	1.2185
3	25-29	111	139	1.2523
4	30-34	84	78	0.9286
5	35-39	67	28	0.4179
6	40-44	50	05	0.1000
7	45+	31	0	0.0000
Total fertility rate				3.9423

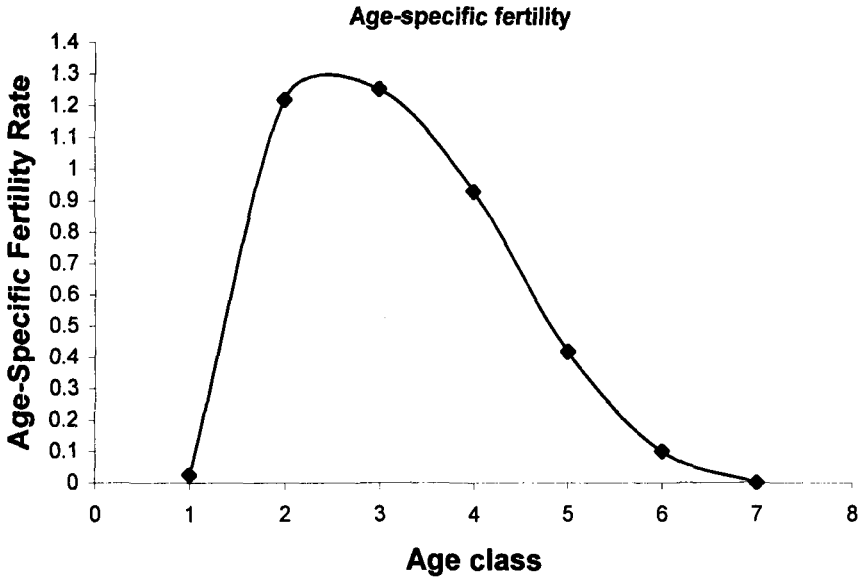


FIGURE 8. AGE-SPECIFIC FERTILITY RATE BY AGE CLASS (age groups as shown in Table 43)

Table 43 shows the age-specific fertility rate of the Idu Mishmi women. It is found that the age-specific fertility rate increases from the mothers aged 15-49 years, to the mothers, aged 25-49years. The age-specific fertility rate in this period increases from 0.0250 to 1.2523 and thereafter it steeply decreases from 0.9286 in age group 30-34years to 0.0000 in age group 45+years. However, the total fertility rate (T.F.R.) in this population is found to be 3.9423.

Table 44. Breeding size, effective population size, coefficient of breeding isolation and variance due to drift.

Population	Breeding size	Effective population size (N_e)	Coefficient of breeding isolation (N_{em})	Variance due to drift σ^2_{dq} (Where q =0.5)
Idu Mishmi	187	161	0	0.000776

Table 44 gives the breeding size, effective population size, coefficient of breeding isolation and variance due to drift among the Idu Mishmi. It is already mentioned that the total population size is 562 of which 187 individuals (i.e., 33.27%) actually constitute the breeding size in this population. It is also found that the effective population size is 161, which means 28.65% of the total population and 86.10% of the breeding size. In the present study, it has been found that there is not a single case of marriage between Idu Mishmi and other populations. The Table 44 indicates that the coefficient of breeding isolation (N_{em}) among the Idu Mishmi is zero, which indicates that changes due to genetic drift in this population is very great.

In this population, it is found that the variance due to random genetic drift per generation is 0.000776 with an initial gene frequency of 0.5 (Table 44).

Table 45. Index of total selection intensity.

According to Crow's formula (1958)	According to Johnston and Kensinger (1971)
Number of mothers aged 40yrs and above = 46 Average number of livebirths per woman aged 40yrs and above, X=5.1087 Variance in the number of livebirths due to fertility, V_f =2.6186 Total number of livebirths to women aged 40yrs and above =235 Total number of premature deaths (died before the 15th yrs of life) =25 Proportion of premature death, P_d =0.1064 Proportion of survivors, P_s =0.8936 Index of selection due to infant mortality, I_m =0.1191 Index of selection due to fertility, I_f = 0.1003 Index of total selection intensity, I =0.2067	Number of mothers aged 40yrs and above =46 Mean number of livebirths per woman of completed fertility (i.e., 40yrs and above); X =5.1087 Variance in the number of livebirths due to fertility, V_f =2.6186 Proportion of child death (i.e., death before 15years of age) P_d =0.1064 Proportion of survivors, birth to reproductive age, P_s =0.8936 Total number of prenatal death =13 Total number of pregnancies =248 Proportion of survivors to birth, P_b =0.9476 Proportion of embryonic death (i.e., prenatal death), P_{ed} =0.0524 Index of selection due to fertility, I_f =0.1003 Index of selection due to embryonic mortality (prenatal mortality), I_{me} =0.0553 Index of selection due to child mortality (mortality before 15yrs of age), I_{mc} =0.1191 Index of total selection intensity, I =0.2535

Table 45 shows the index of total selection intensity in the Idu mishmi. It has been calculated according to the formula given by Crow (1958) as well as according to the modified formula given by Johnston and Kensinger (1971). The results have been set out separately in the Table 45. It shows that there are 46 mothers, who are aged 40years and above. The mean number of live births (X) is 5.1087 with its variance (V_f) 2.6186. Total number of live births to women aged 40years and above is 235. The number of premature deaths (i.e., before 15years of age) is 25. According to Crow's formula, the proportion of premature deaths (P_d) is found to be 0.1064 and proportion of survivors (P_s) is 0.8936. The index selection due to mortality (I_m) is 0.1191 and that due to fertility (I_f) is 0.1003. So, the index of total selection intensity (I), according to Crow's formula is 0.2067. It is seen that the selection is taking place more due to differential mortality than due to differential fertility.

According to Johnston and Kensinger's modified formula, it has been found that proportion of child death i.e., P_d, proportion of survivors (i.e., birth to reproductive age) P_s and the proportion of survivors to birth, P_b arte 0.1064, 0.8936 and 0.9476 respectively. It is also seen that the proportion of embryonic deaths (i.e., abortions and still births) P_{ed} is 0.0524. The index of selection due to fertility (I_f), embryonic mortality (I_{me}) and child mortality (I_{mc}) are 0.1003, 0.0553 and 0.1191 respectively. Basing on all these indices, it is found that the total selection intensity (I) is 0.2535 in the Idu Mishmi, which is higher than that found according to Crow's formula (1958).

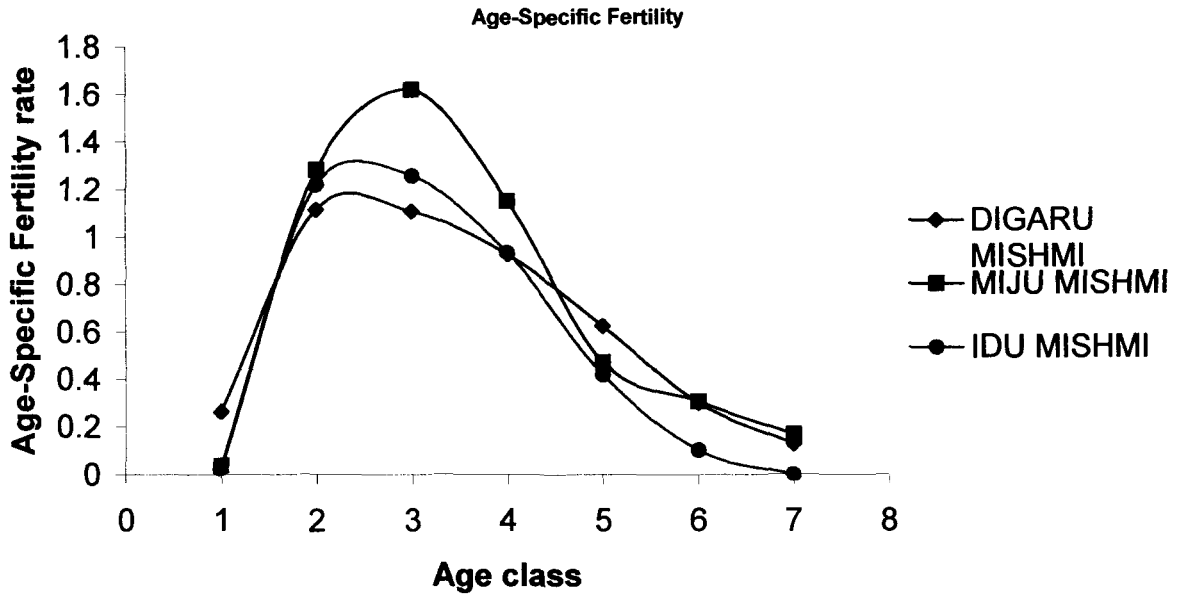


FIGURE 9. AGE-SPECIFIC FERTILITY RATE OF THE DIGARU MISHMI, MIJU MISHMI AND IDU MISHMI.

Figure 9 shows the comparative age-specific fertility rate of the Digaru Mishmi, Miju Mishmi and Idu Mishmi. It is seen that the age-specific fertility rate is higher in Miju Mishmi, followed by Idu Mishmi and Digaru Mishmi. In case of the Digaru Mishmi, the age-specific fertility rate increases upto the mothers aged 20-24years, whereas, in case of Miju Mishmi and Idu Mishmi, the age-specific fertility rate increases upto the mothers aged 25-29years.

CHAPTER - V
ANTHROPOMETRY

In this chapter we shall deal with anthropometric characteristics of the Mishmis of Arunachal Pradesh. In the present study altogether 13 measurements each, have been taken on three sub groups of Mishmis, viz.- Digaru Mishmi (107 males and 104 females), Miju Mishmi (102 males and 104 females) and Idu Mishmi (154 males and 143 females) respectively.

Table 46. Anthropometric measurements of the Digaru Mishmi (Male).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s. d.
1	Height vertex	107	146.2 – 171.2	157.65 ± 0.47	4.85
2	Sitting height vertex	107	76.5 – 95.5	85.22 ± 0.33	3.39
3	Chest girth	107	73.3 – 105.2	88.11 ± 0.51	5.30
4	Head length	107	16.6 – 20.7	18.86 ± 0.06	0.655
5	Head breadth	107	13.4 – 15.8	14.37 ± 0.05	0.509
6	Head circumference	107	54.3 – 61.7	56.90 ± 0.15	1.54
7	Least frontal breadth	107	9.8 – 13.7	12.20 ± 0.07	0.756
8	Nasal height	107	3.8 – 5.4	4.79 ± 0.35	3.63
9	Nasal breadth	107	3.3 – 4.5	3.76 ± 0.02	0.24
10	Bizygometic breadth	107	11.2 –14.7	13.24 ± 0.05	0.56
11	Bigonial breadth	107	9.7 – 12.7	11.28 ± 0.06	0.64
12	Mid-arm-circumference	107	19.6 –31.0	25.06 ± 0.19	2.01
13	Weight	107	31.0 – 83.5 (kg)	54.77 ± 0.73	7.54

Table 46 shows the ranges, means and standard errors of anthropometric measurements among 107 Digaru Mishmi males. It is seen that the height vertex among the males varies between 146.2 cm and 171.2 cm, and the mean is 157.65±0.47 cm. So far as the sitting height vertex is concerned, it is seen that it ranges between 76.5 cm and 95.5 cm, with the mean of 85.22±0.33 cm. The mean of the chest girth is found to be 88.11±0.51 cm. It ranges between 73.3cm and 105.2 cm.

Four different measurements have been taken on the head viz., length, breadth, circumference and least frontal breadth. It is found that the head length among the Digaru Mishmi males varies from 16.6 cm to 20.7 cm and the mean is18.86±0.06cm. The head breadth is found to vary from 13.4cm to 15.8cm and its mean is 14.37±0.05 cm. The circumference of head varies from 54.3 cm to 61.7 cm and its mean is 56.90±0.15 cm. The least frontal breadth varies between 9.8 cm and 13.7 cm, and the mean is 12.20±0.07cm.

Two different measurements have been taken on nose. They are nasal height and nasal breadth. From the Table, it is observed that the nasal height and nasal breadth vary from 3.8cm to 5.4cm and from 3.3cm to 4.5cm respectively. The mean nasal height is 4.79±0.35cm and the mean nasal breadth is 3.76±0.02cm.

Two measurements on face have been taken. These are bizygomatic breadth and bigonial breadth. It is found that bizygomatic breadth ranges between 11.2 cm and 14.7 cm, the mean is 13.24±0.05cm, whereas the bigonial breadth ranges from 9.7cm to 12.7 cm, the mean is 11.28±0.06 cm.

Only one measurement is taken on limb, i.e., mid-arm-circumference. The range of this circumference varies between 19.6 cm and 31.0 cm and the mean is 25.06±0.19cm.

Body weight of 107 adult Digaru Mishmi males has been taken. It is found that body weight among the adult males varies between 31.0 kg and 83.5 kg. The mean body weight is 54.77± 0.73 kg.

Table 47. INDICES (Male).

Sl. No.	Character	No.	Range	Mean ± s. e.	s. d.
1	Cephalic index	107	66.50 –86.83	76.30 ± 0.35	3.60
2	Nasal index	107	64.81 – 105.13	85.05 ± 0.72	7.47
3	Relative sitting height vertex index	107	49.61 – 59.08	54.03 ± 0.17	1.77
4	Relative chest girth index	107	47.78 – 64.34	55.94 ± 0.29	3.04
5	Ponderal index	107	2.15 –2.80	2.40 ± 0.01	0.10
6	Jugo-frontal index	107	73.68 –104.46	92.07 ± 0.51	5.32
7	Jugo-mandibular index	107	75.57 – 96.21	85.31 ± 0.40	4.11
8	Pignet-vervaek index	107	74.69 – 115.41	90.60 ± 0.64	6.58
9	Transverse fronto-parietal index	107	66.22 – 95.03	84.90 ± 0.58	5.97
10	Trans-cephalo-facial index	107	79.43 – 102.82	92.10 ± 0.42	4.33

Ten indices have been calculated from the above measurements. The results are shown in table 47.

The mean of cephalic index is found to be 76.30±0.35, varying between 66.50 and 86.83.

The nasal index among the Digaru Mishmi males varies between 64.81 and 105.13. The mean of this index is found to be 85.05±0.72.

The relative sitting height vertex index among the Digaru Mishmi males ranges from 49.61 to 59.08. The mean of this index is 54.03±0.17.

The relative chest girth index among them varies from 47.78 to 64.34. The mean for this index is found to be 55.94±0.29.

The ponderal index ranges from 2.15 to 2.80. The mean is 2.40±0.01.

The jugo-frontal index is found to be varying between 73.68 and 104.46. Its mean is 92.07±0.51.

The value of jugo-mandibular index varies from 75.57 to 96.21. Its mean is 85.31±0.40.

Among the Digaru Mishmi males, the pignet-vervaek index is found to be varying from 74.69 to 115.41. Its mean is 90.60±0.64. The transverse fronto-parietal index ranges from 66.22 to 95.03, the mean of which is 84.90±0.58. The mean of trans-cephalo-facial index is 92.10±0.42. The index varies from 79.43 to 102.82.

Table 48. Anthropometric measurements of the Digaru Mishmi (Female).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s. d.
1	Height vertex	104	138.8 –158.6	148.96 ± 0.38	3.83
2	Sitting height vertex	104	72.4 – 87.7	79.97 ± 0.32	3.23
3	Chest girth	104	75.4 – 103.5	84.81 ± 0.54	5.45
4	Head length	104	16.6 – 19.6	18.13 ± 0.05	0.52
5	Head breadth	104	12.1 – 15.3	13.80 ± 0.06	0.62
6	Head circumference	104	51.2 – 58.4	55.20 ± 0.15	1.50
7	Least frontal breadth	104	10.6 – 13.2	11.80 ± 0.06	0.61
8	Nasal height	104	3.0 – 4.9	4.14 ± 0.03	0.32
9	Nasal breadth	104	2.8 – 4.4	3.57 ± 0.03	0.28
10	Bizygometic breadth	104	10.8 – 13.6	12.85 ± 0.05	0.54
11	Bigonial breadth	104	9.6 – 12.4	11.11 ± 0.06	0.62
12	Mid-arm-circumference	104	19.4 – 30.6	24.28 ± 0.20	2.08
13	Weight	104	30.0 – 65.5 (kg)	48.35 ± 0.61	6.23

Table 48 shows the ranges, means and standard errors of anthropometric measurements of 104 Digaru Mishmi females.

In the Table, it is seen that the height vertex among the Digaru Mishmi females ranges from 138.8cm to 158.6cm and the mean is 148.96±0.38cm. It is also seen that the mean of sitting

height vertex is 79.97±0.32cm, ranges from 72.4cm to 87.7cm. The mean chest girth among the Digaru Mishmi females is 84.81±0.54cm. The minimum chest girth is 75.4cm and the maximum girth is 103.5cm.

Four measurements have been taken on the head, viz., length, breadth, circumference and least frontal breadth. It is found that the head length among the Digaru Mishmi females varies from 16.6cm to 19.6cm, and the mean is 18.13±0.05cm. The head breadth is found to be varying between 12.1cm and 15.3cm. Its mean is 13.80±0.06cm. The mean of head circumference is 55.20±0.15cm. The minimum circumference of head is 51.2cm and the maximum circumference of head is 58.4cm. The least frontal breadth varies from 10.6cm to 13.2cm. Its mean is 11.80±0.06cm.

Two different measurements have been taken on nose. They are nasal height and nasal breadth. The minimum height of nose is 3.0cm and the maximum height is 4.9cm. The mean nasal height is 4.14±0.03cm. The range of nasal breadth is found to vary between 2.8cm and 4.4cm, and the mean is 3.57±0.03cm.

Bizygomatic breadth and bigonial breadth are the two measurements that are taken on the face. The bizygomatic breadth of the Digaru Mishmi females ranges between 10.8cm and 13.6cm, and the mean is 12.85±0.05cm. The range of bigonial breadth varies from 9.6cm to 12.4cm. Its mean is 11.11±0.06cm.

Mid-arm-circumference is the only measurements that have been taken on the limb of Digaru Mishmi females. It varies between 19.4cm and 30.6cm. The mean for mid-arm-circumference is 24.28±0.20cm.

The body weight of 104 Digaru Mishmi adult females has been taken. It is observed that the body weight ranges between 30.0kg and 65.5kg. Its mean is 48.35±0.61kg.

Table 49. INDICES (Female).

Sl. No.	Character	No.	Range	Mean ± s. e.	s. d.
1	Cephalic index	104	68.37 – 87.95	76.16 ± 0.38	3.83
2	Nasal index	104	57.14 – 105.55	85.75 ± 0.77	7.88
3	Relative sitting height vertex index	104	47.67 – 57.28	53.68 ± 0.16	1.63
4	Relative chest girth index	104	49.77 – 71.04	56.95 ± 0.36	3.71
5	Ponderal index	104	2.23 – 2.77	2.44 ± 0.01	0.09
6	Jugo-frontal index	104	83.59 – 104.27	91.79 ± 0.39	4.02
7	Jugo-mandibular index	104	77.2 – 110.18	86.45 ± 0.43	4.34
8	Pignet-vervaek index	104	76.22 – 115.99	89.38 ± 0.66	6.73
9	Transverse fronto-parietal index	104	72.6 – 98.51	85.64 ± 0.53	5.42
10	Trans-cephalo-facial index	104	78.91 – 106.3	93.31 ± 0.53	5.44

Ten indices that are calculated from the above anthropometric measurements of Digaru Mishmi females are shown in the Table 49.

The cephalic index varies between 68.37 and 87.95. Its mean is 76.16±0.38.

The nasal index varies between 57.14 and 105.55, and the mean is 86.75±0.77.

The mean of relative sitting height vertex index is 53.68±0.16, varying between 47.67 and 57.28.

The relative chest girth index varies between 49.77 and 71.04. The mean for this index is 56.95±0.36. The ponderal index ranges from 2.23 to 2.77. Its mean is 2.44±0.01.

The jugo-frontal index ranges from 83.59 to 104.27, and its mean is 91.79±0.39. The jugo-mandibular index of Digaru Mishmi females varies from 77.2 to 110.18. The mean for this is 86.45±0.43.

Among the Digaru Mishmi females, the pignet-vervaek index is found to be varying from 76.22 to 115.99. Its mean is 89.38 ± 0.66.

The trans-fronto-parietal index ranges between 72.6 and 98.51, and the mean is 85.64±0.53. The trans-cephalo-facial index varies from 78.91 to 106.3. Its mean is 93.31±0.53.

Table 50. Classification of anthropometric characters of the Digaru Mishmi (Male).

Character	Frequency	Percentage
Stature		
Very short	4	3.74
Short	73	68.22
Lower (below) medium	21	19.63
Medium	6	5.61
Upper (above) medium	1	0.93
Tall	2	1.87
Total	107	100.00
Cephalic index		
Hyperdolichocephal	6	5.61
Dolichocephal	49	45.79
Mesocephal	38	35.51
Brachycephal	12	11.21
Hyperbrachycephal	2	1.87
Total	107	99.99
Nasal index		
Leptorrhine	3	2.80
Mesorrhine	46	42.99
Platyrrhine	56	52.34
Hyperplatyrrhine	2	1.87
Total	107	100.00
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	13	12.15
Broad	31	28.97
Very broad	63	58.88
Total	107	100.00
Jugo-frontal index		
Very narrow	0	0.00
Narrow	1	0.93
Medium	2	1.87
Broad	6	5.61
Very broad	98	91.59
Total	107	100.00
Relative chest-girth index		
Narrow chest	8	7.48
Medium	41	38.32
Broad	58	54.21
Total	107	100.01

Table 50 shows the classification of anthropometric characters of Digaru Mishmi males. These classifications are given by Martin which have been adopted from Das and Deka (1992-1993).

Stature- From the Table, it is seen that nearly 68.22% of all Digaru Mishmi adult males of short stature. 19.63% belong to below medium stature and 5.61% belong to medium stature. Rests are very short, above medium and tall statured people.

Cephalic index- The cephalic index shows that 45.79% of all adult males are dolichocephalic, whereas 35.51% are found to be mesocephalic and 11.21 are brachycephalic. The frequencies of hyperdolichocephalic and hyperbrachycephalic are 5.61% and 1.87% respectively.

Nasal index- Nearly 52.34% of all adult males have platyrrhine nose, followed by 42.99% of mesorrhine nose. The frequencies of leptorrhine and hyperplatyrrhine noses are 2.80% and 1.87% respectively.

Jugo-mandibular index- The majority (58.88%) of all Digaru Mishmi adult males have been very broad type. 28.97% are of broad type and 12.15% of medium type.

Jugo-frontal index- Among the Digaru Mshmi males, the frequency of very broad type is found to be quite high, i.e., 91.59%, followed by 5.61% to be broad. 1.87% and 0.93% are to be of medium and narrow type respectively.

Relative chest girth index- The majority of the Digaru Mishmi adult males have broad chest (54.21%), whereas 38.32% have medium chest and 7.48% have narrow chest.

Therefore, from Table 50, it is seen that Digaru Mishmi males are mostly of short statured people with dolichocephalic type of head, platyrrhine nose and broad chest. The jugo-frontal index and jugo-mandibular index indicates that they have got very broad face.

Classification of anthropometric characters of Digaru Mishmi females have been shown in the Table 51.

Stature- From the Table, it is seen that nearly 45.19% of all Digaru Mishmi adult females are of below medium stature. 40.38% belong to short stature and 10.58% belong to medium stature. Rests are very short and above medium statured people.

Table 51. Classification of anthropometric characters of the Digaru Mishmi (Female).

Character	Frequency	Percentage
Stature		
Very short	2	1.92
Short	42	40.38
Lower (below) medium	47	45.19
Medium	11	10.58
Upper (above) medium	2	1.92
Tall	0	0.00
Total	104	99.99
Cephalic index		
Hyperdolichocephal	9	8.65
Dolichocephal	46	44.23
Mesocephal	36	34.62
Brachycephal	11	10.58
Hyperbrachycephal	2	1.92
Total	104	100.00
Nasal index		
Leptorhine	2	1.92
Mesorrhine	41	39.42
Platyrrhine	57	54.81
Hyperplatyrrhine	4	3.85
Total	104	100.00
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	3	2.88
Broad	14	13.46
Very broad	87	83.65
Total	104	99.99
Jugo-frontal index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	0	0.00
Broad	10	9.62
Very broad	94	90.38
Total	104	100.00
Relative chest-girth index		
Narrow chest	1	0.96
Medium	50	48.08
Broad	53	50.96
Total	104	100.00

Cephalic index- The cephalic index shows that nearly 44.23% of all adult females are of dolichocephalic head, whereas 34.26% are found to be of mesocephalic head and 10.58% are of brachycephalic head. Rests are of hyperdolichocephalic head and hyperbrachycephalic head.

Nasal index- Nearly 54.81% of all adult females have platyrrhine type of nose, which is followed by 39.42% of mesorrhine type of nose. The frequencies of leptorrhine and hyperplatyrrhine are 1.92% and 3.85% respectively.

Jugo-mandibular index- The majority i.e., 83.65% of all Digaru Mishmi adult females have very broad type. 13.46% belong to broad type and 2.88% belong to medium type.

Jugo-frontal index- Among the Digaru Mishmi adult females, the frequency of very broad type is found to be of 90.38%. Rests are of broad type.

Relative chest girth- The majority of adult females have broad chest (50.96%), whereas 48.08% have medium chest and 0.96% have narrow chest.

Thus from the Table 51, it is found that the Digaru Mishmi females are mostly of below medium statured people with dolichocephalic type of head, platyrrhine nose and broad chest. The jugo-frontal index and jugo-mandibular index indicates that they have got very broad face.

Now, we shall deal with anthropometric characteristics of Miju Mishmi.

Table 52. Anthropometric measurements of the Miju Mishmi (Male).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s. d.
1	Height vertex	102	149.1 – 170.4	159.28 ± 0.54	5.42
2	Sitting height vertex	102	78.6 – 92.5	86.35 ± 0.36	3.60
3	Chest girth	102	73.8 – 100.5	87.94 ± 0.51	5.13
4	Head length	102	17.4 – 20.4	18.96 ± 0.07	0.70
5	Head breadth	102	13.3 – 15.5	14.71 ± 0.05	0.46
6	Head circumference	102	55.2 – 60.8	57.73 ± 0.13	1.29
7	Least frontal breadth	102	10.9 – 13.6	12.30 ± 0.06	0.61
8	Nasal height	102	3.7 – 5.4	4.43 ± 0.03	0.32
9	Nasal breadth	102	3.4 – 4.4	3.77 ± 0.02	0.23
10	Bizygometic breadth	102	12.2 – 14.6	13.32 ± 0.05	0.48
11	Bigonial breadth	102	10.2 – 13.2	11.53 ± 0.06	0.58
12	Mid-arm-circumference	102	20.0 – 30.9	25.58 ± 0.18	1.83
13	Weight	102	48.0 – 74.0 (kg)	57.39 ± 0.52	5.30

The ranges, means and standard errors of anthropometric measurements of 102 Miju Mishmi males have been shown in the Table 52.

The height vertex of Miju Mishmi males ranges from 149.1cm to 170.4 cm. The mean is 159.28±0.54 cm. The sitting height vertex varies from 78.6 cm to 92.5 cm, and its mean is 86.35±0.36 cm. Among the Miju Mishmi males, the chest girth varies between 73.8cm and 100.5cm. The mean of this is 87.94±0.51 cm.

The four different measurements taken on head are length, breadth, circumference and least frontal breadth. The head length varies from 17.4 cm to 20.4 cm. The mean for this is 18.96±0.07 cm. The head breadth ranges between 13.3 cm and 15.5 cm, and its mean is 14.71±0.05 cm. The Minimum circumference of the head is 55.2 cm and the maximum circumference is 60.8 cm. Its mean is 57.73±0.13 cm. The least frontal breadth varies from 10.9cm to 13.6 cm. The mean for this breadth is 12.30±0.06 cm.

The nasal height and nasal breadth are the two measurements that have been taken on the nose. The nasal height and nasal breadth are the two measurements that have been taken on the nose. The nasal height ranges between 3.7 cm and 5.4 cm., and the mean is 4.43±0.03 cm. The nasal breadth ranges between 3.4 cm and 4.4 cm, and its mean is 3.77±0.02 cm.

The two measurements taken on face are bizygomatic breadth and bigonial breadth. Among the Miju Mishmi males, the bizygomatic breadth varies from 12.2cm to 14.6cm. Its mean is 13.32±0.05cm. The bigonial breadth varies from 10.2cm to 13.2cm. Its mean is 11.53±0.06cm. Mid-arm-circumference is the only measurement that has been taken on the limb. The mid-arm-circumference varies between 20.0cm and 30.9cm. Its mean is 25.58±0.18cm.

Body weight among the Miju Mishmi adult males have been taken. The body weight ranges between 48.0kg to 74.0kg. The mean is 57.39±0.52kg.

Ten different indices have been calculated from the above anthropometric measurements. They are shown in the Table 53.

The cephalic index among the Miju Mishmi males ranges from 66.17 to 86.86, and the mean is 77.68±0.37.

Table 53. INDICES (Male).

Sl. No.	Character	No.	Range	Mean ± s. e.	s. d.
1	Cephalic index	102	66.17 – 86.86	77.68 ± 0.37	3.78
2	Nasal index	102	64.81 – 102.32	85.59 ± 0.72	7.25
3	Relative sitting height vertex index	102	50.05 – 56.91	54.19 ± 0.14	1.43
4	Relative chest girth index	102	48.39 – 62.41	55.22 ± 0.26	2.60
5	Ponderal index	102	2.26 – 2.58	2.42 ± 0.01	0.07
6	Jugo-frontal index	102	82.57 – 103.03	92.44 ± 0.44	4.48
7	Jugo-mandibular index	102	71.53 – 101.59	86.62 ± 0.44	4.48
8	Pignet-vervaek index	102	83.48 – 108.9	91.41 ± 0.50	5.04
9	Transverse fronto-parietal index	102	73.2 – 96.24	83.72 ± 0.46	4.60
10	Trans-cephalo-facial index	102	83.01 – 98.63	90.55 ± 0.33	3.29

The nasal index varies from 64.81 to 102.32. Its mean is 85.59±0.72.

The relative sitting height index varies between 50.05 and 56.91, and the mean is 54.19±0.14.

The relative chest girth index varies from 48.39 to 62.41, and the mean is 55.22±0.26. The ponderal index ranges between 2.26 and 2.58. Its mean is 2.42±0.01.

The jugo-frontal index ranges between 82.57 and 103.03, and the mean is 92.44±0.44. The jugo-mandibular index varies from 71.53 to 101.59, and its mean is 86.62±0.44.

The pignet-vervaek index varies from 83.48 to 108.9, and the mean of this index is 91.41±0.50.

Among the Miju Mishmi males, the transverse fronto-parietal index is found to be varying between 73.2 and 96.24. The mean is 83.72±0.46. The trans-cephalo-facial index ranges between 83.01 and 98.63. Its mean is 90.55±0.33.

In the Table 54, the different ranges, means and standard errors of anthropometric characters of 104 Miju Mishmi females have been shown.

Among the Miju Mishmi females, it is seen that the height vertex varies from142.6cm to 160.6cm, and the mean is 150.28±0.40cm. So far the sitting height is concerned, it is found that

it varies between 73.7cm and 89.3cm. Its mean is 80.83±0.33cm. The girth of chest of Miju Mishmi adult females varies from 73.3cm to 97.3cm. Its mean is 86.92±0.44cm.

Table 54. Anthropometric measurements of the Miju Mishmi (Female).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s. d.
1	Height vertex	104	142.6 – 160.6	150.28 ± 0.40	4.09
2	Sitting height vertex	104	73.7 – 89.3	80.83 ± 0.33	3.35
3	Chest girth	104	73.3 – 97.3	86.92 ± 0.44	4.44
4	Head length	104	17.1 – 19.7	18.30 ± 0.06	0.61
5	Head breadth	104	13.2 – 15.2	14.11 ± 0.04	0.41
6	Head circumference	104	53.3 – 59.5	56.39 ± 0.14	1.45
7	Least frontal breadth	104	10.7 – 12.8	11.81 ± 0.05	0.48
8	Nasal height	104	3.3 – 4.8	4.13 ± 0.03	0.31
9	Nasal breadth	104	3.0 – 4.2	3.53 ± 0.02	0.24
10	Bizygometic breadth	104	11.3 – 13.8	12.87 ± 0.05	0.46
11	Bigonial breadth	104	10.3 – 12.8	11.29 ± 0.06	0.58
12	Mid-arm circumference	104	20.6 – 28.7	24.90 ± 0.17	1.78
13	Weight	104	34.0 – 66.0 (kg)	51.74 ± 0.53	5.39

Four different measurements on head have been taken. They are length, breadth, circumference and least frontal breadth. It is observed that the head length varies between 17.1cm and 19.7cm, and its mean is 18.30±0.06cm. The head breadth ranges from 13.2cm and 15.2cm. Its mean is 14.11±0.04cm. The mean of head circumference is 56.39±0.14cm. The minimum circumference of head is 53.3cm and the maximum circumference is 59.5cm. The least frontal breadth ranges between 10.7cm and 12.8cm, and the mean for this is 11.81±0.05cm.

Two measurements have been taken on nose, viz., height and breadth. The nasal height among the Miju Mishmi females varies from 3.3cm to 4.8cm. Its mean is 4.13±0.03cm, whereas the nasal breadth varies from 3.0cm to 4.2cm, and the mean is 3.53±0.02cm.

Two measurements taken on the face are bizygomatic breadth and bigonial breadth. Bizygomatic breadth is found to be varying between 11.3cm and 13.8cm. Its mean is 12.87±0.05cm. The bigonial breadth varies between 10.3cm and 12.8cm, and the mean is 11.29±0.06cm. Among the Miju Mishmi females, the mid-arm-circumference ranges between 20.6cm and 28.7cm. Its mean

is 24.90±0.17cm. The body weight among the adult females is found to vary between 34.0kg and 66.0kg. The mean of the weight is 51.74±0.53kg.

Table 55. INDICES (Female).

Sl. No.	Character	No.	Range	Mean ± s. e.	s. d.
1	Cephalic index	104	70.59 – 83.52	77.15 ± 0.27	2.77
2	Nasal index	104	66.67 – 105.88	85.90 ± 0.70	7.16
3	Relative sitting height vertex index	104	48.8 – 59.25	53.79 ± 0.18	1.79
4	Relative chest girth index	104	51.86 – 64.7	57.86 ± 0.29	2.96
5	Ponderal index	104	2.24 – 2.66	2.48 ± 0.01	0.09
6	Jugo-frontal index	104	84.56 – 101.63	91.82 ± 0.40	4.06
7	Jugo-mandibular index	104	78.03 – 104.06	87.82 ± 0.47	4.77
8	Pignet-vervaek index	104	77.9 – 103.71	92.23 ± 0.56	5.72
9	Transverse fronto-parietal index	104	75.35 – 92.42	83.71 ± 0.34	3.49
10	Trans-cephalo-facial index	104	79.58 – 100.75	91.25 ± 0.36	3.69

Ten different indices that have been calculated from the anthropometric measurements of the Miju Mishmi females are shown in the Table 55.

The cephalic index among the Miju Mishmi females varies from 70.59 to 83.52. Its mean is 77.15±0.27.

The nasal index varies from 66.67 to 105.88, and the mean is 85.90±0.70.

The relative sitting height index varies between 48.8 and 59.25. The mean is 53.79±0.18.

The relative chest girth index is found to vary between 51.86 and 64.7. Its mean is 57.86±0.29.

The ponderal index varies from 2.24 to 2.66. The mean of this index is 2.48±0.01.

The jugo-frontal index is found to be in the range of 84.56 and 101.63. Its mean is 91.82±0.40.

The jugo-mandibular index ranges between 78.03 and 104.06, and its mean is 87.82±0.47.

The pignet-vervaek index varies between 77.9 and 103.71. Its mean is 92.23±0.56.

The transverse fronto-parietal index ranges from 75.35 to 92.42, and the mean is 83.71±0.34.

The trans-cephalo-facial index varies between 79.58 and 100.75. Its mean is 91.25±0.36.

Table 56. Classification of anthropometric characters of the Miju Mishmi (Male).

Character	Frequency	Percentage
Stature		
Very short	3	2.94
Short	57	55.88
Lower (below) medium	21	20.59
Medium	9	8.82
Upper (above) medium	6	5.88
Tall	6	5.88
Total	102	99.99
Cephalic index		
Hyperdolichocephal	4	3.92
Dolichocephal	29	28.43
Mesocephal	48	47.06
Brachycephal	19	18.63
Hyperbrachycephal	2	1.96
Total	102	100.00
Nasal index		
Leptorrhine	2	1.96
Mesorrhine	45	44.12
Platyrrhine	53	51.96
Hyperplatyrrhine	2	1.96
Total	102	100.00
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	1	0.98
Medium	2	1.96
Broad	32	31.37
Very broad	67	65.69
Total	102	100.00
Jugo-frontal index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	0	0.00
Broad	5	4.90
Very broad	97	95.10
Total	102	100.00
Relative chest-girth index		
Narrow chest	5	4.90
Medium	65	63.73
Broad	32	31.37
Total	102	100.00

The classification of anthropometric characters of Miju Mishmi males have been shown in the Table 56.

Stature- It is seen that 55.88% of Miju Mishmi adult males are of short stature, whereas 20.59% are of below medium stature and 8.82% are medium statured people. Rests belong to very short, above medium and tall stature.

Cephalic index- Nearly 47.06% of all Miju Mishmi adult males belongs to mesocephal. 28.43% are of dolichocephals and 18.63% are of brachycephals. Rests are hyperdolichocephals and hyperbrachycephals.

Nasal index- 51.96% of adult males have platyrrhine nose, followed by 44.12% mesorrhine nose. The frequencies of leptorrhine and hyperleptorrhine noses are found to be 1.96% each.

Jugo-mandibular index- The majority (65.69%) of all adult males has very broad type, whereas 31.37% belong to broad type. The frequencies of medium and narrow are found to be 1.96% and 0.98% respectively.

Jugo-frontal index- It is seen that nearly 95.10% of all Miju Mishmi males have very broad type. Only 4.90% have broad type.

Relative chest girth index- The majority (63.73%) of all Miju Mishmi males have medium chest, whereas only 31.37% have broad chest and 4.90% have narrow chest.

Thus, from the Table 56, it is found that the Miju Mishmi males are mostly of short statured people with mesocephalic head, platyrrhine nose and medium chest. The jugo-frontal index and jugo-mandibular index shows that they have got very broad face.

Table 57 shows the classification of anthropometric characters of Miju Mishmi females.

Stature- Nearly 38.46% of all Miju Mishmi females are of below medium stature, whereas 37.50% are of short stature and 16.35% are of medium stature. The frequencies of upper medium and tall stature are found to be of 4.81% and 2.88% respectively.

Table 57. Classification of anthropometric characters of the Miju Mishmi (Female).

Character	Frequency	Percentage
Stature		
Very short	0	0.00
Short	39	37.50
Lower (below) medium	40	38.46
Medium	17	16.35
Upper (above) medium	5	4.81
Tall	3	2.88
Total	104	100.00
Cephalic index		
Hyperdolichocephal	3	2.88
Dolichocephal	29	27.88
Mesocephal	61	58.65
Brachycephal	11	10.58
Total	104	99.99
Nasal index		
Leptorrhine	1	0.96
Mesorrhine	51	49.04
Platyrrhine	48	46.15
Hyperplatyrrhine	4	3.85
Total	104	100.00
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	0	0.00
Broad	17	16.35
Very broad	87	83.65
Total	104	100.00
Jugo-frontal index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	0	0.00
Broad	15	14.42
Very broad	89	85.58
Total	104	100.00
Relative chest-girth index		
Narrow chest	1	0.96
Medium	27	25.96
Broad	76	73.08
Total	104	100.00

Cephalic index- The cephalic index shows that nearly 58.65% of all adult females are mesocephals. 27.88% are found to be dolichocephals. The frequencies of brachycephals and hyperdolichocephals are 10.58% and 2.88% respectively.

Nasal index- Nearly 40.04% of all Miju Mishmi females have mesorrhine nose, followed by 46.15% of platyrrhine nose. 3.85% have hyperplatyrrhine nose and 0.96% have leptorrhine nose.

Jugo-mandibular index- The majority (83.65%) of all adult females has very broad type. Only 16.35% have broad type.

Jugo-frontal index- The jugo-frontal index indicates that 85.58% of females have very broad type, followed by 14.42% of broad type.

Relative chest girth index- It is seen that nearly 73.08% of Miju Mishmi females have broad chest, whereas 25.96% have medium chest and 0.96% have narrow chest.

Thus, from the Table 57, we have found that the Miju Mishmi females are mostly of below medium statured people with mesocephalic type of head, mesorrhine nose and broad chest. The jugo-frontal index and jugo-mandibular index shows that they have very broad face.

Lastly, we shall deal with the anthropometric characteristics of Idu Mishmi.

Table 58. Anthropometric measurements of the Idu Mishmi (Male).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s. d.
1	Height vertex	154	135.3 – 171.2	155.51 ± 0.45	5.53
2	Sitting height vertex	154	74.2 – 94.7	85.13 ± 0.28	3.44
3	Chest girth	154	72.8 – 98.9	85.47 ± 0.42	5.26
4	Head length	154	17.6 – 20.5	18.94 ± 0.05	0.59
5	Head breadth	154	13.7 – 15.8	15.17 ± 0.04	0.45
6	Head circumference	154	53.5 – 60.8	57.80 ± 0.12	1.49
7	Least frontal breadth	154	11.1 – 13.7	12.38 ± 0.05	0.61
8	Nasal height	154	3.7 – 4.8	4.20 ± 0.02	0.24
9	Nasal breadth	154	3.2 – 4.2	3.68 ± 0.02	0.22
10	Bizygometic breadth	154	11.2 – 14.5	13.29 ± 0.04	0.53
11	Bigonial breadth	154	10.4 – 13.5	11.77 ± 0.04	0.53
12	Mid-arm-circumference	154	21.2 – 29.5	24.85 ± 0.16	1.95
13	Weight	154	42.0 – 65.5 (kg)	53.49 ± 0.41	5.03

The ranges, means and standard errors that have been calculated from 13 different anthropometric measurements of 154 Idu Mishmi males are shown in the Table 58.

It is seen that among the Idu Mishmi adult males the height vertex varies from 135.3cm to 171.2cm. Its mean is 155.51±0.45cm. So far the sitting height vertex is concerned, the mean of this is 85.13±0.28cm. It varies from 74.2cm and 94.7cm. The chest girth of all adult males is found to vary between 72.8cm and 98.9cm, and the mean is 85.47±0.42cm.

Four different measurements have been taken on the head, viz., length, breadth, circumference and least frontal breadth. The head length seems to be varying from 17.6cm and 20.5cm, and the mean is 18.94±0.05cm. The head breadth varies between 13.7cm and 15.8cm. Its mean is 15.17±0.04cm. The head circumference ranges between 53.5cm and 60.8cm, with the mean of 57.80±0.12cm. The least frontal breadth ranges between 11.1cm and 13.7cm, and the mean is 12.38±0.05cm.

The two measurements that have been taken on nose are nasal height and nasal breadth. The nasal height is found to be varying from 3.7cm to 4.8cm, and its mean is 4.20±0.02cm, whereas the nasal breadth varies from 3.2cm to 4.2cm, with the mean of 3.68±0.02cm.
Bizygomatic breadth and bigonial breadth are the two measurements taken on the face. It is seen that the bizygomatic breadth varies between 11.2cm and 14.5cm. The mean of this is 13.29±0.04cm. The bigonial breadth varies from 10.4cm to 13.5cm, and the mean is 11.77±0.04cm.

The mid-arm-circumference among the Idu Mishmi males have been taken. The minimum mid-arm-circumference is 2.12cm and the maximum circumference is 29.5cm. The mean is 24.85±0.16cm.

The body weight among the Idu Mishmi adult males are found to be vary from 42.0kg to 65.5kg. The mean body weight is 53.49±0.41kg.

Table 59. INDICES (Male).

Sl. No.	Character	No.	Range	Mean ± s. e.	s. d.
1	Cephalic index	154	69.95 - 86.81	80.18 ± 0.26	3.24
2	Nasal index	154	70.21 - 102.7	87.74 ± 0.48	5.91
3	Relative sitting height vertex index	154	50.37 - 59.91	54.78 ± 0.16	1.93
4	Relative chest girth index	154	46.26 - 63.68	54.97 ± 0.28	3.42
5	Ponderal index	154	2.2 - 2.68	2.42 ± 0.007	0.09
6	Jugo-frontal index	154	78.17 - 108.55	93.25 ± 0.39	4.86
7	Jugo-mandibular index	154	76.59 - 108.0	88.70 ± 0.39	4.81
8	Pignet-vervaek index	154	77.80 - 102.64	89.33 ± 0.44	5.51
9	Transverse fronto-parietal index	154	71.34 - 93.62	81.66 ± 0.39	4.84
10	Trans-cephalo-facial index	154	72.26 - 100.0	87.69 ± 0.33	4.08

Table 59 shows ten different indices that have been calculated from the above anthropometric measurements on Idu Mishmi males.

The cephalic index ranges from 69.95 to 86.81. The mean of this index is 80.18±0.26.

The nasal index varies from 70.21 to 102.7, and the mean is 87.74±0.48.

The relative sitting height index varies from 50.37 to 59.91, with the mean of 54.78±0.16.

The relative chest girth index ranges between 46.26 and 63.68, with the mean of 54.97±0.28. The ponderal index varies from 2.2 to 2.68, and the mean is 2.42±0.007.

The jugo-frontal index is found to be varying between 78.17 and 108.55. Its mean is 93.25±0.39.

The jugo-mandibular index ranges between 76.59 and 108.0, and the mean is 88.70±0.39.

The pignet-vervaek index ranges between 77.80 and 102.64, with the mean of 89.33±0.44.

The transverse fronto-parietal index seems to vary between 71.34 and 93.62, and its mean is 81.66±0.39. The trans-cephalo-facial index varies between 72.26 and 100.0, with mean of 87.69±0.33.

The Table 60 shows the ranges, means and standard errors of 13 anthropometric measurements of 143 Idu Mishmi females.

The height vertex is found to be varying between 136.8cm and 163.5cm. Its mean is 149.02 ± 0.41cm. The sitting height vertex varies from 72.4cm to 92.4cm, and its mean is 81.68 ±0.32cm.

Table 60. Anthropometric measurements of the Idu Mishmi (Female).

Sl. No.	Character	Total No.	Range (in cm)	Mean ± s. e.	s.d.
1	Height vertex	143	136.8 – 163.5	149.02 ± 0.41	4.92
2	Sitting height vertex	143	72.4 – 92.4	81.68 ± 0.32	3.82
3	Chest girth	143	73.4 – 91.4	83.46 ± 0.34	4.11
4	Head length	143	16.9 – 19.3	18.2 ± 0.04	0.53
5	Head breadth	143	13.2 – 16.2	14.61 ± 0.04	0.51
6	Head circumference	143	52.4 – 59.4	56.56 ± 0.25	3.03
7	Least frontal breadth	143	10.7 – 13.4	12.08 ± 0.05	0.55
8	Nasal height	143	3.6 – 4.6	4.00 ± 0.02	0.25
9	Nasal breadth	143	2.9 – 4.0	3.51 ± 0.02	0.30
10	Bizygometic breadth	143	11.9 – 14.3	13.09 ± 0.05	0.56
11	Bigonial breadth	143	10.2 – 12.8	11.46 ± 0.05	0.57
12	Mid-arm-circumference	143	20.5 – 29.4	24.76 ± 0.16	1.86
13	Weight	143	38.0 – 62.5 (kg)	50.31 ± 0.50	5.96

The chest girth among the Idu Mishmi adult females have been found to be in the range of 73.4cm and 91.4cm. Its mean is 83.46 ± 0.34cm.

Four different measurements have been taken on the head, viz., length, breadth, circumference and least frontal breadth. It is seen that head length varies from 16.9cm to 19.3cm. Its mean is 18.2 ± 0.04cm. The head breadth seems to be varying from 13.2cm to 16.2cm, and the mean is 14.61 ± 0.04cm. The head circumference varies from 52.4cm to 59.4cm. Its mean is 56.56 ± 0.25cm. The least frontal breadth seems to vary between 10.7cm and 13.4cm, with the mean of 12.08 ± 0.05cm.

The two measurements taken on the nose are nasal height and nasal breadth. The nasal height varies from 3.6cm to 4.6cm, with the mean of 4.00 ± 0.02cm. The nasal breadth found to be varying from 2.9cm to 4.0cm. The mean is 3.51 ± 0.02cm.

Among the Idu Mishmi females, two measurements have been taken on the face. They are bizygomatic breadth and bigonial breadth. The bizygomatic breadth varies between 11.9cm and 14.3cm, and its mean is 13.09 ± 0.05cm. The bigonial breadth varies between 10.2cm and 12.8cm, and the mean is 11.46 ± 0.05cm.

The mid-arm-circumference among the Idu Mishmi adult females are found to be vary between 20.5cm and 29.4cm. The mean is 24.76 ± 0.16cm.

The body weight among the adult females are seems to be ranging between 38.0kg and 62.5kg. The mean body weight is 50.31 ± 0.50kg.

Table 61. INDICES (Female)

Sl. No.	Character	No.	Range	Mean ± s.e.	s.d.
1	Cephalic index	143	69.11 – 88.7	80.30 ± 0.29	3.51
2	Nasal index	143	70.73 – 100.0	87.77 ± 0.54	6.42
3	Relative sitting height vertex index	143	50.51 – 59.5	54.80 ± 0.14	1.64
4	Relative chest girth index	143	50.18 – 62.46	56.02 ± 0.21	2.47
5	Ponderal index	143	2.3 – 2.67	2.47 ± 0.007	0.08
6	Jugo-frontal index	143	78.83 – 103.3	92.34 ± 0.43	5.13
7	Jugo-mandibular index	143	74.47 – 97.71	87.62 ± 0.44	5.23
8	Pignet-vervaek index	143	78.24 – 101.15	89.11 ± 0.40	4.75
9	Transverse fronto-parietal index	143	70.39 – 96.21	82.79 ± 0.40	4.72
10	Trans-cephalo-facial index	143	75.15 – 103.01	89.78 ± 0.41	4.84

Table 61 shows the indices that have been calculated from the anthropometric measurements among the Idu Mishmi females.

The cephalic index ranges between 69.11 and 88.7, with the mean of 80.30 ± 0.29.

The nasal index varies between 70.73 and 100.0. Its mean is 87.77 ± 0.54.

The relative sitting height vertex index is found to be varying from 50.51 to 59.5, and the mean is 54.80 ± 0.14.

The relative chest girth index ranges between is found 50.18 and 62.46, and the mean is 56.02 ± 0.21. The ponderal index varies from 2.3 to 2.67, with the mean of 2.47 ± 0.007.

The jugo-frontal index varies between 78.83 and 103.3, and its mean is 92.34 ± 0.43. The jugo-mandibular index between 74.47 and 97.71, and the mean is 87.62 ± 0.44.

The pignet-vervaek index is found to be varying from 78.24 to 101.15, and its mean is 89.11 ± 0.40. The transverse fronto-parietal index varies from 70.39 to 96.21, and its mean is 82.79 ±

0.40. The trans-cephalo-facial index is found to be varying from 75.15 and 103.01. Its mean is 89.78 ± 0.41.

Table 62. Classification of anthropometric characters of the Idu Mishmi (Male)

Character	Frequency	Percentage
Stature		
Very short	25	16.23
Short	95	61.69
Lower (below) medium	28	18.18
Medium	3	1.95
Upper (above) medium	2	1.30
Tall	1	0.65
Total	154	100.00
Cephalic index		
Hyperdolichocephal	1	0.65
Dolichocephal	12	7.79
Mesocephal	80	51.95
Brachycephal	56	36.36
Hyperbrachycephal	5	3.25
Total	154	100.00
Nasal index		
Leptorrhine	0	0.00
Mesorrhine	53	34.42
Platyrrhine	100	64.94
Hyperplatyrrhine	1	0.65
Total	154	100.01
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	5	3.25
Broad	21	13.64
Very broad	128	83.12
Total	154	100.01
Jugo-frontal index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	1	0.65
Broad	12	7.79
Very broad	141	91.56
Total	154	100.00
Relative chest-girth index		
Narrow chest	18	11.69
Medium	81	52.60
Broad	55	35.71
Total	154	100.00

Table 62 shows the classification of anthropometric characters of Idu Mishmi males.

Stature- It is seen that nearly 61.69% of all Idu Mishmi males are of short stature, whereas 18.18% are of below medium stature and 16.23% are of very short stature. Rests are of medium, above medium and tall stature.

Cephalic index- Nearly 51.95% of all Idu Mishmi adult males are mesocephals, followed by 36.36% are brachycephals and 7.79% are dolichocephals. The frequencies of hyperbrachycephals and hyperdolichocephals are 3.25% and 0.65% respectively.

Nasal index- 64.94% of all adult males have platyrrhine nose, followed by 34.42% of mesorrhine nose and 0.65% of hyperplatyrrhine nose.

Jugo-mandibular index- The majority (83.12%) of all adult males have very broad type, whereas 13.64% belongs to broad type and 3.25% belong to medium type.

Jugo-frontal index- it is seen that nearly 91.56% of all Idu Mishmi adult males have very broad type. The frequencies of broad and medium type are 7.79% and 0.65% respectively.

Relative chest girth index- The majority (52.60%) of all adult males have medium chest, whereas 35.71% have broad chest and 11.69% have narrow chest.

Thus, from Table 62, it is seen that the Idu Mishmi males are mostly of short statured people with mesocephalic head, platyrrhine nose and medium chest. The jugo-mandibular index and jugo-frontal index shows that they have very broad face.

Table 63 shows the classification of anthropometric characters of Idu Mishmi females.

Stature- It is seen that nearly 45.45% of all Idu Mishmi adult females are of short stature, whereas 28.67% are of below medium stature and 13.99% are of medium stature. Rests are very short, above medium and tall statured people.

Cephalic index- The cephalic index shows that nearly 48.95% of all Idu Mishmi adult females are mesocephals. 34.27% are found to be of brachycephals and 9.79% are dolichocephals. The frequencies of hyperbrachycephals and hyperdolichocephals are 6.29% and 0.70% respectively.

Table 63. Classification of anthropometric characters of the Idu Mishmi (Female)

Character	Frequency	Percentage
Stature		
Very short	7	4.90
Short	65	45.45
Lower (below) medium	41	28.67
Medium	20	13.99
Upper (above) medium	6	4.20
Tall	4	2.80
Total	143	100.01
Cephalic index		
Hyperdolichocephal	1	0.70
Dolichocephal	14	9.79
Mesocephal	70	48.95
Brachycephal	49	34.27
Hyperbrachycephal	9	6.29
Total	143	100.00
Nasal index		
Leptorrhine	0	0.00
Mesorrhine	46	32.17
Platyrhine	93	65.03
Hyperplatyrhine	4	2.80
Total	143	100.00
Jugo-mandibular index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	8	5.59
Broad	21	14.69
Very broad	114	79.72
Total	143	100.00
Jugo-frontal index		
Very narrow	0	0.00
Narrow	0	0.00
Medium	8	5.59
Broad	15	10.49
Very broad	120	83.92
Total	143	100.00
Relative chest-girth index		
Narrow chest	1	0.70
Medium	66	46.15
Broad	76	53.15
Total	143	100.00

Nasal index- Majority (65.03%) of all adult females have platyrrhine nose, followed by 32.17% have mesorrhine nose and 2.80% have hyperplatyrrhine nose.

Jugo-mandibular index- It is seen that nearly 79.72% of all adult females have very broad type, whereas 14.69% have broad type and 5.59% have medium type.

Jugo-frontal index- The majority (83.92%) of all adult females have very broad type, followed by 10.49% have broad type and 5.59% have medium type.

Relative chest girth index- It is found that nearly 53.15% of all Idu Mishmi females have broad chest, whereas 46.15% have medium chest and 0.70% have narrow chest.

Thus, from the Table 63, we have found that the Idu Mishmi females are mostly of short statured people with mesocephalic head, platyrrhine nose and broad chest. The jugo-frontal index and jugo-mandibular index indicate that they have very broad face.

Table 65 shows the distance measures, calculated on the basis of the values for 12 anthropometric measurements among 22 Mongoloid populations of Northeast India including the Mishmis of Arunachal Pradesh. When the three Mishmi populations are compared with other populations, the least distance is seen between Digaru Mishmi and Kalaktang Monpa (3.32). The maximum distance is observed between Idu Mishmi and Kalaktang Monpa (11.22). The other populations come in between. The distance between the Digaru and Miju Mishmi, Digaru and Idu Mishmi and Miju and Idu Mishmi is found to be 3.44, 3.91 and 6.11 respectively.

Figure 10 shows the dendrogram constructed following the method given by Nei *et al.* (1983). The dendrogram shows that in respect of anthropometric characters, the Miju Mishmi remains quite apart from remaining populations compared. However, Miju Mishmi shows closeness to Dirang Monpa and Tawang Monpa. The Digaru Mishmi also remains apart from rest of the Mongoloid populations in respect of this trait. However, it shows some closeness with the Kalaktang Monpa, Khampti, Gallong, Miju Mishmi, Dirang Monpa and Tawang Monpa. The dendrogram further shows that in respect of anthropometric traits, the Idu males are closer to the Tangsa.

Table 64- Anthropometric characteristics (mean) of 22 Mongoloid populations of Arunachal Pradesh.

Population	Total no.	Anthropometric characters													Authors
		Height vertex	Sitting height vertex	Chest girth	Head length	Head breadth	Bizygo-matic breadth	Nasal height	Nasal breadth	Least frontal breadth	Head circum-ference	Bigonial breadth	Mid arm circum-ference	Weight	
Nocte	108	160.83	83.24	83.82	17.52	14.28	13.75	5.28	3.69	10.19	56.29	9.67	-	54.74	Goswami and Das, 1990
Wancho	127	159.27	82.16	85.25	18.77	15.38	14.01	5.21	3.69	10.56	57.16	9.75	-	58.59	-do-
Tangsa	136	152.21	82.16	84.08	19.03	14.36	13.79	5.03	3.77	10.34	56.01	9.58	-	54.65	-do-
Singpho	76	158.31	82.83	84.28	18.63	14.52	13.63	5.07	3.69	10.39	55.38	9.74	-	55.92	-do-
Khampti	102	159.95	84.57	87.43	18.68	14.59	13.68	5.19	3.80	10.51	55.86	10.16	-	57.57	-do-
Gallong	141	161.63	84.66	85.61	19.10	14.06	13.51	5.34	3.66	10.11	55.21	10.08	-	59.62	-do-
Minyong	116	156.99	82.79	85.24	19.07	14.19	13.68	5.30	3.57	10.12	55.63	9.84	-	58.54	-do-
Hill Miri	100	157.74	84.14	86.34	19.52	14.80	14.14	5.33	3.86	10.16	55.61	10.38	-	54.82	-do-
Tagin	130	160.87	85.56	85.73	19.04	14.66	13.25	4.73	3.48	10.61	55.75	10.58	-	52.93	-do-
Apatani: Guth	163	162.47	84.36	87.06	18.91	15.10	13.86	5.07	3.43	10.10	54.91	10.43	-	53.59	-do-
Apatani: Guchi	105	158.85	83.04	84.90	18.75	15.06	13.83	4.91	3.62	10.12	54.66	10.39	-	51.53	-do-
Nishi	117	156.40	81.54	85.11	18.79	14.41	13.83	4.87	3.70	11.70	56.07	10.49	-	51.91	-do-
Aka	109	155.77	83.48	85.98	18.69	15.01	14.05	5.16	3.66	10.01	54.55	10.38	-	52.01	-do-
Khowa	96	157.55	83.27	86.37	18.43	15.03	14.24	4.67	3.83	10.06	54.44	10.86	-	53.50	-do-
Miji	212	157.76	81.43	88.18	18.82	14.71	14.01	4.68	3.78	11.75	56.82	11.06	-	53.33	-do-
Sherdukpen	125	160.66	84.35	87.18	18.91	14.75	14.08	5.14	3.63	10.23	54.21	10.54	-	53.69	-do-
Dirang Monpa	140	160.60	84.79	92.28	18.87	14.92	13.66	5.01	3.66	10.72	55.88	10.71	-	58.31	-do-
Kalaktang Monpa	160	158.87	84.86	90.15	18.73	15.42	13.53	4.78	3.67	10.78	55.66	10.72	-	55.16	-do-
Tawang Monpa	143	162.45	86.19	92.01	19.21	15.30	13.68	4.91	3.63	10.91	57.30	10.66	-	58.91	-do-
Digaru Mishmi	107	157.65	85.22	88.11	18.86	14.37	13.24	4.79	3.76	12.20	56.90	11.28	25.06	54.77	Present study
Miju Mishmi	102	159.28	86.35	87.94	18.96	14.71	13.32	4.43	3.77	12.30	57.73	11.53	25.58	57.39	-Do-
Idu Mishmi	154	155.51	85.13	85.47	18.94	15.17	13.29	4.20	3.68	12.38	57.80	11.77	24.85	53.49	-Do-

Table 65 – Genetic distance values for twelve antropometic measurements among 22 Mongoloid populations.

	Nocte	Wancho	Tangsa	Singpho	Khampti	Gallong	Minyong	Hill Miri	Tagin	Apa: Guth	Apa: Guchi	Nishi	Aka	Khowa	Miji	Sherdukpen	Dirang Monpa	Kalaktang Monpa	Tawang Monpa	Digaru Mishmi	Miju Mishmi	Idu Mishmi
Nocte	0																					
Wancho	4.92	0																				
Tangsa	8.83	8.33	0																			
Singpho	3.22	3.68	6.32	0																		
Khampti	5.06	3.83	9.28	4.34	0																	
Gallong	5.80	4.39	11.10	5.53	3.39	0																
Minyong	5.86	3.13	6.34	3.17	4.28	5.16	0															
Hill Miri	4.70	5.06	6.41	3.04	3.88	6.36	4.31	0														
Tagin	4.08	7.11	9.69	5.14	5.20	6.91	7.48	4.19	0													
Apa:Guth	4.58	7.02	11.08	5.84	4.90	6.39	7.88	5.07	2.81	0												
Apa:Guchi	4.57	7.62	7.64	4.62	6.96	8.84	7.42	4.15	3.90	4.89	0											
Nishi	6.08	7.58	5.41	5.00	7.81	10.04	7.02	4.71	6.28	7.48	3.66	0										
Aka	6.58	8.09	5.34	5.17	7.35	9.78	6.90	3.78	5.85	7.04	3.35	3.26	0									
Khowa	5.07	6.39	6.45	3.75	5.36	7.76	5.62	2.42	4.55	5.19	2.90	3.83	2.49	0								
Miji	6.38	6.56	7.42	5.50	6.07	8.89	6.68	4.28	6.02	6.27	5.08	3.79	4.87	3.95	0							
Sherdukpen	4.59	6.66	9.55	4.86	4.35	6.39	6.80	3.61	2.76	2.01	3.92	6.28	5.41	3.51	5.26	0						
Dirang Monpa	9.52	7.82	12.64	8.96	5.01	7.03	8.28	7.57	8.54	7.40	10.42	11.04	10.35	8.54	7.96	7.13	0					
Kalaktang Monpa	7.18	6.85	9.58	6.45	3.97	7.18	6.82	4.32	5.46	5.17	6.77	7.43	6.43	4.91	4.84	4.22	4.22	0				
Tawang Monpa	10.12	8.57	14.36	10.14	5.92	7.18	9.64	8.92	9.01	7.92	11.66	12.57	12.04	10.18	9.60	8.23	2.85	5.92	0			
Digaru Mishmi	6.46	6.45	7.92	5.51	4.43	7.42	6.11	3.56	4.91	6.06	6.16	5.85	5.58	4.57	4.18	4.95	6.55	3.32	7.73	0		
Miju Mishmi	7.02	5.86	10.06	6.47	3.65	5.77	6.31	5.35	5.98	6.66	8.42	8.62	8.44	6.90	6.71	6.24	5.56	4.50	5.71	3.44	0	
Idu Mishmi	7.20	7.64	6.06	5.98	7.21	9.62	7.01	4.76	6.22	8.25	6.12	4.77	4.99	5.23	5.38	7.13	10.20	6.69	11.22	3.91	6.11	0

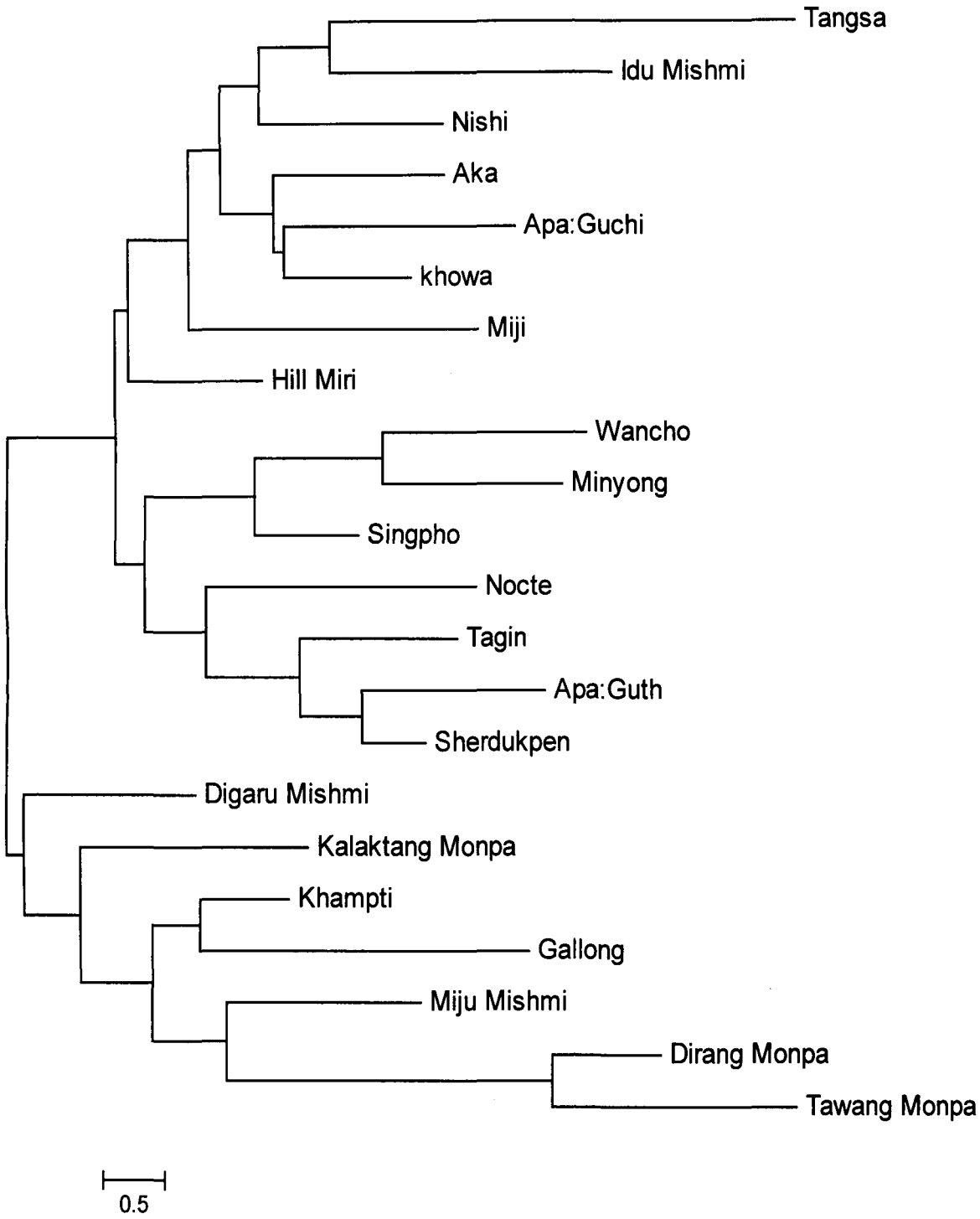


FIGURE 10. DENDROGRAM SHOWING THE RELATIONSHIP OF MISHMI POPULATION WITH OTHER POPULATIONS OF NORTH EAST INDIA IN RESPECT OF ANTHROPOMETRIC TRAITS.

CHAPTER - VI
GENETIC MARKERS

In this chapter, we shall deal with some genetic markers among Digaru Mishmi, Miju Mishmi and Idu Mishmi of Arunachal Pradesh.

First, we shall deal with some genetic markers among the Digaru Mishmi.

Table 66. Genetic markers among the Digaru Mishmi (Male).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	107	A=25	23.36	p= 0.1305	D/σ = ± 0.097
		B=18	16.82	q= 0.0936	χ^2=135.0019, d. f. =1,
		O=63	58.88	r= 0.7759	P<0.05, Significant.
		AB=1	0.9346		
Rh blood groups	107	Rh (+)=107	100.00	D=1.000	χ^2=0, d. f. =1, P>0.05,
		Rh (-)=0	0.00	d= 0.000	Insignificant.
PTC taste-blindness	107	Tasters=58	54.21	T=0.3233	χ^2=8.4997, d. f. =1,
		Non-tasters=49	45.79	t=0.6767	P<0.05, Significant.
Colour blindness	107	Normal =107	100.00	C= 1.000	χ^2=0, d. f. =1, P>0.05,
		Colourblind =0	0.00	c=0.000	Insignificant.

In the Table 66, the results for four genetic markers, viz., ABO and Rh blood groups, PTC-taste blindness and colour blindness among the Digaru Mishmi males have been set out. It is found that the phenotypic frequencies of A, B, AB and O blood groups are 23.36%, 16.82%, 0.9346% and 58.88% respectively. The gene frequencies of p, q, and r are 0.1305, 0.0936 and 0.7759 respectively. The D/σ value is ±0.097 and χ^2 value is 135.0019 (d. f. = 1, P<0.05). So, the χ^2 values indicate that the population in not in equilibrium in respect of ABO blood groups. Table 66 also shows the results of Rh blood groups, carried out among the Digaru Mishmi males. 107 individuals have been tested with anti-D antisera. All 107 individuals are found to be of Rh^+ type. So, the frequency of Rh^+ individuals is 100.00%. The frequencies of D and d genes are 1.000 and 0.000 respectively. The χ^2 value (χ^2 = 0, d. f. =1, P>0.05) shows that, so far as the Rh blood group system is concerned, this population is in genetic equilibrium. It may be mentioned that generally the frequency of Rh^- gene i.e., d, is generally absent or if present, it stays in a very low dose among the Indian mongoloid populations (Bhattacharjee, 1968).

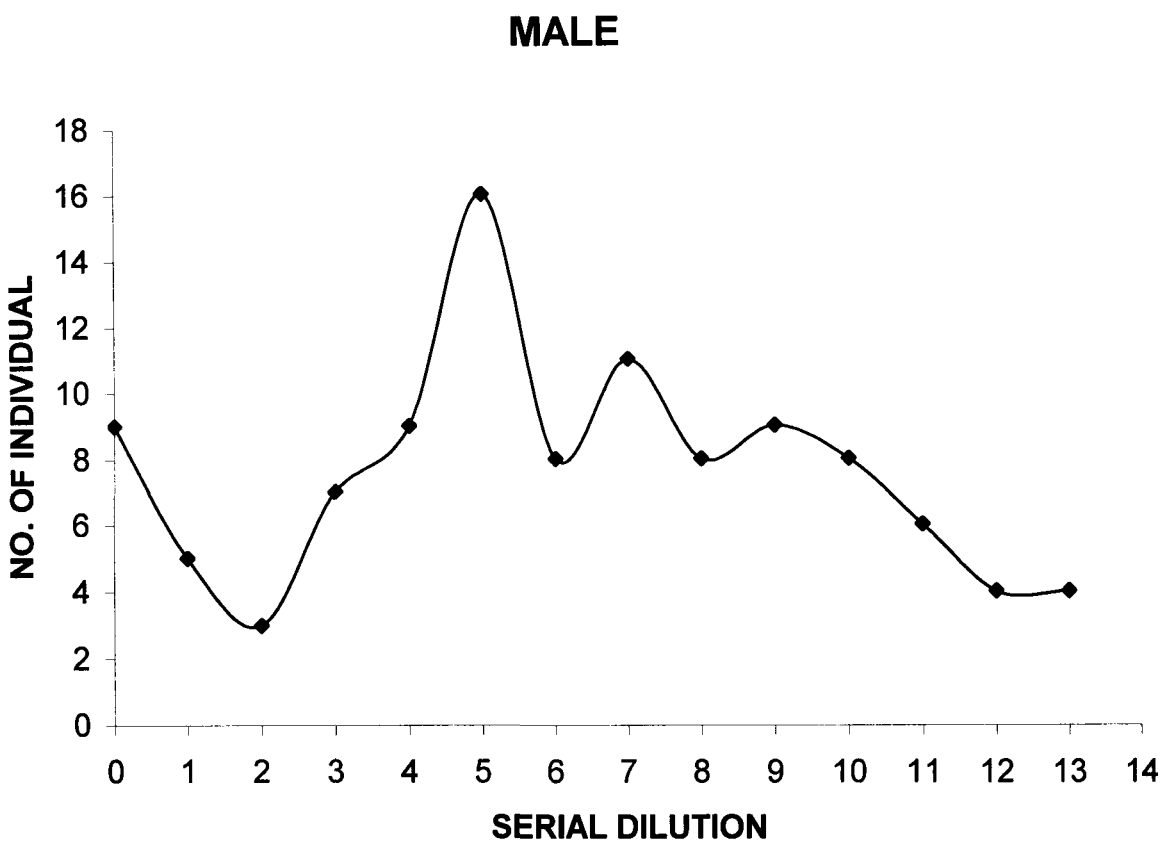


FIGURE 11 DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE DIGARU MISHMI (MALE).

Altogether 107 Digaru Mishmi males have been tested for PTC taste-blindness, following the method suggested by Harris and Kalmus (1949). The antimode falls on no.6. So, all the Digaru Mishmi males, having threshold value between 0 and 6, have been taken as non-tasters and the rests of the males are taken as tasters. It is found that out of 17 individuals, 54.21% are tasters and 45.79% are non-tasters among the Digaru Mishmi males. The frequencies of T and t genes are 0.3233 and 0.6767 respectively. The χ^2 value (χ^2=8.4997, d. f. = 1, P>0.05) indicates that the population, in respect of this genetic trait, is not in equilibrium.

Table 66 further shows that the result of colour blindness among the Digaru Mishmi males. Altogether 107 males have been examined with the Ishihara chart. Out of 107 males, none of the individuals is found to be colour blind.

Table 67. Genetic markers among the Digaru Mishmi (Female).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	104	A=41	39.42	p= 0.2464	D/σ = ±0.0209 χ^2=7.5816, d. f. =1, P<0.05 Significant.
		B=10	9.62	q= 0.0696	
		O=49	47.12	r= 0.6840	
		AB=4	3.85		
Rh blood groups	104	Rh (+)=103	99.04	D=0.902	χ^2=0.000003, d. f. =1, P>0.05, Insignificant.
		Rh (-)=1	0.96	d=0.098	
PTC taste blindness	104	Tasters=57	54.81	T=0.3278	χ^2=8.4467, d. f. =1, P<0.05, Significant.
		Non-tasters=47	45.19	t=0.6722	
Colour blindness	104	Normal = 104	100.00	C= 1.000	χ^2=0, d. f. =1, P>0.05, Insignificant.
		Colourblind=0	0.00	c=0.000	

Table 67 shows the results for four genetic markers, viz., ABO and Rh blood groups, PTC-taste blindness and colour blindness among the Digaru Mishmi females. It is found that the phenotypic frequencies of A, B, AB and O blood groups are 39.42%, 9.62%, 3.85% and 47.12% respectively. The gene frequencies of p, q, and r are 0.2464, 0.0696 and 0.6840 respectively. The D/σ value is ±0.0209 and the χ^2 value is 7.5816 (d. f. =1, P<0.05). So, the χ^2 value indicates that the population is not in genetic equilibrium in respect of ABO blood groups. Table 67 also shows the results of results of Rh blood groups, carried out among the Digaru Mishmi females. 104 females have been tested with anti-D antisera. Out of 104 individuals, only one individual is found to be of Rh^- type. So, the frequencies of Rh^+ and Rh^- individuals are 99.04% and 0.96% respectively. The frequencies of D and d genes are 0.9020 and 0.0980 respectively. The χ^2 value (χ^2=0.000003, d. f. =1, P>0.05) shows that so far as the Rh blood group system is concerned, this population is in genetic equilibrium.

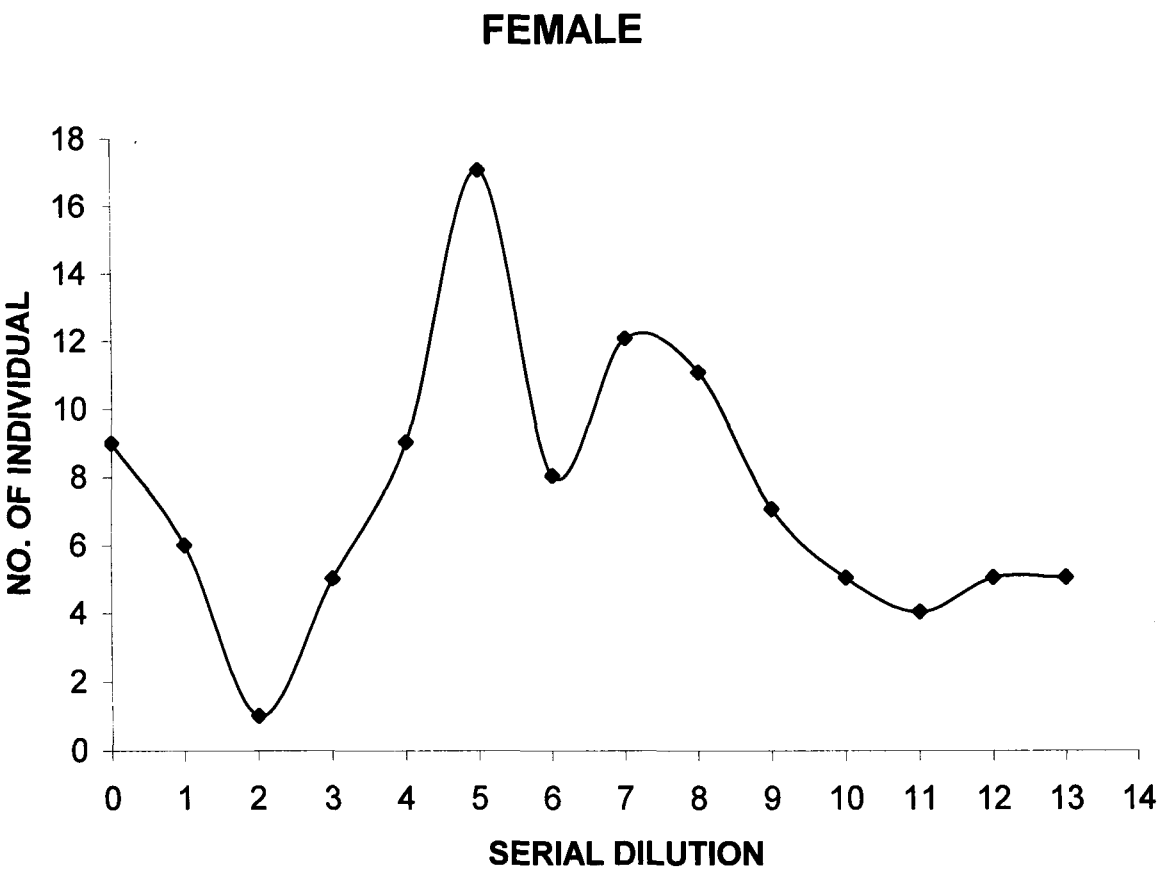


FIGURE 12 DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE DIGARU MISHMI FEMALE.

Altogether 104 individuals have been tested for PTC taste-blindness. The antimode falls on no.6. So, all the individuals, having threshold value between 0 and 6, have been taken as non-tasters and the rest of the individuals have been taken as tasters. It is found that out of 104 females, 54.81% are tasters and 45.19% non-tasters. The frequencies of T and t genes are 0.3278 and 0.6722 respectively. The χ^2 value (χ^2=8.4467, d. f. =1, P<0.05) indicates that the population, in respect of this genetic trait, is not in genetic equilibrium.

Table 67 further shows the results of colour blindness among the Digaru Mishmi females. Altogether 104 females have been examined with the Ishihara chart. Out of 104 females, none of the individuals is found to be colour blind.

Table 68. ABO blood groups by generation.

Generation	Age groups (in years)	ABO blood groups					Total
			O	A	B	AB	
III	-24	No	35	18	5	1	59
		%	59.32	30.51	8.47	1.69	99.99
II	25-48	No	59	37	17	4	117
		%	50.43	31.62	14.53	3.42	100.00
I	49+	No	18	11	6	0	35
		%	51.43	31.43	17.14	0.00	100.00
			112	66	28	5	211

χ^2 (between all generation) = 3.6662, d. f. = 6, P>0.05 Insignificant.
χ^2 (between I and II) =1.3238, d. f. = 3, P>0.05 Insignificant.
χ^2 (between II and III) =2.1574, d. f. =3, P>0.05 Insignificant.
χ^2 (between I and III) =2.2526, d. f. =3, P>0.05 Insignificant.

Table 68 shows that there are some differences in blood group frequencies between generations. However, it is seen that frequency of O blood group is highest in the third generation, whereas in case of blood group A, the frequency is highest in second generation and in case of blood group B, the frequency is highest in first generation.

The inter-generational differences in ABO blood group, when tested by χ^2, are found to be statistically insignificant [χ^2 (between all generation) = 3.6662, d. f. = 6, P>0.05; χ^2 (between I and II) =1.3238, d. f. = 3, P>0.05; χ^2 (between II and III) =2.1574, d. f. =3, P>0.05; χ^2 (between I and III) =2.2526, d. f. =3, P>0.05]. It indicates that in respect of ABO blood group system, the effect of drift on the Digaru Mishmi is not apparently perceptible, according to the method suggested by Glass (1956).

Table 69. PTC taste-blindness by generation.

Generations	Age groups (in years)	Tasters		Non-tasters		Total		Gene frequency 't'
		No.	%	No.	%	No.	%	
III	-24	45	59.21	31	40.79	76	100.00	0.6387
II	25-48	52	49.52	53	50.48	105	100.00	0.7105
I	49+	18	60.00	12	40.00	30	100.00	0.6325
Total		115		96		211		

χ^2 (between all generation) = 2.0946, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =1.0257, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =1.6634, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =0.0056, d. f. =1, P>0.05 Insignificant.

Table 69 shows the distribution of taste-blindness by generation. It is found that the frequencies of non-tasters in I, II and III generations are 40.00%, 50.48% and 40.79% respectively. However, there is no significant difference, in respect of PTC taste-blindness [χ^2 (between all generation) = 2.0946, d. f. = 2, P>0.05; χ^2 (between I and II) =1.0257, d. f. = 1, P>0.05; χ^2 (between II and III) =1.6634, d. f. =1, P>0.05; χ^2 (between I and III) =0.0056, d. f. =1, P>0.05].

Table 70. Incompatible mating among the Digaru Mishmi.

Male x Female		Frequency
A x O	0.2336 x 0.4712	0.1101
B x O	0.1682 x 0.4712	0.0793
AB x O	0.0093 x 0.4712	0.0044
A x B	0.2336 x 0.0962	0.0225
B x A	0.1682 x 0.3942	0.0663
AB x A	0.0093 x 0.3942	0.0037
AB x B	0.0093 x 0.0962	0.0009
	Total =	0.2872 or 28.72%

Compatible mating = 1 – (28.72) = 71.28%

Table 70 shows the pattern of incompatible mating among the Digaru Mishmi. It is found that on the basis of the ABO blood groups, nearly 28.72% of all matings are incompatible. Since the frequency of Rh^- blood group is less than 1%, incompatible matings, in respect of the Rh system, cannot be significant among the Digaru Mishmi. However, it may be postulated that through ABO incompatible matings, selection still finds an ample opportunity to play its role in this population.

Now, we shall deal with some genetic markers among the Miju Mishmi.

Table 71 shows the results for four genetic markers, viz., ABO and Rh blood groups, PTC-taste blindness and colour blindness among the Miju Mishmi males. It is found that the phenotypic frequencies of A, B, AB and O blood groups are 27.45%, 22.55%, 3.92% and 46.08% respectively.

Table 71. Genetic markers among the Miju Mishmi (Male).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	102	A=28	27.45	p= 0.1722	D/σ = ±0.0438 χ^2=29.9268, d. f. =1, P<0.05 Significant
		B=23	22.55	q= 0.1430	
		O=47	46.08	r= 0.6848	
		AB=04	3.92		
Rh blood groups	102	Rh (+)=97	95.10	D=0.7786	χ^2=0.00000084, d. f. =1, P>0.05 Insignificant
		Rh (-)=5	4.90	d=0.2214	
PTC taste blindness	102	Tasters=49	48.04	T =0.2792	χ^2=6.3072, d.f. =1, P<0.05, Significant
		Non-tasters=53	51.96	t = 0.7208	
Colour blindness	102	Normal=102	100.00	C=1.000	χ^2=0, d. f. =1, P>0.05, Insignificant.
		Colourblind=0	0.00		

The gene frequencies of p, q, and r are 0.1722, 0.1430 and 0.6848 respectively. The D/σ value is ± 0.0438 and the χ^2=0, d. f. =1, P>0.05, value is 29.9268 (d. f. =1, P<0.05). So, the χ^2 value indicates that the population is not in equilibrium in respect of ABO blood groups. Table 71 also shows the results of Rh blood group, carried out among the Miju Mishmi males. 102 Miju Mishmi males have been tested with anti-D antisera. Out of 102 males, 5 individuals are found to be of Rh^- type. So, the frequencies of Rh^+ and Rh^- individuals are 96.10% and 4.90% respectively. The frequencies of D and d are 0.7786 and 0.2214 respectively. The χ^2 value (0.00000084, d. f. =1, P>0.05) shows that, so far the Rh blood group system is concerned, this population is in genetic equilibrium.

102 Miju Mishmi males have been tested for PTC taste-blindness. The antimode falls on no.6. So, all the individuals, having threshold value between 0 and 6, have been taken as non-tasters and the rest of the individuals are taken as tasters. It is seen that out of 102 males 102 males, 48.04% are tasters and 51.96% are non-tasters. The frequencies of T and t genes are 0.2792 and 0.7208 respectively. The χ^2 value (χ^2 =6.3072, d. f. =1, P<0.05) indicates that the population, in respect of this trait, is not in genetic equilibrium.

Table 71 further shows the results of colour blindness test among the Miju Mishmi males. Altogether 102 males have been examined with the Ishihara chart. Out of 102 males, none of the males have been found to be colour blind.

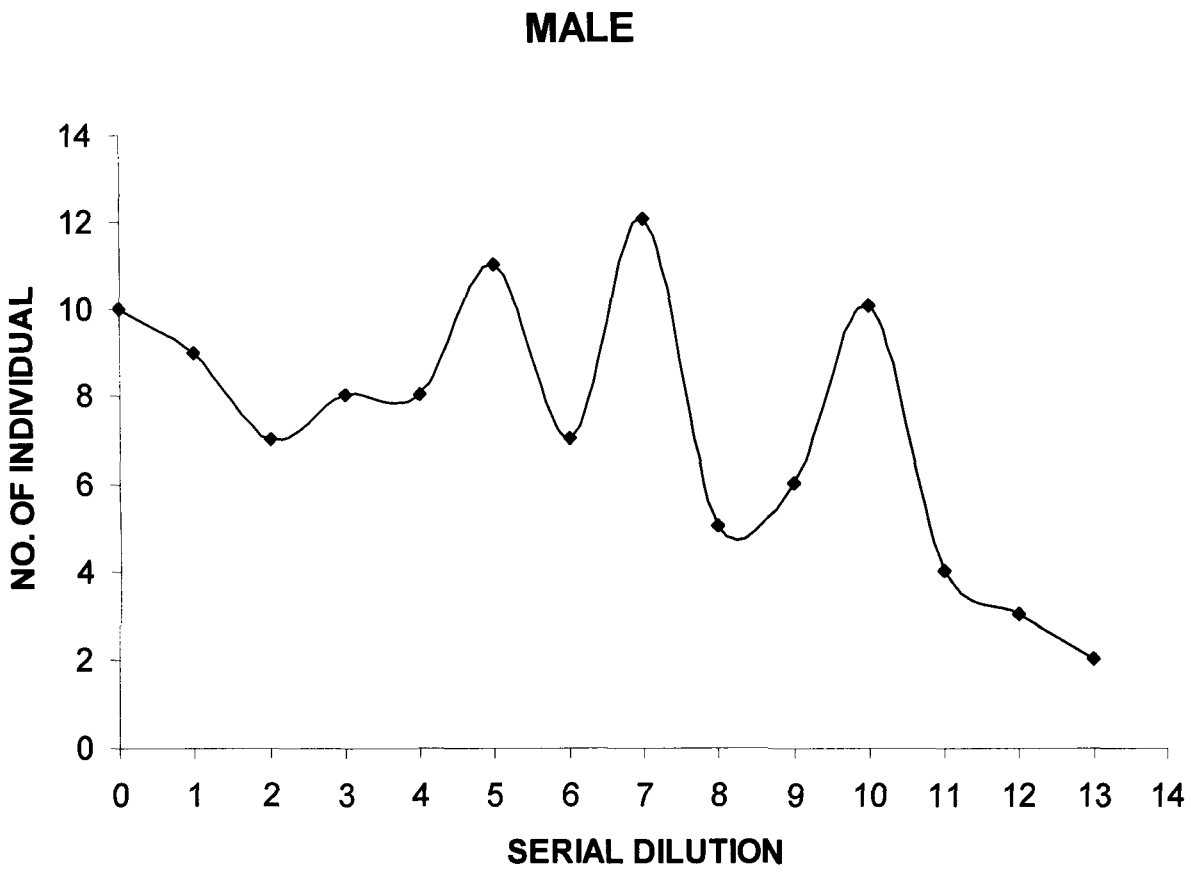


FIGURE 13 DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE MIJU MISHMI MALE.

Table 72. Genetic markers among the Miju Mishmi (Female).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	104	A=28	26.92	p=0.1900	D/σ = ±0.0924
		B=20	19.23	q= 0.1441	χ^2=141.4504, d. f. =1,
		O=48	46.15	r=0.6659	P<0.05, Significant
		AB=8	7.69		
Rh blood groups	104	Rh (+)=98	94.23	D=0.7598	χ^2=0.00000012,d.f. =1,
		Rh (-)=6	5.77	d=0.2402	P>0.05, Insignificant
PTC taste-blindness	104	Tasters=50	48.08	T=0.2794	χ^2=6.4383, d. f. =1,
		Non-tasters=54	51.92	t=0.7206	P<0.05 Significant
Colour blindness	104	Normal=104	100.00	C=1.000	χ^2=0, d. f. =1, P>0.05,
		Colourblind=0	0.00		Insignificant.

Table 72 shows the results for four genetic makers, viz., ABO and Rh blood groups, PTC taste-blindness and colour blindness among the Miju Mishmi females. It is seen that the phenotypic frequencies of A, B, AB and O are 26.92%, 19.23%, 7.69% and 46.15% respectively. The gene frequencies of p, q and r are 0.1900, 0.1441 and 0.6659 respectively. The D/σ value is ±0.0924 and the χ^2 value is 141.4504 (d. f. =1, P<0.05). So, the χ^2 value indicates that the population is not in equilibrium, in respect of ABO blood groups. In the Table 72, the results of Rh blood groups among the Miju Mishmi have been set out. The frequency of Rh^+ and Rh^- individuals are 94.23% and 5.77% respectively. The frequencies of D and d genes are 0.7598 and 0.2402 respectively. The χ^2 value (χ^2 =0.00000012, d. f. =1, P>0.05) shows that the population is in genetic equilibrium, in respect of this genetic trait.

Altogether 104 Miju Mishmi females have been tested for PTC taste-blindness. The antimode falls on no.6. It is found that out of 104 females, 48.08% are tasters and 51.91% are non-tasters. The gene frequencies of T and t are 0.2794 and 0.7206 respectively. The χ^2 value (χ^2 =6.4383, d. f. =1, P<0.05) shows that this population in not in equilibrium, in respect of this genetic trait.

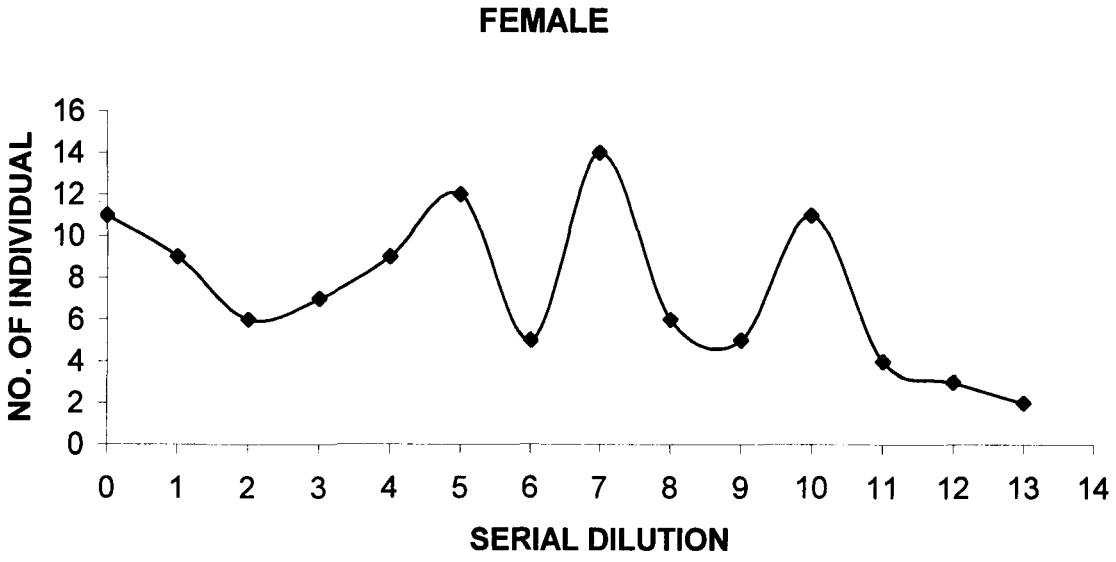


FIGURE 14 DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE MIJU MISHMI FEMALE

Table 72 also shows the results of colour blindness among the Miju Mishmi females. 104 individuals have been examined with Ishihara chart, but none of them is found to be colour blind.

Table 73. ABO blood groups by generation.

Generation	Age groups (in years)	ABO blood groups					Total
			O	A	B	AB	
III	-25	No	36	26	16	5	83
		%	43.37	31.33	19.28	6.02	100.00
II	26-50	No	50	24	24	6	104
		%	48.08	23.08	23.08	5.77	100.01
I	51+	No	9	6	3	1	19
		%	47.37	31.58	15.79	5.26	100.00
			95	56	43	12	206

χ^2 (between all generation) =2.1275, d. f. = 6, P>0.05 Insignificant.
χ^2 (between I and II) =0.8737, d. f. = 3, P>0.05 Insignificant.
χ^2 (between II and III) =1.7133, d. f. = 3, P>0.05 Insignificant.
χ^2 (between I and III) =0.1724, d. f. =3, P>0.05 Insignificant.

Table 73 shows that there are some differences in blood group frequencies between generations. It is seen that the frequency of O blood group is highest in the second generation, whereas in case of blood group A, frequency increases from first generation to third generation. The inter-generational differences in ABO blood group, when tested by χ^2, are found to be statistically insignificant [χ^2 (between all generation) =2.1275, d. f. = 6, P>0.05; χ^2 (between I and II) =0.8737, d. f. = 3, P>0.05; χ^2 (between II and III) =1.7133, d. f. = 3, P>0.05; χ^2 (between I and III) =0.1724, d. f. =3, P>0.05]. It indicates that in respect of ABO blood group system, the effect of drift on the Miju Mishmi is not apparently perceptible, according to the method suggested by Glass (1956).

Table 74. PTC taste-blindness by generation.

Generations	Age groups (in years)	Tasters		Non-tasters		Total		Gene frequency 't'
		No.	%	No.	%	No.	%	
III	-25	44	55.70	35	44.30	79	100.00	0.6656
II	26-50	45	42.45	61	57.55	106	100.00	0.7586
I	51+	10	47.62	11	52.38	21	100.00	0.7237
Total		99		107		206		

χ^2 (between all generation) = 3.1821, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.1905, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =3.1801, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =0.4357, d. f. =1, P>0.05 Insignificant.

Table 74 shows the distribution of taste-blindness by generation. It is found that the frequencies of non-tasters in I, II and III generations are 52.38%, 57.55% and 44.30% respectively. However, there is no significant difference, in respect of PTC taste-blindness [χ^2 (between all generation) = 3.1821, d. f. = 2, P>0.05; χ^2 (between I and II) =0.1905, d. f. = 1, P>0.05; χ^2 (between II and III) =3.1801, d. f. =1, P>0.05; χ^2 (between I and III) =0.4357, d. f. =1, P>0.05].

Table 75 shows the pattern of incompatible matings among the Miju Mishmi. It is found that on the basis of the ABO blood groups, nearly 38.05% of all matings are incompatible. Since the frequency of Rh^- blood group is very less, incompatible matings in respect of the Rh system cannot be significant among the Miju Mishmi.

Table 75. Incompatible mating among the Miju Mishmi.

Male x Female		Frequency
A x O	0.2745 x 0.4615	0.1267
B x O	0.2255 x0.4615	0.1041
AB x O	0.0392 x 0.4615	0.0181
A x B	0.2745 x 0.1923	0.0528
B x A	0.2255 x 0.2692	0.0607
AB x A	0.0392 x 0.2692	0.0106
AB x B	0.0392 x 0.1923	0.0075
	Total =	0.3805 or 38.05%

Compatible mating = 1 – (38.05) = 61.95%

Lastly, we shall deal with some genetic markers among the Idu Mishmi.

Table 76. Genetic markers among the Idu Mishmi (Male).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	154	A = 35	22.73	p=0.1259	D/σ = ±0.1535
		B= 39	25.32	q=0.1410	χ^2=748.8578, d. f. =1, P<0.05, Significant.
		O=79	51.30	r=0.7331	
		AB= 1	0.6493		
Rh blood groups	154	Rh (+)=143	92.86	D =0.7328	χ^2=0.000016, d. f. =1, P>0.05, Insignificant.
		Rh (-)=11	7.14	d =0.2672	
PTC taste blindness	154	Tasters= 95	61.69	T = 0.3810	χ^2=5.9749, d. f. =1, P<0.05, Significant.
		Non-tasters=59	38.31	t = 0.6190	
Colour blindness	154	Normal =154	100.00	C=1.000	χ^2=0, d. f. =1, P>0.05, Insignificant.
		Colourblind=0	0.00		

In the Table 76, the results for four genetic traits, viz., ABO and Rh blood groups, PTC-taste blindness and colour blindness among the Idu Mishmi males have been set out. It is found that the phenotypic frequencies of A, B, AB and O are 22.73%, 25.39%, 0.6493% and 51.30% respectively. The gene frequencies of p, q and r are 0.1259, 0.1410 and 0.7331 respectively. The D/σ value is ± 0.1535 and the χ^2 value is 748.8578 (d. f. = 1, $P<0.05$). So, the χ^2 value indicates that the population is not in genetic equilibrium in respect of ABO blood group. Table 76 also shows the results of the Rh blood groups, carried out among the Idu Mishmi males. Out of 154 males, 11 individuals are found to be of Rh^- type. So, the frequencies of Rh^+ and Rh^- individuals are 92.86% and 7.14% respectively. The frequencies of D and d are 0.7328 and 0.2672 respectively. The χ^2 value ($\chi^2=0.000016$, d. f. =1, $P>0.05$) shows that in respect of this genetic trait, the population is in genetic equilibrium.

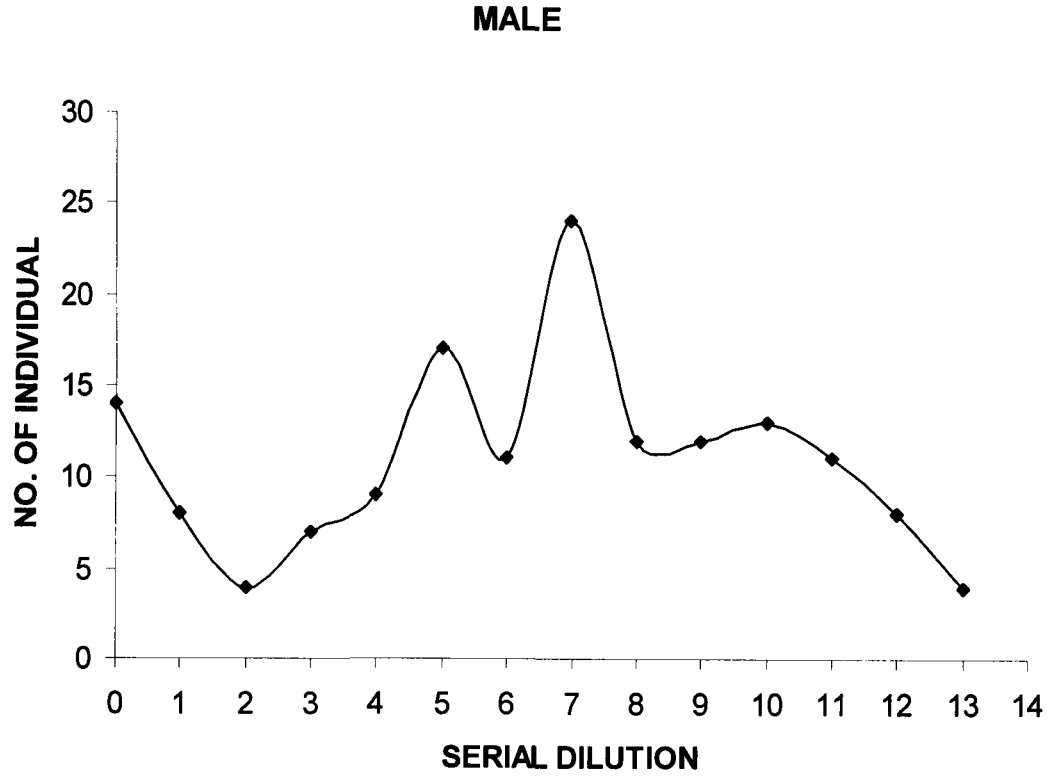


FIGURE 15. DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE IDU MISHMI MALE.

Altogether 154 Idu Mishmi males have been tested for PTC-taste blindness. The antimode falls on no.6. So, all the Individuals having threshold value between 0 and 6, have been taken as non-tasters and the rest of the individuals are taken as tasters. It is seen that out of 154 males, 38.31% are tasters and 61.69% are non-tasters. The frequencies of T and t genes are 0.2146 and 0.7854 respectively. The χ^2 value (χ^2 =5.9749, d. f. =1, P<0.05) shows that in respect of this trait, this population is not in equilibrium.

Table 76 further shows the result of colourblindness among the Idu Mishmi males. Out of 154 males, none of the individuals have been found to be colourblind.

Table 77. Genetic markers among the Idu Mishmi (Female).

Genetic markers	No. tested	Phenotype frequencies	%	Gene frequencies	Inferences
ABO blood groups	143	A = 40	27.97	p=0.1611	D/σ = ±0.1332 χ^2=504.9616, d. f. =1, P<0.05, Significant.
		B= 32	22.38	q =0.1282	
		O=69	48.25	r=0.7107	
		AB= 2	1.40		
Rh blood groups	143	Rh (+)=143	100.00	D =1.000	χ^2=0, d. f. =1, P>0.05, Insignificant.
		Rh (-)=0	0.00	d =0.000	
PTC taste blindness	143	Tasters=87	60.84	T=0.3742	χ^2=14.4146, d. f. =1, P<0.05, Significant
		Non-tasters=56	39.16	t=0.6258	
Colour blindness	143	Normal=143	100.00	C=1.000	χ^2=0, d. f. =1, P>0.05, Insignificant.
		Coilourblind=0	0.00		

Table 77 shows the results for four genetic markers, viz., ABO and Rh blood groups, PTC-taste blindness and colour blindness among the Idu Mishmi females. It is seen that the phenotypic frequencies of A, B, AB and O are 27.97%, 22.38%, 1.40% and 48.25% respectively. The frequencies of p, q and r are 0.1611, 0.1282 and 0.7107 respectively. The D/σ value is ±0.1332 and the χ^2 value is 504.9616 (d. f. =1, P<0.05). So, the χ^2 value indicates that the population is not in genetic equilibrium in respect of ABO blood group. Table 77 also shows the results of Rh blood groups among the Idu Mishmi females. Out of 143 females, all are found to be of Rh^+ type. So, the frequency of Rh^+ individuals is 100.00%. The gene frequencies of D and d are 1.000 and 0.000 respectively. The χ^2 value (χ^2=0, d. f. =1, P>0.05) shows that, so far as the Rh blood group system is concerned, this population is in genetic equilibrium.

Altogether 143 Idu Mishmi females have been tested for PTC-taste blindness. It is seen that out of 143 females, 60.84% are tasters and 39.16% are non-tasters. The frequencies of T and t genes are 0.3742 and 0.6258 respectively. The χ^2 value (χ^2 =14.4146, d. f. =1, P<0.05) shows that in respect of this trait this population is not in genetic equilibrium.

Table 77 further shows the results of colour blindness among the Idu Mishmi females. Out of 143 individuals, none of them have been found to be colour blind.

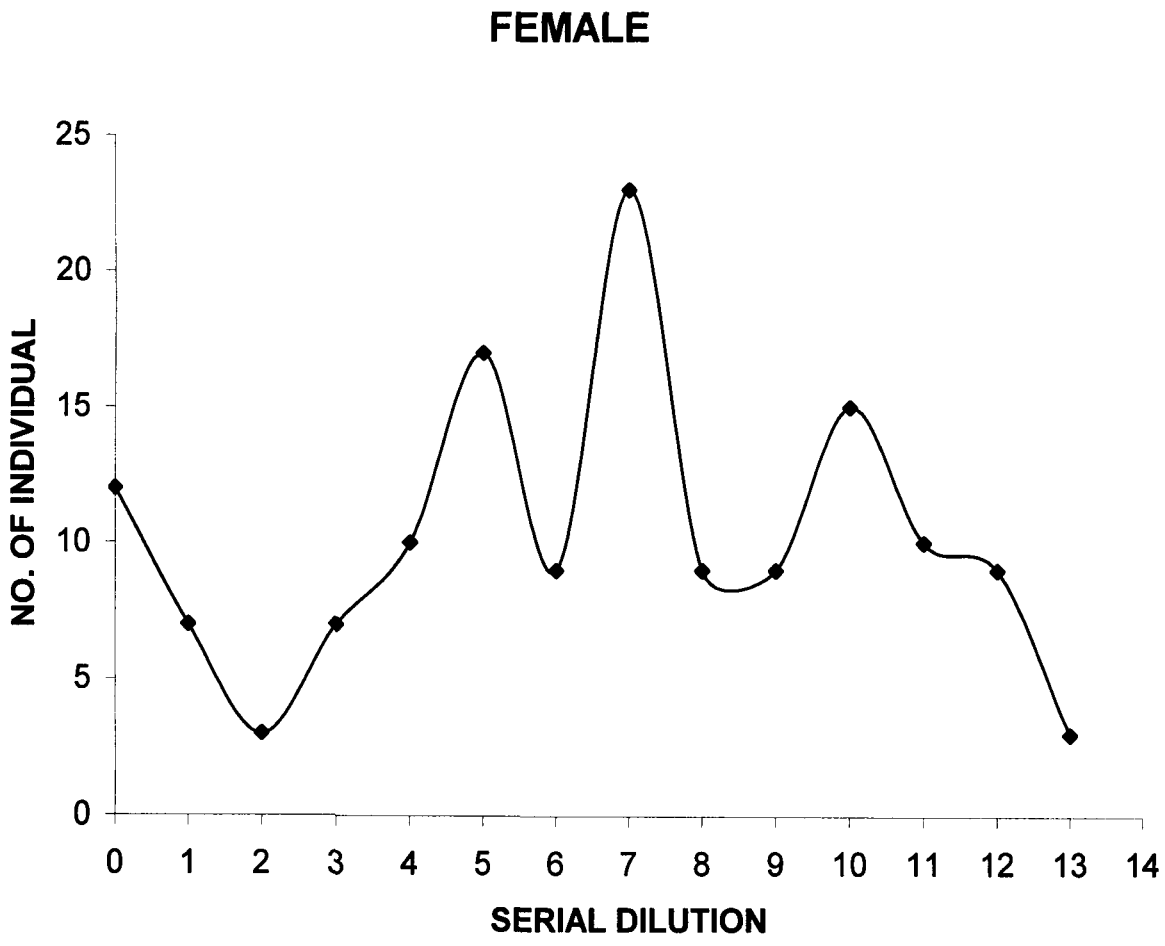


FIGURE 16. DISTRIBUTION OF PTC TASTE BLINDNESS AMONG THE IDU MISHMI FEMALE.

Table 78. ABO blood groups by generation.

Generation	Age groups (in years)	ABO blood groups					Total
			O	A	B	AB	
III	-25	No	55	28	23	2	108
		%	50.93	25.93	21.30	1.85	100.01
II	26-50	No	84	41	44	1	170
		%	49.41	24.12	25.88	0.59	100.00
I	51+	No	9	6	4	0	19
		%	47.37	31.58	21.05	0.00	100.00
			148	75	71	3	297

χ^2 (between all generation) =2.3615, d. f. = 6, P>0.05 Insignificant.
χ^2 (between I and II) =0.6658, d. f. = 3, P>0.05 Insignificant.
χ^2 (between II and III) =1.6708, d. f. =3, P>0.05 Insignificant.
χ^2 (between I and III) =0.5857, d. f. =3, P>0.05 Insignificant.

Table 78 shows that there are some differences in blood group frequencies between generations. It is seen that the frequency of blood group O increases from generation I to generation III, whereas the frequency of A blood group is highest in the generation I and frequency of B blood group is highest in generation II.

The inter-generational differences in ABO blood group, when tested by χ^2, are found to be statistically insignificant [χ^2 (between all generation) =2.3615, d. f. = 6, P>0.05, χ^2 (between I and II) =0.6658, d. f. = 3, P>0.05, χ^2 (between II and III) =1.6708, d. f. =3, P>0.05, χ^2 (between I and III) =0.5857, d. f. =3, P>0.05]. It indicates that in respect of ABO blood group system, the effect of drift on the Idu Mishmi is not apparently perceptible.

Table 79. PTC-taste blindness by generation.

Generations	Age groups (in years)	Tasters		Non-tasters		Total		Gene frequency 't'
		No.	%	No.	%	No.	%	
III	-25	56	50.91	54	49.09	110	100.00	0.7006
II	26-50	80	48.78	84	51.22	164	100.00	0.7157
I	51+	10	43.48	13	56.52	23	100.00	0.7518
Total		146		151		297		

χ^2 (between all generation) =0.4412, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.2272, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.1193, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =0.4202, d. f. =1, P>0.05 Insignificant.

Table 79 shows the distribution of taste-blindness by generation. It is found that the frequencies of non-tasters in I, II and III generations are 56.52%, 51.22% and 49.09% respectively. However, there is no significant difference, in respect of PTC taste-blindness [χ^2 (between all generation) = 0.4412, d. f. = 2, P>0.05; χ^2 (between I and II) =0.2272, d. f. = 1, P>0.05; χ^2 (between II and III) =0.1193, d. f. =1, P>0.05; χ^2 (between I and III) =0.4202, d. f. =1, P>0.05].

Table 80. Incompatible mating among the Idu Mishmi.

Male x Female		Frequency
A x O	0.2273 x 0.4825	0.1097
B x O	0.2532 x 0.4825	0.1222
AB x O	0.0065 x 0.4825	0.0031
A x B	0.2273 x 0.2238	0.0509
B x A	0.2532 x 0.2797	0.0708
AB x A	0.0065 x 0.2787	0.0018
AB x B	0.0065 x 0.2238	0.0014
	Total =	0.3599 or 35.99%

Compatible mating = 1 – (35.99) = 64.01%

Table 80 shows the pattern of incompatible matings among the Idu Mishmi. It is found that on the basis of ABO blood groups, nearly 35.99% of all matings are incompatible. Since the frequency of Rh- blood group is very less, incompatible mating in respect of the Rh system cannot be significant among the Idu Mishmi.

Inter-population differences have been worked out in respect of ABO blood group, Rh blood group and PTC taste blindness. It is observed that in respect of ABO blood group the inter-population differences, when tested by χ^2, are found to be statistically significant [χ^2 (between all populations) = 20.0843, d. f. = 6, P<0.05; χ^2 (between Digaru and Miju) =8.2084, d. f. = 3, P<0.05; χ^2 (between Miju and Idu) =10.4721, d. f. =3, P<0.05; χ^2 (between Digaru and Idu) =10.4771, d. f. =3, P<0.05].

Table 81: ABO blood group, PTC taste sensitivity and Rh blood group by population.

Population		ABO blood group			PTC taste sensitivity		Rh blood group	
	No	p(A)	q(B)	r(O)	T	t	D	d
Digaru Mishmi	211	0.186	0.082	0.732	0.325	0.675	0.932	0.068
Miju Mishmi	206	0.181	0.144	0.675	0.279	0.721	0.769	0.231
Idu Mishmi	297	0.143	0.135	0.722	0.378	0.622	0.808	0.192

ABO blood group

χ^2 (between all populations) =20.0843, d. f. = 6, P<0.05 Significant.

χ^2 (between Digaru and Miju) =8.2084, d. f. = 3, P<0.05 Significant.

χ^2 (between Miju and Idu) =10.4721, d. f. = 3, P<0.05 Significant.

χ^2 (between Digaru and Idu) =10.4771, d. f. =3, P<0.05 Significant.

Rh blood group

χ^2 (between all populations) =8.2960, d. f. = 2, P<0.05 Significant.

χ^2 (between Digaru and Miju) =8.8302, d. f. = 1, P<0.05 Significant.

χ^2 (between Miju and Idu) =0.7785, d. f. = 1, P>0.05 Insignificant.

χ^2 (between Digaru and Idu) =5.5793, d. f. =1, P<0.05 Significant.

PTC taste blindness

χ^2 (between all populations) =8.7191, d. f. = 2, P<0.05 Significant.

χ^2 (between Digaru and Miju) =1.7326, d. f. = 1, P>0.05 Insignificant.

χ^2 (between Miju and Idu) =8.6233, d. f. = 1, P<0.05 Significant.

χ^2 (between Digaru and Idu) =2.3332, d. f. =1, P>0.05 Insignificant.

In respect of Rh blood group, inter-population differences are found to be statistically significant (χ^2 =8.2960, d. f. =2, P<0.05). Again, when compared between the populations, it found that the differences between Digaru and Miju Mishmi, and between Digaru and Idu Mishmi are statistically significant [χ^2 (between Digaru and Miju Mishmi) =8.8302, d. f. = 1, P<0.05, χ^2 (between Digaru and Idu Mishmi) =5.5793, d. f. =1, P<0.05, χ^2 (between Miju and Idu Mishmi) =0.7785, d. f. =1, P>0.05].

In respect of PTC taste blindness, the χ^2 value (χ^2 =8.7191, d. f. =2, P<0.05) shows that there is significant difference among the three Mishmi populations. Again, when compared between the two populations, significant difference observed between Miju Mishmi and Idu Mishmi (χ^2 =8.6233, d. f. =1, P<0.05).

Table 82- Gene frequencies of ABO and PTC taste blindness by populations.

Population	ABO blood group				PTC Taste blindness			Authors
	No. tested	p(A)	q(B)	r(O)	No. tested	T	t	
Wancho	330	0.234	0.123	0.643	330	0.714	0.286	Goswami and Das, 1990
Tangsa	390	0.136	0.182	0.682	390	0.636	0.364	-do-
Singpho	267	0.214	0.163	0.623	267	0.534	0.466	-do-
Khampti	293	0.161	0.181	0.658	297	0.611	0.389	-do-
Gallong	441	0.215	0.152	0.633	405	0.747	0.253	-do-
Miniyong	278	0.175	0.185	0.640	273	0.723	0.277	-do-
Hill Miri	245	0.222	0.121	0.656	229	0.651	0.349	-do-
Tagin	320	0.266	0.161	0.573	320	0.709	0.291	-do-
Apatani	546	0.309	0.153	0.536	513	0.726	0.274	-do-
Nishi	242	0.231	0.186	0.583	241	0.727	0.273	-do-
Aka	251	0.233	0.068	0.693	250	0.791	0.209	-do-
Khowa	211	0.332	0.033	0.633	205	0.651	0.349	-do-
Miji	472	0.302	0.101	0.597	467	0.760	0.240	-do-
Sherdukpen	315	0.322	0.134	0.542	331	0.684	0.316	-do-
Dirang Monpa	335	0.248	0.210	0.542	335	0.453	0.547	-do-
Tawang Monpa	438	0.233	0.244	0.524	339	0.523	0.475	-do-
Kalaktang Monpa	327	0.328	0.177	0.495	233	0.463	0.537	-do-
Chutia	184	0.200	0.112	0.688	190	0.452	0.548	Das *et al.* 1985
Lalung	114	0.194	0.228	0.578	94	0.464	0.536	Das *et al.* 1980
Ahom	384	0.164	0.139	0.679	204*	0.462	0.538	Das *et al.* 1980
Digaru Mishmi	211	0.186	0.082	0.732	211	0.325	0.675	Present study
Miju Mishmi	206	0.181	0.144	0.675	206	0.279	0.721	-do-
Idu Mishmi	297	0.143	0.135	0.722	297	0.378	0.622	-do-

Table 83 : Denetic distances for 23 populations of Assam and Arunahal Pradesh.

	Wancho	Tangsa	Singpho	Khampti	Gallong	Miniyong	Hill Miri	Tagin	Apatani	Nishi	Aka	Khowa	Miji	Sherduken	Dirang Monpa	Tawang Monpa	Kalaktang Monpa	Chutia	Lalung	Ahom	Digru Mishmi	Miju Mishmi	Idu Mishmi
Wancho	0																						
Tangsa	0.0066	0																					
Singpho	0.0096	0.0054	0																				
Khampti	0.0061	0.0005	0.0027	0																			
Gallong	0.0008	0.0064	0.0126	0.0067	0																		
Miniyong	0.0027	0.003	0.0104	0.0037	0.0011	0																	
Hill Miri	0.0012	0.0042	0.0044	0.0031	0.0032	0.0039	0																
Tagin	0.0014	0.0083	0.0092	0.0068	0.0015	0.0031	0.0028	0															
Apatani	0.0030	0.0136	0.0130	0.0115	0.0033	0.0062	0.0054	0.0007	0														
Nishi	0.0020	0.0065	0.0106	0.0060	0.0009	0.0013	0.0039	0.0006	0.002	0													
Aka	0.0041	0.0174	0.0245	0.0182	0.0051	0.0098	0.0081	0.0086	0.0095	0.0096	0												
Khowa	0.0100	0.0254	0.0185	0.0223	0.0162	0.0225	0.0094	0.0137	0.0134	0.0191	0.0101	0											
Miji	0.0023	0.0164	0.0181	0.0153	0.0033	0.0081	0.0057	0.0029	0.0022	0.0048	0.003	0.0082	0										
Sherduken	0.0032	0.0136	0.0098	0.0108	0.0050	0.0082	0.0041	0.0013	0.0008	0.0038	0.0105	0.0092	0.0028	0									
Dirang Monpa	0.0219	0.0149	0.0034	0.0103	0.0255	0.022	0.0145	0.0182	0.0216	0.0203	0.0434	0.0308	0.0314	0.0172	0								
Tawang Monpa	0.0164	0.0102	0.0032	0.0067	0.0178	0.0143	0.0113	0.0119	0.015	0.0126	0.0366	0.0311	0.025	0.0128	0.0016	0							
Kalaktang Monpa	0.0222	0.0218	0.0062	0.0158	0.0270	0.0262	0.0157	0.0175	0.0188	0.0215	0.0422	0.0248	0.0279	0.0137	0.002	0.0043	0						
Chutia	0.0186	0.0123	0.0033	0.0091	0.0244	0.0221	0.0104	0.0209	0.026	0.0237	0.0334	0.02	0.0291	0.0201	0.0066	0.0106	0.0098	0					
Lalung	0.0214	0.0105	0.0029	0.0072	0.0239	0.0188	0.0139	0.0186	0.0235	0.0193	0.0429	0.0349	0.0331	0.0199	0.0011	0.0017	0.006	0.0063	0				
Ahom	0.0186	0.0085	0.0025	0.0061	0.0228	0.0187	0.0105	0.0202	0.0261	0.0214	0.0352	0.0263	0.0309	0.0214	0.0054	0.0078	0.0108	0.0011	0.0035	0			
Digru Mishmi	0.0419	0.031	0.0161	0.0265	0.0509	0.0474	0.0292	0.0459	0.0527	0.0503	0.0596	0.0359	0.0557	0.0432	0.0164	0.0258	0.0203	0.0051	0.0165	0.0078	0		
Miju Mishmi	0.0509	0.0346	0.0179	0.0295	0.0588	0.0528	0.0369	0.0518	0.059	0.0553	0.0752	0.0512	0.0672	0.0499	0.0129	0.0222	0.0185	0.0088	0.0127	0.0092	0.0031	0	
Idu Mishmi	0.0328	0.018	0.0092	0.0151	0.0386	0.0331	0.0217	0.0356	0.0432	0.0374	0.0519	0.0377	0.0483	0.0364	0.0103	0.016	0.0174	0.003	0.008	0.0023	0.0031	0.0036	0

Table 83 shows the distance measures, calculated on the basis of the values for ABO blood groups and PTC taste blindness of 23 populations of Northeast India including the Mishmis of Arunachal Pradesh. When the three Mishmi populations are compared with other populations, the least distance is observed between Idu Mishmi and Ahom (0.0023). The distances between Digaru Mishmi and Miju Mishmi and, between Digaru Mishmi and Idu Mishmi are same (0.0031). The maximum distance is noted between Miju Mishmi and Aka (0.0752). The other populations come in between. The point to note that the distance between the Digaru and Miju Mishmi, Digaru and Idu Mishmi and Miju and Idu Mishmi is found to be 0.0031, 0.0031 and 0.0036 respectively.

Figure 17 shows the dendrogram constructed by following the method of Nei (1973). The dendrogram shows that in respect of the genetic markers viz. ABO blood group and PTC taste sensitivity, the Digaru, Miju and Idu Mishmi are closer to each other than the rest of the Mongoloid populations of Arunachal Pradesh and Assam compared. The Digaru and Miju are seen in the same cluster indicating that they are the closest. However, the Chutia, Ahom and Lalung also stand nearer to the Mishmi populations compared to the rest.

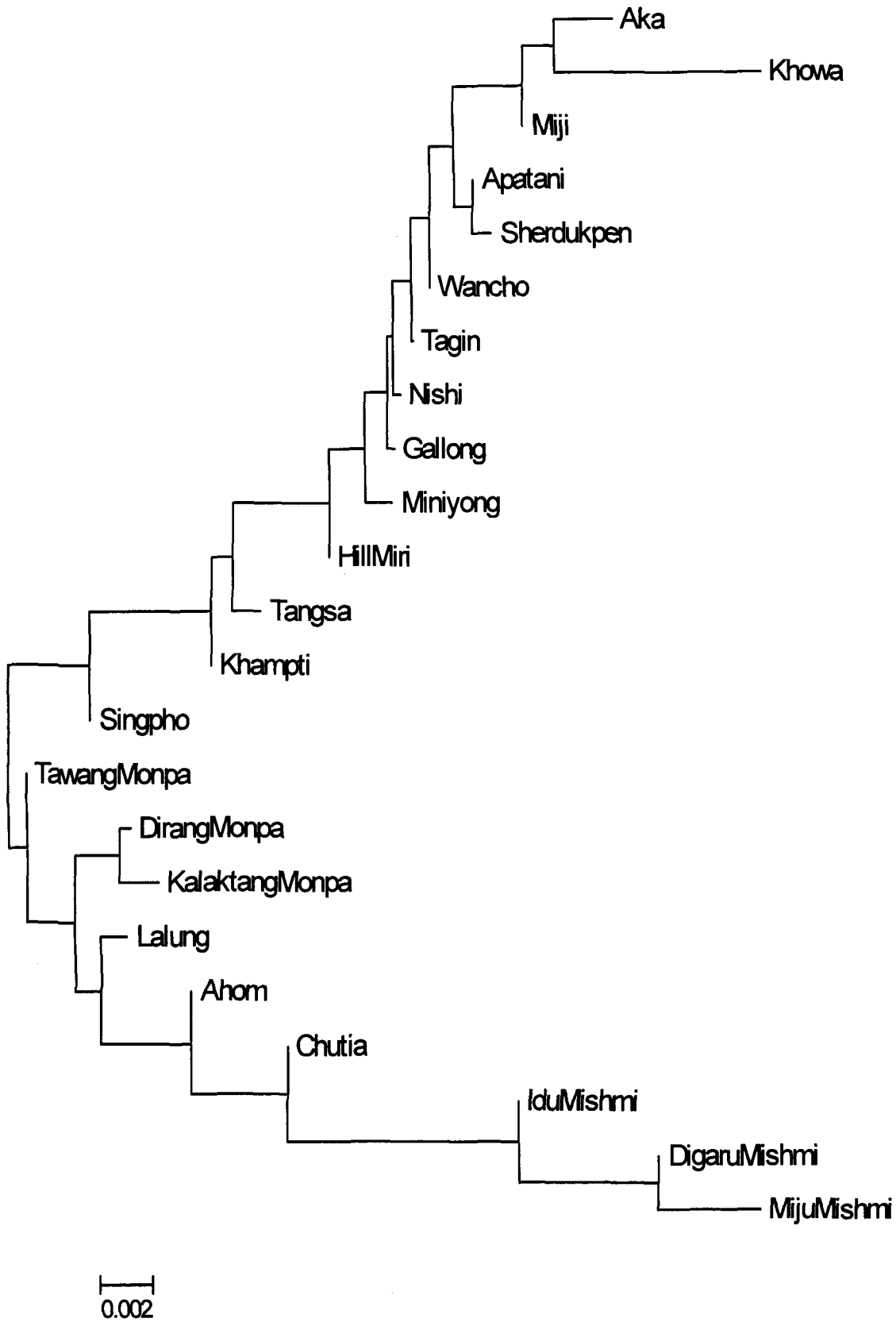


FIGURE 17. DENDROGRAM REPRESENTING GENETIC MARKERS (ABO BLOOD GROUP AND PTC TASTE SENSITIVITY).

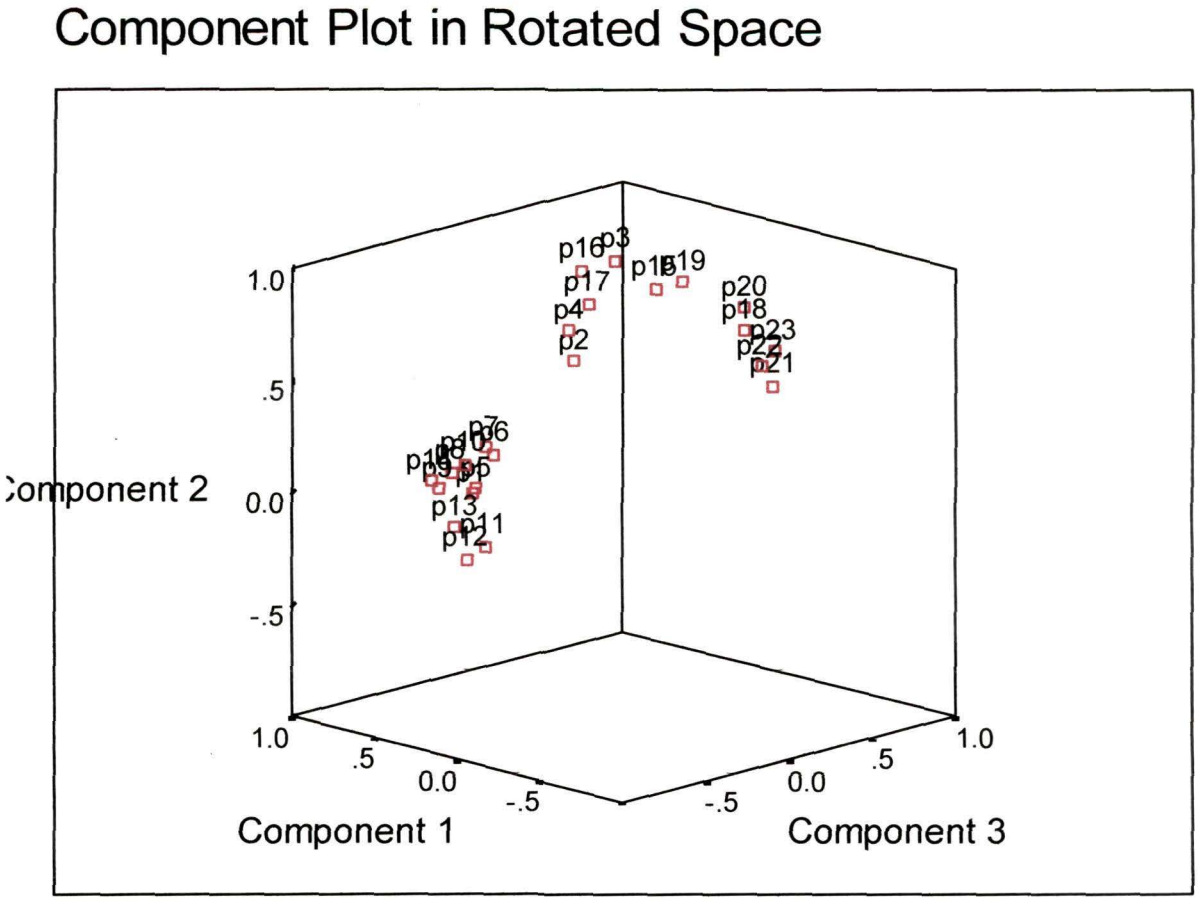


FIGURE 18. PRINCIPAL COMPONENT ANALYSIS BETWEEN THE POPULATIONS OF NORTH EAST INDIA. Codes used in the figure: P1- Wancho, P2- Tangsa, P3- Singpho, P4- Khampti, P5- Gallong, P6- Miniyong, P7- Hill Miri, P8- Tagin, P9- Apatani, P10- Nishi, P11- Aka, P12- Khowa, P13- Miji, P14- Sherdukpen, P15-Dirang Monpa, P16- Tawang Monpa, P17- Kalaktang Monpa, P18- Chutia, P19- Lalung, P20- Ahom, P21- Digaru Mishmi, P22- Miju Mishmi, P23- Idu Mishmi.

Figure 18 shows the PCA plot of 23 populations (including Mishmis) based on Component 1, Component 2 and Component 3 scores. In general, the scattering pattern obtained shows similarities with the clustering pattern obtained in the dendrogram (Fig.17). It is seen that Digaru Mishmi, Miju Mishmi, Idu Mishmi, Chutia and Ahom are placed in the same cluster confirming the dendrogram obtained.

CHAPTER - VII
DERMATOGLYPHICS

In this chapter, we shall discuss about the dermatoglyphic characteristics of Digaru, Miju and Idu Mishmi of Arunachal Pradesh. First, we shall discuss about the dermatoglyphic characteristics of the Digaru Mishmi.

Table 84. Pattern types for each digit of left and right hands in Digaru Mishmi Male (N=105).

Pattern			Right hand						Left hand						Grand total
			I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL	Whorl	W^C	02 (1.90)	05 (4.76)	05 (4.76)	09 (8.57)	03 (2.86)	24 (4.57)	02 (1.90)	08 (7.62)	02 (1.90)	10 (9.52)	01 (0.95)	23 (4.38)	47 (4.48)
		W^S	40 (38.10)	35 (33.33)	25 (23.81)	46 (43.81)	19 (18.10)	165 (31.43)	29 (27.62)	32 (30.48)	34 (32.38)	43 (40.95)	21 (20.00)	159 (30.29)	324 (30.86)
	Composite	LPL	11 (10.48)	07 (6.67)	03 (2.86)	05 (4.76)	05 (4.76)	31 (5.90)	07 (6.67)	05 (4.76)	04 (3.81)	02 (1.90)	03 (2.86)	21 (4.00)	52 (4.95)
		CPL	05 (4.76)	02 (1.90)	02 (1.90)	08 (7.62)	07 (6.67)	24 (4.57)	03 (2.86)	02 (1.90)	01 (0.95)	09 (8.57)	01 (0.95)	16 (3.05)	40 (3.81)
		TL	01 (0.95)	01 (0.95)	0 (0.00)	0 (0.00)	0 (0.00)	02 (0.38)	11 (10.48)	0 (0.00)	01 (0.95)	0 (0.00)	01 (0.95)	13 (2.28)	15 (1.43)
		ACC	01 (0.95)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.19)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.95)	0 (0.00)	01 (0.19)	02 (0.19)
LOOP		LU	38 (36.19)	43 (40.95)	65 (61.90)	35 (33.33)	71 (67.62)	252 (48.00)	43 (40.95)	41 (39.05)	58 (55.24)	38 (36.19)	77 (73.33)	257 (48.95)	509 (48.48)
		LR	02 (1.90)	09 (8.57)	03 (2.86)	01 (0.95)	0 (0.00)	15 (2.86)	02 (1.90)	10 (9.52)	01 (0.95)	0 (0.00)	0 (0.00)	13 (2.48)	28 (2.67)
ARCH		P^A	05 (4.76)	02 (1.90)	02 (1.90)	01 (0.95)	0 (0.00)	10 (1.90)	08 (7.62)	06 (5.71)	03 (2.86)	02 (1.90)	01 (0.95)	20 (3.81)	30 (2.86)
		T^A	0 (0.00)	01 (0.95)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.19)	0 (0.00)	01 (0.95)	01 (0.95)	0 (0.00)	0 (0.00)	02 (0.38)	03 (0.29)
Total			105	105	105	105	105	525	105	105	105	105	105	525	1050

Figures in parentheses represent percentage.

Table 84 shows the pattern types for each digit of left and right hands in males. The most common pattern in both right and left hand digits is ulnar loops followed by whorls. The maximum number of whorls occurs in second and fourth digits of both hands. However, the total frequency of whorls is higher in right than the left hand digits. The composite patterns (lateral pocket loop, twin loop, central pocket loop and accidental) exhibit a higher frequency of occurrence on the right hand digits. In both the hands maximum number of ulnar loops are found on digit III and V. Radial loop is higher in the second digits in both the hands. The occurrence of arch is the lowest in frequency compared to other finger patterns. However, the number of plain arch is higher compared to the tented arch in both hands.

Table 85. Finger pattern in Digaru Mishmi Male (N=105)

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	60	57.14	38	36.19	02	1.90	05	4.76
	L	52	49.52	43	40.95	02	1.90	08	7.62
II	R	50	47.62	43	40.95	09	8.57	03	2.86
	L	47	44.76	41	39.05	10	9.52	07	6.67
III	R	35	33.33	65	61.90	03	2.86	02	1.90
	L	42	40.00	58	55.24	01	0.95	04	3.81
IV	R	68	64.76	35	33.33	01	0.95	01	0.95
	L	65	61.90	38	36.19	0	0.00	02	1.90
V	R	34	32.38	71	67.62	0	0.00	0	0.00
	L	27	25.71	77	73.33	0	0.00	01	0.95
Total	R	247	47.05	252	48.00	15	2.86	11	2.09
	L	233	44.38	257	48.95	13	2.48	22	4.19
Grand total		480	45.71	509	48.48	28	2.67	33	3.14

Table 85 shows the finger pattern types among the Digaru Mishmi males. The most common pattern in the digits of both right and left hands is ulnar loop, which is followed by whorl. The maximum number of ulnar loops occurs in III and V digits of both hands. In general, the percentage of ulnar loop increases in the following way-

Right hand: IV → I → II → III → V.

Left hand: IV→ II → I → III → V.

While combining all digits together, it is found that in right hand the frequency of ulnar loop is 48.00%, followed by whorl (47.05%). The frequencies of radial loop and arch are 2.86% and 2.09% respectively. For left hand the order is almost the same. The frequencies of ulnar loop, whorl, radial loop and arch are 48.95%, 44.38%, 2.48% and 4.19% respectively. Combining both hands together, it is found that the frequencies of ulnar loop, whorl, arch and radial loop are 48.48%, 45.71%, 3.14%, and 2.67% respectively. Combining ulnar and radial loops together, it is found that the frequency of loops is 51.15 %, whereas that of whorl is 45.71% and that of arch is 3.14%.

The highest frequency of whorls is found on digit IV, followed by digit I. The frequency of whorls increases in the following way-

Left hand: V→ III → II → I → IV. Right hand: V → III → II → I → IV.

Arches are very few in number. The highest percentage of arches is found on digit I, followed by digit II. It gradually decreases from digit I to digit V in both hands. The highest percentage is seen on the digit I of left hand (7.62%) and digit II of left hand (6.67%).

The frequency of radial loop, in general, is very low. The highest percentage is seen on the II digit of left hand (9.52%) and right hand (8.57%).

Table 86 shows the pattern types for each digit of left and right hands in Digaru Mishmi females. The most common pattern in both right and left hand digits is ulnar loops, followed by whorls. The maximum number of whorls occurs in first and fourth digits of both hands. However, the total frequency of whorls is higher in left hand than the right hand digits. The composite patterns (lateral pocket loop, twin loop, central pocket loop and accidental) exhibit a higher frequency of occurrence on the left hand digits. In both the hands, maximum number of ulnar loops are found on digit III and V. Radial loop is higher in the second digits in both the hands. The occurrence of arch is the lowest in frequency compared to other finger patterns.

Table 86: Pattern types for each digit of left and right hands in Digaru Mishmi Female (N=107).

Pattern			Right hand						Left hand						Grand total
			I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL		W^C	03 (2.80)	01 (0.93)	03 (2.80)	11 (10.28)	01 (0.93)	19 (3.55)	03 (2.80)	03 (2.80)	01 (0.93)	05 (4.67)	01 (0.93)	13 (2.43)	32 (2.99)
		W^S	40 (37.38)	46 (42.99)	29 (27.10)	43 (40.19)	19 (17.76)	177 (33.08)	39 (36.45)	42 (39.25)	30 (28.04)	47 (43.93)	20 (18.69)	178 (33.27)	355 (33.18)
		LPL	04 (3.74)	03 (2.80)	01 (0.93)	01 (0.93)	04 (3.74)	13 (2.43)	04 (3.74)	02 (1.87)	02 (1.87)	01 (0.93)	01 (0.93)	10 (1.87)	23 (2.15)
		CPL	01 (0.93)	02 (1.87)	02 (1.87)	07 (6.54)	06 (5.61)	18 (3.36)	03 (2.80)	06 (5.61)	02 (1.87)	08 (7.48)	07 (6.54)	26 (4.86)	44 (4.11)
		TL	06 (5.61)	0 (0.00)	01 (0.93)	0 (0.00)	0 (0.00)	07 (1.31)	09 (8.41)	0 (0.00)	02 (1.87)	01 (0.93)	01 (0.93)	13 (2.43)	20 (1.87)
		ACC	0 (0.00)	01 (0.93)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.19)	0 (0.00)	01 (0.93)	01 (0.93)	0 (0.00)	0 (0.00)	02 (0.37)	03 (0.28)
LOOP		LU	43 (40.19)	42 (39.25)	67 (62.62)	45 (42.06)	74 (69.16)	271 (50.65)	34 (31.78)	41 (38.32)	62 (57.94)	43 (40.19)	74 (69.16)	254 (47.48)	525 (49.07)
		LR	01 (0.93)	08 (7.48)	01 (0.93)	0 (0.00)	0 (0.00)	10 (1.87)	03 (2.80)	08 (7.48)	02 (1.87)	0 (0.00)	0 (0.00)	13 (2.43)	23 (2.35)
ARCH		P^A	09 (8.41)	04 (3.74)	03 (2.80)	0 (0.00)	03 (2.80)	19 (3.55)	12 (11.21)	04 (3.74)	05 (4.67)	02 (1.87)	03 (2.80)	26 (4.86)	45 (4.21)
		T^A	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Total			107	107	107	107	107	535	107	107	107	107	107	535	1070

Figures in parentheses represent percentage.

Table 87. Finger pattern in Digaru Mishmi Female (N=107)

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	54	50.47	43	40.19	01	0.93	09	8.41
	L	58	54.21	34	31.78	03	2.80	12	11.21
II	R	53	49.53	42	39.25	08	7.48	04	3.74
	L	54	50.47	41	38.32	08	7.48	04	3.74
III	R	36	33.64	67	62.62	01	0.93	03	2.80
	L	38	35.51	62	57.94	02	1.87	05	4.67
IV	R	62	57.94	45	42.06	0	0.00	05	4.67
	L	62	57.94	43	40.19	0	0.00	0	0.00
V	R	30	28.04	74	69.16	0	0.00	02	1.87
	L	30	28.04	74	69.16	0	0.00	03	2.80
Total	R	235	43.93	271	50.65	10	1.87	19	3.55
	L	242	45.23	254	47.48	13	2.43	26	4.86
Grand total	L+R	477	44.58	525	49.06	23	2.15	45	4.21

Table 87 shows the finger pattern types among the Digaru Mishmi females. The most common pattern on the digits of both right hand and left hand is ulnar loop, followed by whorl. The maximum number of ulnar loops occurs in III and V digits of both hands. Generally, the percentage of ulnar loop decreases in the following way-

Right hand: V→ III → IV → I → II.
Left hand: V → III → IV → II → I.

Combining all digits together, it is found that in the right hand the frequency of ulnar loop is 50.65%, followed by 43.93% of whorls. The frequencies of radial loop and arch are 1.87% and 3.55% respectively. For left hand, the order is the same. The frequencies of ulnar loop, whorl, radial loop and arch are 47.48%, 45.23%, 2.43% and 4.86% respectively. Combining both hands together, it is found that the frequencies of ulnar loop, whorl, radial loop and arch are 49.06%, 44.58%, 2.15% and 4.21% respectively.

The highest frequency of whorl is found on digit IV, followed by digit I, in both hands. In general, the frequencies of whorl decreases in the following way-

Right hand: IV→ I → II → III → V.
Left hand: IV → I → II → III → V.

Arches are found to be very few in number. The highest frequency is found on digit of right hand (11.21%), followed by digit I of left hand (8.41%). Generally, the frequencies of arches decreases in the following way-

Right hand: I → IV → II → III → V.
Left hand: I → III → II → V → IV.

The frequency of radial loop is still fewer in number. The II digits of right and left hands show the highest frequency of 7.48% each.

Table 88. INDICES.

INDICES	MALE (N=105)	FEMALE (N=107)
Furuhata's Index	89.38	87.04
Dankmeijer's Index	6.87	9.43
Pattern Intensity Index	14.26	14.04

Table 88 shows all digital indices. The Furuhata's Index is 89.38 in males and 87.04 in females. The Dankmeijer's Index is found to be 6.87 in males and 9.43 in females. The Pattern intensity index in male and female is 14.26 and 14.04 respectively. In general, these indices are higher in males than in females, excepting the Dankmeijer's Index, which is higher in females.

Table 89. Main line formula in Digaru Mishmi.

Main line formula	Right hand				Left hand				Total (Right hand + Left hand)			
	Male		Female		Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
11-9-7	28	26.67	20	18.69	6	5.71	3	2.80	34	16.19	23	10.75
11-7-7	5	4.76	3	2.80	4	3.81	5	4.67	9	4.29	8	3.74
10-7-6	1	0.95	4	3.74	0	0.00	1	0.93	2	0.95	5	2.34
9-7-5	35	33.33	33	30.84	34	32.38	24	22.43	69	32.86	57	26.64
9-0-5	3	2.86	2	1.87	2	1.90	6	5.61	5	2.38	8	3.74
8-6-5	9	8.57	7	6.54	7	6.67	7	6.54	16	7.62	14	6.54
7-5-5	17	16.19	22	20.56	37	35.24	40	37.38	54	25.71	62	28.97
7-5-3	1	0.95	0	0.00	4	3.81	3	2.80	5	2.38	3	1.40

Table 89 shows the main formulae in the Digaru Mishmi. Only eight mainline formulae have been discussed since the other mainline formulae have appeared in this population in very low frequencies. It is seen that the mainline formula 9-7-5 appears in the highest frequency on right hands of both male and female, whereas the highest frequency of the mainline formula 7-5-

5 is found to be on the left hands of both male and female. It is found that the mainline formula 11-9-7 has appeared in considerably higher frequency on right hand of males, whereas the mainline formula 7-5-5 is found to be of higher frequency on the right hands of females. Combining both hands together, it is seen that frequency of the mainline formula 11-9-7 for males and females are 16.19% and 10.75% respectively. The frequencies of the mainline formulae 11-7-7 and 10-7-6 are 4.29% and 0.95% respectively in males and 3.74% and 2.34% respectively in females. The frequencies of the mainline formulae 9-0-5, 8-6-5 and 7-5-3 are 2.38%, 7.62% and 2.38% respectively in males and 3.74%, 6.54% and 1.40% respectively in females. the frequencies of the main line formulae 9-7-5 and 7-5-5 are 32.86% 25.71% respectively in males, and 26.64% and 28.97% respectively in females.

Table 90. Different location of the axial triradii.

Triradius	Male				Female				Total (Left +Right)			
	Right		Left		Right		Left		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
t-missing	0	0.00	0	0.00	01	0.93	0	0.00	00	0.00	01	0.47
t	67	63.81	76	72.38	55	51.40	52	48.60	143	68.10	107	50.00
t'	36	34.29	26	24.76	46	42.99	50	46.73	62	29.52	96	44.86
t"	0	0.00	02	1.90	02	1.87	04	3.74	02	0.95	06	2.80
tt'	02	1.90	01	0.95	02	1.87	0	0.00	03	1.43	02	0.93
tt"	0	0.00	0	0.00	01	0.93	01	0.93	00	0.00	02	0.93
	105	100.00	105	99.99	107	99.99	107	100	210	100.00	214	99.99

Table 90 shows the position of axial triradius on palm in the Digaru Mishmi. It is found that the axial triradius t appears in highest frequency on both hands of both the sexes. Next to t comes the axial triradius t' which appears in higher frequency on both hands of both the sexes in comparison to the other axial triradii t', t" and tt". The axial triradius tt" appears only on both the

hands of females with the frequency of 0.93% each. The axial triradius t is missing only from right hand of a female individual with the frequency of 0.93%. However, combining both hands together, it is seen that the frequencies of the axial triradii t, t′ and t″ are 68.10%, 29.52% and 0.95% respectively in male, and 50.00%, 44.86% and 2.80% respectively in females. It may be noted that the frequencies of dual formation triradii tt′ are 1.43% and 0.93% respectively in males and females. The frequency of dual formation triradii tt″ is 0.93% in female, but no such dual formation is noticed in male.

Table 91. C-line termination of the Digaru Mishmi.

Sex	Side	Termination type-c									
		Ulnar		Radial		Proximal		Absent		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Male	R	69	65.71	30	28.57	3	2.86	03	2.86	105	100.00
	L	94	89.52	08	7.62	0	0.00	03	2.86	105	100.00
	R+L	163	77.62	38	18.09	3	1.43	06	2.86	210	100.00
Female	R	70	65.42	25	23.36	6	5.61	06	5.61	107	100.00
	L	89	83.18	05	4.67	4	3.74	09	8.41	107	100.00
	R+L	159	74.30	30	14.02	10	4.67	15	7.01	214	100.00
Grand total	R+L	322	75.94	68	16.04	13	3.07	21	4.95	424	100.00

Table 91 shows the frequencies of different type of 'c'line termination in the Digaru Mishmi. The occurrence of ulnar termination is most common on both hands of both sexes. It is followed by radial termination in both sexes. The termination of 'c' line is missing more in female (7.01%) than in male (2.86%). Combining both hands together, it is seen that the frequencies of ulnar and radial termination of 'c' line in male are 77.62% and 18.09% respectively and in female 74.30% and 14.02% respectively.

Table 92. 'atd' angle among the Digaru Mishmi Population.

Male (N=105)		Female (N-107)	
Right hand	Left hand	Right hand	Left hand
Mean ±S.E.	Mean ±S.E.	Mean ±S.E.	Mean ±S.E.
44.06 ± 0.43	44.25 ± 0.50	46.60 ± 0.71	46.02 ± 0.54

Table 92 shows the mean 'atd' angle in the Digaru Mishmi. The mean ± s. e. in right and left hands of males are 44.06±0.43 and 44.25±0.50 respectively, and that in females are 46.60±0.71 and 46.02±0.54 respectively.

MALE

WHORLS	ARCHES										
10	7.62										
9	6.67	0.95									
8	6.67										
7	7.62										
6	9.52	0.95									
5	8.57										
4	6.67	0.95	0.95								
3	10.48	0.95									
2	8.57	2.86		0.95							
1	3.81	1.90		0.95							
0	7.62	1.90		0.95	0.95			0.95			
	0	1	2	3	4	5	6	7	8	9	10

FIGURE 19. BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE DIGARU MISHMI MALE INDIVIDUAL.

Figure 19 shows bimanuar with percent frequencies of finger pattern combination in the Digaru Mishmi males. There are 7.62% of males each are monomorphic i.e., only with whorls, or loops in all the fingers. 10.48% of all males have three whorls and seven loops. Whereas 9.52% have six whorls and four loops and 8.75% have two whorls and eight loops. Equal percentage of males have equal number of whorls and loops (i.e., 5 each). There are again 7.62% of males, who have seven whorls and three loops.

There are 6.67% of males each having nine whorls and one loop; eight whorls and two loops; four whorls and six loops. 3.81% of Digaru Mishmi males have one whorl and nine loops. There are 2.86% of males, who have two whorls, one arch and seven loops. There are 1.90% of them each having one whorl, one arch and eight loops; one arch and nine loops.

There are 0.95% of males each having nine whorls and one arch; six whorls, one arch and three loops; four whorls, one arch and five loops; three whorls, one arch and six loops; four whorls, two arches and four loops; two whorls, three arches and five loops; one whorl, three arches and six loops; three arches and seven loops; four arches and six loops; and seven arches and three loops.

FEMALE

WHORLS	ARCHES										
	0	1	2	3	4	5	6	7	8	9	10
10	8.41										
9	9.35										
8	7.48										
7	4.67										
6	10.28										
5	5.61		0.93								
4	4.67	0.93									
3	8.41	0.93	1.87								
2	8.41	1.87	0.93								
1	8.41		1.87	0.93	0.93	0.93					
0	5.61	4.67			0.93				0.93		

FIGURE 20. BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE DIGARU MISHMI FEMALE INDIVIDUALS.

Figure 20 shows bimanuar with percent frequencies of finger pattern combination in the Digaru Mishmi females. It is seen that 8.41% and 5.61% of all Digaru Mishmi females are monomorphic i.e., having only whorls or loops respectively. There are 10.28% of Digaru Mishmi females, who have six whorls and four loops. 9.35% of females have nine whorls and one loop. 8.41% of all females have three whorls and seven loops. Equal percent of females (8.41%) have two whorls and eight loops; one whorl and nine loops. The figure 19 further shows that 7.48% of all females have eight whorls and two loops. Again 5.61% of them have equal number of whorl and loop only (i.e., 5 each).

There are 4.67% of females, each having seven whorls and three loops; four whorls and six loops; one arch and nine loops.

There are 1.87% of females each having two whorls, one arch and seven loops; three whorls, two arches and five loops; one whorl, two arches and seven loops.

0.93% of females have four whorls, one arch and five loops; three whorls, one arch and six loops; five whorls, two arches and three loops; two whorls, two arches and six loops; one whorl, three arches and six loops; one whorl, four arches and five loops; four arches and six loops; one whorl, five arches and four loops; and eight arches and two loops.

Table 93 shows the pattern types for each digit of left and right hands in Miju Mishmi males. The most common pattern in both right and left hand digits is whorls, followed by ulnar loops. The maximum number of whorls occurs in first and fourth digits of both hands. However, the total frequency of whorls is higher in right than the left hand digits. The composite patterns (lateral pocket loop, twin loop, central pocket loop and accidental) exhibit a higher frequency occurrence on the left hand digits. In both the hands, maximum number of ulnar loops are found on digit III and V. Radial loop is higher in the second digits in both the hands. The occurrence of arch is lowest in frequency compared to other finger patterns. However, the number of plain arch is higher compared to tented arch.

Now, we shall discuss about the dermatoglyphic characteristics of the Miju Mishmi.

Table 93. Pattern types for each digit of left and right hands in Miju Mishmi Male (N=102).

Pattern		Right hand						Left hand						Grand total
		I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL	W^C	08 (7.83)	05 (4.90)	04 (3.92)	14 (13.73)	0 (0.00)	31 (6.08)	02 (1.96)	01 (0.98)	05 (4.90)	05 (4.90)	0 (0.00)	13 (2.55)	44 (4.31)
	W^S	47 (46.08)	49 (48.04)	34 (33.33)	54 (52.94)	23 (22.55)	207 (40.59)	41 (40.20)	43 (42.16)	30 (29.41)	57 (55.88)	19 (18.63)	190 (37.25)	397 (38.92)
	LPL	04 (3.92)	01 (0.98)	03 (2.94)	0 (0.00)	0 (0.00)	08 (1.57)	03 (2.94)	04 (3.92)	01 (0.98)	02 (1.96)	07 (6.86)	17 (3.33)	25 (2.45)
	CPL	05 (4.90)	03 (2.94)	03 (2.94)	10 (9.80)	06 (5.88)	27 (5.29)	0 (0.00)	05 (4.90)	01 (0.98)	07 (6.86)	05 (4.90)	18 (3.53)	45 (4.41)
	TL	02 (1.96)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	02 (0.39)	10 (9.80)	0 (0.00)	04 (3.92)	0 (0.00)	0 (0.00)	14 (2.75)	16 (1.57)
	ACC	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.98)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.20)	01 (0.10)
LOOP	LU	34 (33.33)	28 (27.45)	53 (51.96)	22 (21.57)	71 (69.61)	208 (40.78)	40 (39.22)	34 (33.33)	56 (54.90)	29 (28.43)	71 (69.61)	230 (45.10)	438 (42.94)
	LR	01 (0.98)	13 (12.75)	03 (2.94)	01 (0.98)	0 (0.00)	18 (3.53)	02 (1.96)	10 (9.80)	03 (2.94)	0 (0.00)	0 (0.00)	15 (2.94)	33 (3.24)
ARCH	P^A	01 (0.98)	03 (2.94)	01 (0.98)	0 (0.00)	02 (1.96)	07 (6.86)	04 (3.92)	04 (3.92)	0 (0.00)	02 (1.96)	0 (0.00)	10 (1.96)	17 (1.67)
	T^A	0 (0.00)	0 (0.00)	01 (0.98)	01 (0.98)	0 (0.00)	02 (0.39)	0 (0.00)	0 (0.00)	02 (1.96)	0 (0.00)	0 (0.00)	02 (0.39)	04 (0.39)
Total		102	102	102	102	102	510	102	102	102	102	102	510	1020

Figures in parentheses represent percentage.

Table 94. Finger pattern in Miju Mishmi Male (N=102).

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	66	64.71	34	33.33	01	0.98	01	0.98
	L	56	54.90	40	39.22	02	1.96	04	3.92
II	R	58	56.86	28	27.45	13	12.75	03	2.94
	L	54	52.94	34	33.33	10	9.80	04	3.92
III	R	44	43.14	53	51.96	03	2.94	02	1.96
	L	41	40.20	56	54.90	03	2.94	02	1.96
IV	R	78	76.47	22	21.57	01	0.98	01	0.98
	L	71	69.61	29	28.43	0	0.00	02	1.96
V	R	29	28.43	71	69.61	0	0.00	02	1.96
	L	31	30.39	71	69.61	0	0.00	0	0.00
Total	R	275	53.92	208	40.78	18	3.53	09	1.76
	L	253	49.61	230	45.10	15	2.94	12	2.35
Grand total	R+L	528	51.76	438	42.94	33	3.24	21	2.06

Table 94 shows the finger pattern types among the Miju Mishmi males. The most common patterns in the digits of both right hand and left hands are whorls, which is followed by ulnar loops. The maximum number of whorls occurs in digits I and IV of both hands. In general, in both the hands the percentage of whorls increases in the following way-

Right hand: V → III → II → I → IV.
Left hand: V → III → II → I → IV.

While combining all digits together, it is found that in right hand, the frequency of whorls is 53.92%, followed by ulnar loop (40.78%). The frequencies of radial loops and arches are 3.53% and 1.76% respectively. For the left hand, the order is almost similar. The frequencies of whorls, ulnar loops, radial loops and arches are 49.61%, 45.10%, 2.94% and 2.06% respectively. Again, combining ulnar loops and radial loops together, it is found that the frequency of loop is 46.18%, whereas that of whorl is 51.76% and that of arch is 2.06%.

The highest frequency of ulnar loops is found on digit V, followed by digit III. The frequency of ulnar loop increases in the following way-

Right hand: IV → II → I → III → V.
Left hand: IV → II → I → III → V.

Arches are very low in number. The highest percentage of arches are found on digit II, followed by digit I. Its frequency decreases in the following way-

Right hand: II → III → V → IV =I.
Left hand: I = II → III = IV → V.

The frequency of radial loop is lower than whorls and ulnar loop, whereas it is higher than arches. In general, the radial loops decreases in the following way-

Right hand: II → III → I → IV → V.
Left hand: II → III → I → IV → V.

Table 95. Pattern types for each digit of left and right hands in Miju Mishmi Female (N=103).

Pattern		Right hand						Left hand						Grand total
		I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL	W^C	01 (0.97)	02 (1.94)	02 (1.94)	03 (2.91)	0 (0.00)	08 (1.55)	01 (0.97)	02 (1.94)	01 (0.97)	01 (0.97)	0 (0.00)	05 (0.97)	13 (1.26)
	W^S	51 (49.51)	47 (45.63)	29 (28.16)	53 (51.46)	22 (21.36)	202 (39.22)	43 (41.75)	50 (48.54)	42 (40.78)	63 (61.17)	17 (16.50)	215 (41.75)	417 (40.49)
	LPL	06 (5.83)	01 (0.97)	0 (0.00)	0 (0.00)	0 (0.00)	07 (1.36)	05 (4.85)	01 (0.97)	0 (0.00)	0 (0.00)	03 (2.91)	09 (1.75)	16 (1.55)
	CPL	02 (1.94)	06 (5.83)	02 (1.94)	07 (6.80)	02 (1.94)	19 (3.69)	05 (4.85)	03 (2.91)	0 (0.00)	05 (4.85)	02 (1.94)	15 (2.91)	34 (3.30)
	TL	02 (1.94)	01 (0.97)	0 (0.00)	0 (0.00)	0 (0.00)	03 (0.58)	07 (6.80)	02 (1.94)	01 (0.97)	0 (0.00)	0 (0.00)	10 (1.94)	13 (1.26)
	ACC	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
LOOP	LU	34 (33.01)	30 (29.13)	64 (62.14)	39 (37.86)	79 (76.70)	246 (47.77)	30 (29.13)	26 (25.24)	50 (48.54)	31 (30.01)	79 (76.70)	216 (41.94)	462 (44.85)
	LR	0 (0.00)	10 (9.71)	01 (0.97)	0 (0.00)	0 (0.00)	11 (2.14)	02 (1.94)	14 (13.59)	04 (3.88)	0 (0.00)	0 (0.00)	20 (3.88)	31 (3.01)
ARCH	P^A	07 (6.80)	06 (5.83)	04 (3.88)	01 (0.97)	0 (0.00)	18 (3.50)	10 (9.72)	05 (4.85)	05 (4.85)	03 (2.91)	02 (1.94)	25 (4.85)	43 (4.17)
	T^A	0 (0.00)	0 (0.00)	01 (0.97)	0 (0.00)	0 (0.00)	01 (0.19)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.10)
Total		103	103	103	103	103	515	103	103	103	103	103	515	1030

Figures in parentheses represent percentage.

Table 95 shows the pattern types for each digit of left and right hands in Miju Mishmi females. The most common pattern on the digits of both right hand and left hand digits is whorls, followed by ulnar loops. The maximum number of whorls occurs in the first and fourth digits of both hands. However, the total frequency of whorls is higher in right hand than the left hand digits. The composite patterns (lateral pocket loop, twin loop, central pocket loop and accidental) exhibit a higher frequency of occurrence on the left hand digits. In both the hands, the maximum number of ulnar loops are found on digit III and V. Radial loop is higher in the second digits in both the hands. The occurrence of arch is the lowest in frequency compared to other finger patterns.

Table 96. Finger pattern in Miju Mishmi Female (N=103).

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	62	60.19	34	33.01	0	0.00	07	6.80
	L	61	59.22	30	29.13	02	1.94	10	9.71
II	R	57	55.34	30	29.13	10	9.71	06	5.83
	L	58	56.31	26	25.24	14	13.59	05	4.85
III	R	33	32.04	64	62.14	01	0.97	05	4.85
	L	44	42.72	50	48.54	04	3.88	05	4.85
IV	R	63	61.17	39	37.86	0	0.00	01	0.97
	L	69	66.99	31	30.10	0	0.00	03	2.91
V	R	24	23.30	79	76.70	0	0.00	0	0.00
	L	22	21.36	79	76.70	0	0.00	02	1.94
Total	R	239	46.41	246	47.77	11	2.14	19	3.69
	L	254	49.32	216	41.94	20	3.88	25	4.85
Grand total		493	47.86	462	44.85	31	3.01	44	4.27

Table 96 shows the finger pattern types among the Miju Mishmi females. The most common pattern in the digits of both right and left hands is whorls, which is followed by ulnar loops. The maximum number of whorl occurs in I and IV digits of both hands. In, general, in both hands the percentage of whorls increases in the following way-

Right hand: V → III → II → I → IV.

Left hand: V → III → II → I → IV.

While combining all digits together, it is found that in right hand, the frequency of ulnar loops is 47.77%, followed by whorls (46.41%). The frequency of radial loop and arch are 2.14% and 3.69% respectively. But, in the case of left hand, the frequency of whorls is higher than that of ulnar loops. The frequencies of whorls and ulnar loops are 49.32% and 41.94% respectively. The frequencies of radial loop and arch are 3.88% and 4.85% respectively. Combining both hands together, it is seen that the frequency of whorls is 47.86%, followed by ulnar loops (44.85%). The frequencies of radial loop and arch are 3.01% and 4.27% respectively. Again, combining ulnar loops and radial loops together, it is found that the frequency of loop is 47.86%. The highest frequency of ulnar loops is found in digit V, followed by digit III. Generally, the frequency of ulnar loop increases in the following way-

Right hand: II → I → IV → III → V.
Left hand: II → I → IV → III → V.

Arches are very low in number. The highest percentage of arches are found on digit I, followed by digit II. It gradually decreases from digit I to digit V in both hands. The highest percentage is seen on the digit I of right hand (6.80%) and left hand (9.71%).

The frequency of radial loop, in general, is very low. The highest percentage is seen on digit II of left hand (13.59%) and right hand (9.71%).

Table 97. INDICES.

INDICES	MALE (N=102)	FEMALE (N=103)
Furuhata's index	112.10	100.00
Dankmeijer's index	3.98	8.92
Pattern intensity index	14.97	14.36

Table 97 shows all digital indices. Furuhata's index is 112.10 in males and 100.00 in females. The Dankmeijer's index is found to be 3.98 in males and 8.92 in females. The Pattern intensity index in males and females are 14.97 and 14.36 respectively. In general, these indices are higher in males than in females, excepting the Dankmeijer's index, which is higher in females.

Table 98. Mainline formula in Miju Mishmi.

Main line formula	Right hand				Left hand				Total (Right hand + Left hand)			
	Male		Female		Male		Female		Male		Female	
	No	%	No	%	No	%	No	%	No	%	No	%
11-9-7	23	22.55	20	19.42	8	7.84	4	3.88	31	15.20	24	11.65
11-7-7	6	5.88	4	3.88	5	4.85	1	0.97	11	5.39	5	2.43
10-7-6	2	1.96	11	10.68	14	13.73	8	7.76	16	7.84	19	9.22
9-7-5	31	30.39	33	32.04	31	30.39	24	23.30	62	30.39	57	27.67
8-6-5	15	14.71	4	3.88	12	11.76	6	5.83	27	13.24	10	4.85
7-5-5	10	9.80	20	19.42	24	23.53	41	39.81	34	16.67	61	29.61

Table 98 shows the mainline formulae in the Miju Mishmi. Only six different formulae have been discussed since the other mainline formulae have appeared in this population in very low frequencies. It is seen that the mainline formula 9-7-5 appears in the highest frequency on both the hands of males and right hand of females, whereas the highest frequency of the mainline formula 7-5-5 is found on the left hand of females. It is found that the mainline formula 11-9-7 has appeared in considerably higher frequency on right hand of both the sexes. Combining both hands together, it is seen that the frequency of the mainline formula 9-7-5 is highest in males i.e., 30.39%, whereas the frequency of the mainline formula 7-5-5 is highest in females i.e., 29.61%. The frequencies of mainline formula 11-9-7 in males and females are 15.20% and 11.65% respectively.

Table 99. Different location of the axial triradii.

Triradius	Male				Female				Total (Left + Right)			
	Right		Left		Right		Left		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
t-missing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
t	54	52.94	53	51.96	54	52.43	59	57.28	107	52.45	113	54.85
t'	43	42.16	46	45.10	44	42.72	42	40.78	89	43.63	86	41.75
t"	01	0.98	0	0.00	01	0.97	0	0.00	01	0.49	01	0.48
tt'	02	1.96	03	2.94	03	2.91	02	1.94	05	2.45	05	2.43
tt"	01	0.98	0	0.00	0	0.00	0	0.00	01	0.49	0	0.00
t't"	01	0.98	0	0.00	01	0.97	0	0.00	01	0.49	01	0.48
	102	100.00	102	100.00	103	100.00	103	100.00	204	100.00	206	99.99

Table 99 shows the position of axial triradius on palm in the Miju Mishmi. It is found that the axial triradius t appears in highest frequency on both hands of both the sexes. Next to t comes the axial triradius t′ which appears in higher frequency on both hands of both the sexes in comparison to the other axial triradii t″, tt′, tt″ and t′t″. The axial triradii tt″ appears only on the right hand of one male individual. However, combining both hands together, it is seen that the frequencies of axial triradii t, t′ and t″ are 52.45%, 43.63% and 0.49% respectively in males and 54.85%, 41.75% and 0.48% respectively in females. It may be noted that the frequencies of dual formation triradii tt′ and t′t″ are 2.45% and 0.49% respectively in males and 2.43% and 0.48% respectively in females.

Table 100. C-line termination of the Miju Mishmi.

Sex	Side	Termination type-c									
		Ulnar		Radial		Proximal		Absent		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Male	R	65	63.73	32	31.37	3	2.94	02	1.96	102	100.00
	L	90	88.24	09	8.82	1	0.98	02	1.96	102	100.00
	R+L	155	75.98	41	20.10	4	1.96	04	1.96	204	100.00
Female	R	74	71.84	22	21.36	1	0.97	06	5.83	103	100.00
	L	87	84.47	06	5.83	5	4.85	05	4.85	103	100.00
	R+L	161	78.16	28	13.59	6	2.91	11	5.34	206	100.00
Grand total	R+L	316	77.07	69	16.83	10	2.44	15	3.66	410	100.00

Table 100 shows the frequencies of different types of 'c' line termination in the Miju Mishmi. The occurrence of ulnar termination is most common on both hands of both sexes. It is followed by radial termination in both the sexes. The termination of 'c' line is missing more in females (5.34%) than in males (1.96%). Combining both hands together, the frequencies of ulnar and radial termination of 'c' line in males are 75.98% and 20.10% respectively and in females are 78.16% and 13.59% respectively.

Table 101. 'atd' angle among the Miju Mishmi population.

Male (N=102)		Female (N-103)	
Right hand	Left hand	Right hand	Left hand
Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
43.45 ± 0.56	43.07 ± 0.50	44.70 ± 0.45	44.99 ± 0.44

Table 101 shows the mean 'atd' angle in the Miju Mishmi. The mean ± s. e. in right hand and left hand of males are 43.45 ± 0.56 and 43.07 ± 0.50 respectively, and that in females are 44.70 ± 0.45 and 44.99 ± 0.44 respectively.

MALE

WHORLS	ARCHES										
	0	1	2	3	4	5	6	7	8	9	10
10	11.76										
9	7.84										
8	7.84										
7	10.78										
6	6.86	2.94									
5	10.78										
4	6.86										
3	7.84	0.98	0.98								
2	4.90	0.98			0.98						
1	4.90	0.98	1.96	0.98							
0	6.86	1.96									

FIGURE 21. BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE MIJU MISHMI MALE INDIVIDUALS.

Figure 21 shows the bimanur with percent frequencies of finger pattern combination in the Miju Mishmi males. It is seen that 11.76% and 6.86% of all Miju Mishmi males are monomorphic i.e., having whorls or loops respectively. There are 10.78% of males each having seven whorls and three loops; five whorls and five loops. 7.84% of males have nine whorls and one loop; eight whorls and two loops; three whorls and seven loops. 6.86% of males have six

whorls and four loops; four whorls and six loops. There are 4.90% of males each having two whorls and eight loops; one whorl and nine loops.

There are 2.94% of Miju Mishmi males, who have six whorls, one arch and three loops. 1.96% of males have only one arch and nine loops; one whorl, two arches and seven loops. There are 0.98% of males each having three whorls, one arch and six loops; two whorls, one arch and seven loops; one whorl, one arch and eight loops; three whorls, two arches and five loops; one whorl, three arches and six loops; and two whorls, four arches and four loops.

FEMALE

WHORLS	ARCHES										
	0	1	2	3	4	5	6	7	8	9	10
10	7.77										
9	5.83										
8	11.65										
7	3.88	0.97									
6	13.59		0.97								
5	3.88										
4	10.68		0.97								
3	6.80	1.94									
2	9.71	0.97		0.97							
1	5.83	0.97									
0	4.85	0.97		1.94	2.91	0.97			0.97		

FIGURE 22 BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE MIJU MISHMI FEMALE INDIVIDUALS.

Figure 22 shows the bimanuar with percent frequencies of finger pattern combination in the Miju Mishmi females. It is seen that 7.77% and 4.85% of Miju Mishmi females are monomorphic i.e., having only whorls or loops respectively. 13.59% of all Miju Mishmi females have six whorls and four loops. 11.65% of all females have eight whorls and two loops. 10.68% of them have four whorls and six loops. There are 9.71% females who have two whorls and eight loops. 6.80% of females have three whorls and seven loops. There are 5.83% of females, each having nine whorls and one loop; one whorl and nine loops. 3.88% of females have seven whorls and three loops. Equal percent of females (3.88%) have equal number of whorls and loops i.e., 5 each.

There are 2.91% of Miju Mishmi females, who have four arches and six loops.

Figure 21 further shows that 1.94% of females have three whorls, one arch and six loops; three arches and seven loops. There are 0.97% of females each having seven whorls, one arch and two loops; two whorls, one arch and seven loops; one whorl, one arch and eight loops; one arch and nine loops; six whorls, two arches and two loops; four whorls, two arches and four loops; two whorls, three arches and five loops; five arches and five loops; and eight arches and two loops.

Table 102 shows the pattern types for each digit of left and right hands in Idu Mishmi males. The most common pattern in both right and left hand digits is whorl, followed by ulnar loop. The maximum number of whorls occurs in first and fourth digits of both hands. However, the total frequency of whorls is higher in right than the left hand digits. The composite patterns (lateral pocket loop, twin loop, central pocket loop and accidental) exhibit a higher frequency of occurrence on the left hand digits. In both the hands, maximum number of ulnar loops are found on the digits III and V. Radial loop is higher in the second digits in both the hands. The occurrence of arch is lowest in frequency compared to other finger patterns. However, the number of plain arch is higher compared to tented arch.

Lastly, we shall discuss about the dermatoglyphic characteristics of the Idu Mishmi.

Table 102. Pattern types for each digit of left and right hands in Idu Mishmi Male (N=154).

Pattern		Right hand						Left hand						Grand total
		I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL	W^C	10 (6.49)	07 (4.55)	06 (3.90)	16 (10.39)	03 (1.95)	42 (5.45)	05 (3.25)	09 (5.84)	05 (3.25)	12 (7.79)	01 (0.65)	32 (4.16)	74 (4.81)
	W^S	80 (51.95)	75 (48.70)	48 (31.17)	96 (62.34)	53 (34.42)	352 (45.71)	59 (38.31)	67 (43.51)	63 (40.91)	88 (57.14)	42 (27.27)	319 (41.43)	671 (43.57)
	LPL	11 (7.14)	05 (3.25)	06 (3.90)	02 (1.30)	08 (5.19)	32 (4.16)	10 (6.49)	08 (5.19)	04 (2.60)	05 (3.25)	14 (9.09)	41 (5.32)	73 (4.74)
	CPL	03 (1.95)	01 (0.65)	05 (3.25)	07 (4.55)	08 (5.19)	24 (3.12)	0 (0.00)	02 (1.30)	03 (1.95)	05 (3.25)	01 (0.65)	11 (1.43)	35 (2.27)
	TL	06 (3.90)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	06 (0.78)	16 (10.39)	02 (1.30)	04 (2.60)	0 (0.00)	0 (0.00)	22 (2.86)	28 (1.82)
	ACC	0 (0.00)	01 (0.65)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.13)	0 (0.00)	01 (0.65)	0 (0.00)	01 (0.65)	0 (0.00)	02 (0.26)	03 (0.19)
LOOP	L^U	38 (24.68)	51 (33.12)	86 (55.84)	30 (19.48)	82 (53.25)	287 (37.27)	51 (33.12)	51 (33.12)	71 (46.10)	39 (25.32)	92 (59.74)	304 (39.48)	591 (38.38)
	L^R	02 (1.30)	08 (5.19)	01 (0.65)	02 (1.30)	0 (0.00)	13 (1.69)	07 (4.55)	08 (5.19)	0 (0.00)	01 (0.65)	0 (0.00)	16 (2.08)	29 (1.88)
ARCH	P^A	04 (2.60)	05 (3.25)	02 (1.30)	01 (0.65)	0 (0.00)	12 (1.56)	06 (3.90)	06 (3.90)	04 (2.60)	03 (1.95)	04 (2.60)	23 (2.99)	35 (2.27)
	T^A	0 (0.00)	01 (0.65)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.13)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.06)
Total		154	154	154	154	154	770	154	154	154	154	154	770	1540

Figures in parentheses represent percentage.

Table 103. Finger pattern in Idu Mishmi Male (N=154).

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	110	71.43	38	24.68	02	1.30	04	2.60
	L	90	58.44	51	33.12	07	4.55	06	3.90
II	R	89	57.79	51	33.12	08	5.19	06	3.90
	L	89	57.79	51	33.12	08	5.19	06	3.90
III	R	65	42.21	86	55.84	01	0.65	02	1.30
	L	79	51.30	71	46.10	0	0.00	04	2.60
IV	R	121	78.57	30	19.48	02	1.30	01	0.65
	L	111	72.08	39	25.32	01	0.65	03	1.96
V	R	72	46.75	82	53.25	0	0.00	0	0.00
	L	58	37.66	92	59.74	0	0.00	04	2.60
Total	R	457	59.35	287	37.27	13	1.69	13	1.69
	L	427	55.45	304	39.48	16	2.08	23	2.99
Grand total	L+R	884	57.40	591	38.38	29	1.88	36	2.34

Table 103 shows the finger pattern types among the Idu Mishmi males. The most common pattern in the digits of both right and left hands is whorl, which is followed by ulnar loop. The maximum number of whorls occurs in I and IV digits of both hands. In general, in both the hands the percentage of whorls increases in the following way-

Right hand: III → V → II → I → IV.
Left hand: V → III → II → I → IV.

While combining all digits together, it is found that in right hand, the frequency of whorls is 59.35%, followed by ulnar loops (37.27%). The frequencies of radial loops and arches are 1.69% each. For the left hand, the order is almost similar. The frequencies of whorls, ulnar loops, radial loops and arches are 55.45%, 39.48%, 2.08% and 2.99% respectively. Combining both hands together, it is seen that the frequencies of whorls, ulnar loops, radial loops and arches are 57.40%, 38.38%, 1.88% and 2.34% respectively. Again, combining ulnar loops and radial loops together, it is found that the frequency of loop is 40.26%.

The highest frequency of ulnar loop is found on digit III and V. The frequency of ulnar loop increases in the following way-

Left hand: IV → I = II → III → V. Right hand: IV → I → II → V→ III.

The arches are very low in number. The highest percent of arches are found on digit II, followed by digit I. The frequency of arches increases in the following way-

Left hand: IV → IV =V → II = I. Right hand: V→ IV → III → I → II.

The frequency of radial loop is also very low in number. The highest frequency is seen on digit II of both hands.

Table 104. Pattern types for each digit of left and right hands in Idu Mishmi Female (N=144).

Pattern			Right hand						Left hand						Grand total
			I	II	III	IV	V	Total	I	II	III	IV	V	Total	
WHORL		W^C	02 (1.39)	04 (2.78)	01 (0.69)	10 (6.94)	03 (2.08)	20 (2.78)	02 (1.39)	03 (2.08)	04 (2.78)	10 (6.94)	02 (1.39)	21 (2.92)	41 (2.85)
		W^S	70 (48.61)	66 (45.83)	44 (30.56)	75 (52.08)	39 (27.08)	294 (40.83)	62 (43.06)	57 (39.58)	52 (36.11)	74 (51.39)	30 (20.83)	275 (38.19)	569 (39.51)
		LPL	10 (6.94)	06 (4.17)	03 (2.08)	0 (0.00)	01 (0.69)	20 (2.78)	02 (1.39)	09 (6.25)	04 (2.78)	04 (2.78)	02 (1.39)	21 (2.92)	41 (2.85)
		CPL	02 (1.39)	03 (2.08)	01 (0.69)	06 (4.17)	02 (1.39)	14 (1.94)	04 (2.78)	05 (3.47)	02 (1.39)	09 (6.25)	02 (1.39)	22 (3.06)	36 (2.50)
		TL	06 (4.17)	02 (1.39)	0 (0.00)	0 (0.00)	0 (0.00)	08 (1.11)	12 (8.33)	0 (0.00)	01 (0.69)	0 (0.00)	02 (1.39)	15 (2.08)	23 (1.60)
		ACC	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.69)	01 (0.14)	0 (0.00)	01 (0.69)	0 (0.00)	0 (0.00)	0 (0.00)	01 (0.14)	02 (0.14)
LOOP		L^U	41 (28.47)	53 (36.81)	92 (63.89)	52 (36.11)	96 (66.67)	334 (46.39)	38 (26.39)	44 (30.56)	76 (52.78)	46 (31.94)	102 (70.83)	306 (42.50)	640 (44.44)
		L^R	04 (2.78)	02 (1.39)	0 (0.00)	0 (0.00)	0 (0.00)	06 (0.83)	12 (8.33)	11 (7.64)	0 (0.00)	0 (0.00)	0 (0.00)	23 (3.19)	29 (2.01)
ARCH		P^A	09 (6.25)	08 (5.56)	03 (2.08)	01 (0.69)	02 (1.39)	23 (3.19)	12 (8.33)	10 (6.94)	04 (2.78)	01 (0.69)	04 (2.78)	31 (4.31)	54 (3.75)
		T^A	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	04 (2.78)	01 (0.69)	0 (0.00)	0 (0.00)	05 (0.69)	05 (0.35)
Total			144	144	144	144	144	720	144	144	144	144	144	720	1440

Figures in parentheses represent percentage.

Table 104 shows the pattern types for each digit of left and right hands in Idu Mishmi females. The most common pattern on the digits of both right and left hand is whorl, followed by ulnar loop. The maximum number of whorls occurs in the first and fourth digits of both hands. However, the total frequency of whorl is higher in right hand than the left hand digits. The composite patterns exhibit a higher frequency of occurrence on the left hand digits. In both hands, the maximum number of ulnar loops are found on digit III and V. Radial loop is higher in the first digit in both the hands. The occurrence of arch is the lowest in frequency compared to other finger patterns. Tented arch found to occur in the left hand digits.

Table 105. Finger pattern in Idu Mishmi Female (N=144).

Digits	Sides	Whorl		Loop				Arch	
		No.	%	Ulnar		Radial		No.	%
				No.	%	No.	%		
I	R	90	62.50	41	28.47	04	2.78	09	6.25
	L	82	56.94	38	26.39	12	8.33	12	8.33
II	R	81	56.25	53	36.81	02	1.39	08	5.56
	L	75	52.08	44	30.56	11	7.64	14	9.72
III	R	49	34.03	92	63.89	0	0.00	03	2.08
	L	63	43.75	76	52.78	0	0.00	05	3.47
IV	R	91	63.19	52	36.11	0	0.00	01	0.69
	L	97	67.36	46	31.94	0	0.00	01	0.69
V	R	46	31.94	96	66.67	0	0.00	02	1.39
	L	38	26.39	102	70.83	02	1.39	04	2.78
Total	R	357	49.58	334	46.39	06	0.83	23	3.19
	L	355	49.31	306	42.50	23	3.19	36	5.00
Grand total	L+R	712	49.44	640	44.44	29	2.01	59	4.10

Table 100 shows the finger pattern types among the Idu Mishmi females. The most common pattern in the digits of both right and left hands is whorl, which is followed by ulnar loop. The maximum number of whorls occurs in first and fourth digits of both hands. In general, in both the hands, the percentage of whorls increases in the following way-

Right hand: V → III → II → I → IV.

Left hand: V → III → II → I → IV.

While combining all digits together, it is found that in right hand, the frequency of whorls is 49.58%, followed by ulnar loops (46.39%). The frequencies of radial loop and arch are 0.83%

and 3.19% respectively. For the left hand, the order is similar to that of the right hand. The frequencies of whorl, ulnar loop, radial loop and arch are 49.31%, 42.50%, 3.19% and 5.00% respectively. Combining both hands together is seen that the frequencies of whorl, ulnar loop, radial loop and arch are 49.44%, 44.44%, 2.01% and 4.10% respectively. Again, combining ulnar loop and radial loop together, it is found that the frequency of loop is 46.45%.

The highest frequency of ulnar loop is found on digit V, followed by digit III. The frequency of ulnar loop increases in the following way-

Right hand: I → IV → II → III → V.
Left hand: I → II → IV → III → V.

The arches are very low in number. The highest percentage of arch are found on digit I of right hand (6.25%) and digit II of left hand (9.72%). In general, the frequency of arch increases in the following way-

Right hand: IV → V → III → II → I.
Left hand: IV → V → III → I → II.

The frequency of radial loop, in general, is very low. The highest percentage is seen on digit I of both left hand and right hand with the frequency of 8.33% and 2.78% respectively.

Table 106. INDICES.

INDICES	MALE (N=154)	FEMALE (N=144)
Furuhata's index	142.58	106.43
Dankmeijer's index	4.07	8.29
Pattern intensity index	15.51	14.53

Table 106 shows all digital indices. Furuhata's index is 142.58 in males and 106.43 in females. The Dankmeijer's index is found to be 4.07 in males and 8.29 in females. The Pattern intensity index in males and females is 15.51 and 14.53 respectively. In general, these indices are higher in males than in females, excepting the Dankmeijer's index, which is higher in females.

Table 107. Main line formula in Idu Mishmi.

Main line formula	Right hand				Left hand				Total (Right hand + Left hand)			
	Male		Female		Male		Female		Male		Female	
	No	%	No	%	No	%	No	%	No	%	No	%
11-9-7	21	13.64	15	10.42	3	1.95	7	4.86	24	7.79	22	7.64
11-7-7	6	3.90	6	4.17	6	3.90	1	0.69	12	3.90	7	2.43
10-9-6	4	2.60	0	0.00	3	1.95	2	1.39	7	2.27	2	0.69
10-7-6	14	9.09	16	11.11	10	6.49	14	9.72	24	7.79	30	10.42
9-7-5	40	25.97	33	22.92	26	16.88	18	12.50	66	21.43	51	17.71
8-6-5	29	18.83	27	18.75	22	14.29	20	13.89	51	16.56	47	16.32
7-5-5	19	12.34	32	22.22	65	42.21	63	43.75	84	27.27	95	32.99

Table 107 shows the mainline formula in the Idu Mishmi. Only seven mainline formulae have been discussed since the other mainline formulae have appeared in this population in very low frequencies. It is seen that the mainline formula 9-7-5 appears in the highest frequency on right hands of both the sexes, whereas the highest frequency of the mainline formula 7-5-5 is found on left hands of both the sexes. It is found that the mainline formula 8-6-5 has appeared in considerably higher frequency on right hands of both the sexes. Combining both the hands together, it is seen that the frequency of mainline formula 7-5-5 is highest in both the sexes i.e., males (27.27%) and females (32.99%), frequency of mainline formula 9-7-5 is the second highest in both the sexes. The frequency of mainline formula 8-6-5 is higher compared to the remaining mainline formula in both sexes.

Table 108. Different location of the axial triradii.

Triradius	Male				Female				Total (Left +Right)			
	Right		Left		Right		Left		Male		Female	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
t-missing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
t	71	46.10	76	49.35	40	27.78	45	31.25	147	47.73	85	29.51
t'	78	50.65	75	48.70	101	70.14	96	66.67	153	49.68	197	68.40
t"	02	1.30	01	0.65	02	1.39	03	2.08	03	0.97	05	1.74
tt'	02	1.30	01	0.65	01	0.69	0	0.00	03	0.97	01	0.35
t't"	01	0.65	01	0.65	0	0.00	0	0.00	02	0.65	00	0.00
	154	100.00	154	100.00	144	100.00	144	100.00	308	100.00	288	100.00

Table 108 shows the position of axial triradius on palm in the Idu Mishmi. It is found that the axial triradius t' appears in highest frequency on the right hand in male and both hands in females, whereas the axial triradius t is found in highest frequency on left hand of males. The axial triradii tt't'' type appears only on the right hand and left hand of a male individual. However, combining both hands together, it is seen that the frequencies of t, t', t'' and tt' are 47.73%, 49.68%, 097% and 0.97% respectively in males, and 29.51%, 68.40%, 1.74% and 0.35% respectively in females. It may be noted that the frequencies of dual formation triradii tt' are 0.97% and 0.35% respectively in males and females.

Table 109. C-line termination of the Idu Mishmi.

Sex	Side	Termination type-c									
		Ulnar		Radial		Proximal		Absent		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Male	R	112	72.73	35	22.73	1	0.65	06	3.90	154	100.00
	L	138	89.61	11	7.14	3	1.95	02	1.30	154	100.00
	R+L	250	81.17	46	14.93	4	1.30	08	2.60	308	100.00
Female	R	115	79.86	23	15.97	1	0.69	05	3.47	144	99.99
	L	126	87.50	15	10.42	0	0.00	03	2.08	144	100.00
	R+L	241	83.68	38	13.19	1	0.35	08	2.78	288	100.00
Grand Total	R+L	491	82.38	84	14.09	5	0.84	16	2.68	596	99.99

Table 109 shows the frequencies of different types of 'c' line termination in the Idu Mishmi. The occurrence of ulnar termination is most common on both hands. It is followed by radial termination in both sexes. The termination of 'c' line missing more in female (2.78%) than in male (2.60%). Combining both hands together, the frequencies of ulnar and radial termination of 'c' line in males are 81.17% and 14.93% respectively, and in females are 83.68% and 13.19% respectively.

Table 110. 'atd' angle among the Idu Mishmi population

Male (N=154)		Female (N-144)	
Right hand	Left hand	Right hand	Left hand
Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
45.28 ± 0.40	45.64 ± 0.37	46.12 ± 0.38	46.98 ± 0.41

Table 110 shows the mean 'atd' angle in the Idu Mishmi. The mean ± s. e. in right hand and left hand of males are 45.28 ± 0.40 and 45.64 ± 0.37 respectively, and that in females are 46.12 ± 0.38 and 46.98 ± 0.41 respectively.

MALE

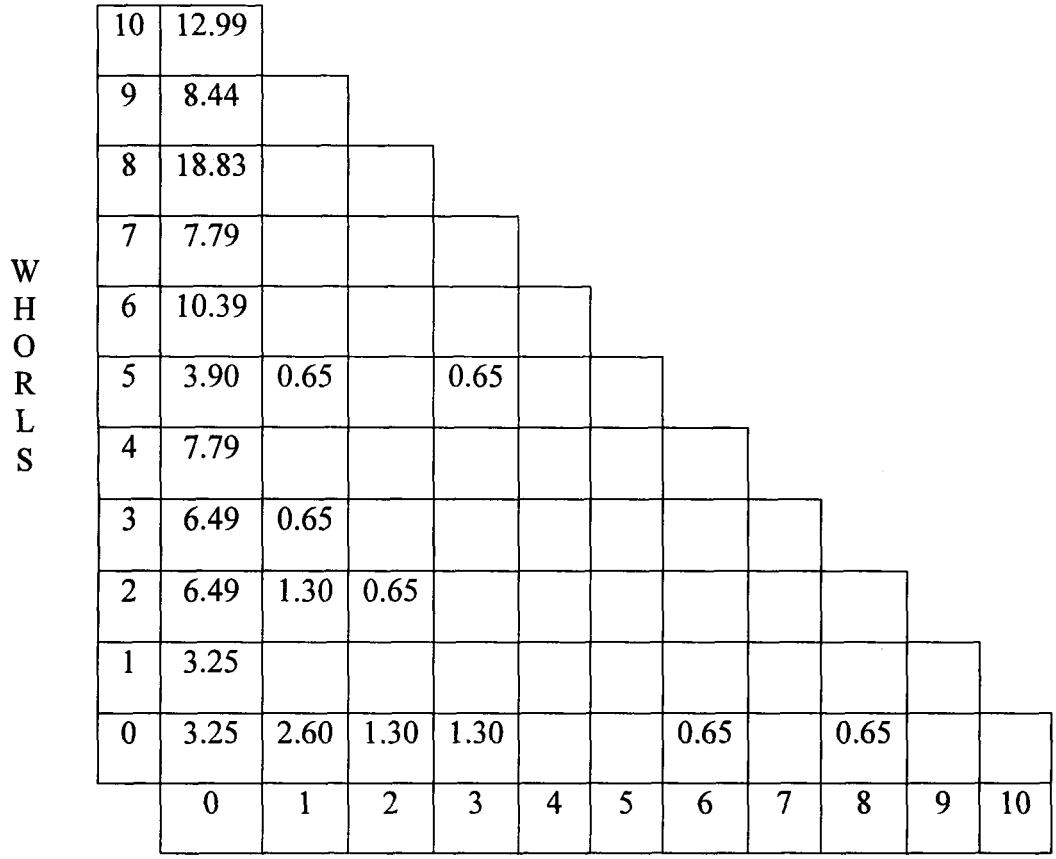


FIGURE 23 BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE IDU MISHMI MALE INDIVIDUALS.

Figure 23 shows bimanur with percent frequencies of finger pattern combination in the Idu Mishmi males. There are 12.99% and 3.25% of all males, who are monomorphic i.e., only with whorls or loops in all the fingers. 18.83% of Idu Mishmi males have eight whorls and two loops. 10.39% of them have six whorls and four loops. 8.44% of them have nine whorls and one loop. There are 7.79% of males, each having seven whorls and three loops; four whorls and six loops. 6.49% of all individuals have three whorls and seven loops; two whorls and eight loops.

3.90% of all males have equal number of whorls and loops i.e., 5 each. 3.25% of them have only one whorl and nine loops.

There are 2.60% of all Idu Mishmi males, who have one arch and nine loops. There are 1.30% of males, each having two whorls, one arch and seven loops; two arches and eight loops; three arches and seven loops.

There are 0.65% of males, each having five whorls, one arch and four loops; three whorls, one arch and six loops; two whorls, two arches and six loops; five whorls, three arches and two loops; six arches and four loops; and eight arches and two loops.

FEMALE

WHORLS	ARCHES										
	0	1	2	3	4	5	6	7	8	9	10
10	13.89										
9	3.47										
8	11.81										
7	4.86	0.69	0.69								
6	6.94	0.69									
5	8.33		0.69								
4	8.33	0.69									
3	9.03	2.08	1.39								
2	4.86	0.69	0.69	1.39							
1	4.17		0.69	0.69		0.69	0.69				
0	5.56	2.78	1.39	0.69	0.69	0.69					

FIGURE 24 BIMANUAR WITH THE PERCENT FREQUENCIES OF FINGER PRINT PATTERN COMBINATIONS IN THE IDU MISHMI FEMALE INDIVIDUALS.

Figure 24 shows bimanuar with percent frequencies of finger pattern combination in the Idu Mishmi females. It is seen that 13.89% and 5.56% of all Idu Mishmi females are monomorphic i.e., having only whorls and loops respectively. There are 11.81% of all females, who have eight whorls and two loops. 9.03% of them have three whorls and seven loops. There are 8.33% of females, each having five whorls and five loops; four whorls and six loops. 6.94% of Idu Mishmi females have seven six whorls and four loops. 4.86% of females have seven whorls and three loops; two whorls and eight loops. 4.17% of them have one whorl and nine loops. 3.47% of females have nine whorls and only one loop.

Figure 24 further shows that 2.78% of Idu Mishmi females have one arch and nine loops whereas 2.08% of them have three whorls, one arch and six loops. There are 1.39% of females, who have three whorls, two arches and five loops; two arches and eight loops; and two whorls, three arches and five loops.

There are 0.69% of all female individuals, each having seven whorls, one arch and two loops; six whorls, one arch and three loops; four whorls, one arch and five loops; two whorls, one arch and seven loops; seven whorls, two arches and one loop; five whorls, two arches and three loops; two whorls, two arches and six loops; one whorl, two arches and seven loops; one whorl, three arches and six loops; three arches and six loops; four arches and six loops; one whorl, five arches and four loops; five arches five loops; and one whorl, six arches and three loops.

Table 112 shows the distance measures, calculated on the basis of the values for finger pattern and pattern intensity index of 29 male populations Northeast India including the Mishmis of Arunachal Pradesh. The three Mishmi populations have been compared with other populations. It is seen that least distance is observed between Idu Mishmi and Tawang Monpa (0.69), followed by Idu Mishmi and Gallong (1.23). The maximum distance is noted between Idu Mishmi and Khamiyang (30.01), followed by Idu Mishmi and Mishing (28.21). The distance between the Digaru and Miju Mishmi, Digaru and Idu Mishmi and Miju and Idu Mishmi is found to be 7.94, 16.05 and 8.20 respectively.

Table 111. Finger patterns and pattern intensity index of 29 Mongoloid (Male) populations of Assam and Arunachal Pradesh.

Population	No of sample	Pattern frequency (%)			PII	Authors
		Whorl	Loop	Arch		
Nocte	102	47.84	49.31	2.65	14.50	Goswami and Das, 1990
Wancho	116	53.71	43.97	2.32	15.14	-do-
Tangsa	149	52.82	45.37	1.81	15.10	-do-
Singpho	107	47.94	49.25	2.62	14.51	-do-
Khampti	127	49.84	46.22	3.70	14.59	-do-
Gallong	151	56.42	40.99	2.45	15.38	-do-
Minyong	93	59.89	38.17	1.94	15.78	-do-
Hill Miri	113	56.02	42.83	1.15	15.49	-do-
Tagin	143	58.07	41.07	0.86	15.72	-do-
Apatani: Guth	169	60.12	38.61	1.60	15.84	-do-
Apatani: Guchi	100	65.33	32.93	0.7	16.35	-do-
Nishi	133	52.41	44.81	2.33	16.96	-do-
Aka	128	58.67	38.43	2.89	15.57	-do-
Khowa	113	55.84	42.48	1.42	15.41	-do-
Miji	284	60.72	37.59	1.69	15.86	-do-
Sherdukpen	162	63.76	35.61	0.49	16.31	-do-
Dirang Monpa	164	63.90	35.49	0.61	16.33	-do-
Kalaktang Monpa	135	56.52	42.44	1.40	15.55	-do-
Tawang Monpa	140	57.57	40.64	1.79	15.58	-do-
Deori	57	54.36	43.51	1.93	15.51	Das et al 1980b
Mishing	57	37.54	60.18	2.28	13.35	-do-
Chutia	62	49.19	47.26	3.55	14.79	-do-
Lalung	106	51.04	47.45	1.51	14.96	Chakravarti and Mukharjee 1961
Ahom	56	46.61	51.25	2.14	14.48	Das et al, 1980b
Moran	55	48.18	50.55	1.24	14.69	-do-
khamiyang	56	35.98	61.13	2.88	13.09	Das and Bhagabati 1962
Digaru Mishmi	105	45.71	51.15	3.14	14.26	Present study
Miju Mishmi	102	51.76	46.18	2.06	14.97	-do-
Idu Mishmi	154	57.40	40.26	2.34	15.51	-do-

Table 112 : Distance matrix based on finger patterns and pattern intensity index among the 29 Mongoloid (male) populations of Assam and Arunachal Pradesh.

	Nocte	Wancho	Tangsa	Singpho	Khampti	Gallong	Minyong	H. Miri	Tagin	Apa: Guth	Apa: Guchi	Nishi	Aka	Khowa	Miji	Sherduk	D. Monpa	K. Monpa	T. Monpa	Deori	Mishing	Chutia	Lalung	Ahom	Moran	Khamiyang	D. Mishmi	M. Mishmi	I. Mishmi
Nocte	0																												
Wancho	7.97	0																											
Tangsa	6.43	1.74	0																										
Singpho	0.12	7.85	6.31	0																									
Khampti	3.83	4.72	3.67	3.74	0																								
Gallong	11.99	4.04	5.71	11.87	8.53	0																							
Minyong	16.48	8.51	10.11	16.36	13.05	4.52	0																						
H. Miri	10.59	2.85	4.16	10.47	7.55	2.29	6.12	0																					
Tagin	13.31	5.47	6.88	13.19	10.18	2.32	3.59	2.73	0																				
Apa: Guth	16.38	8.42	9.98	16.26	13.02	4.50	0.60	5.91	3.29	0																			
Apa: Guchi	24.11	16.16	17.72	24.00	20.70	12.18	7.68	13.62	10.93	7.78	0																		
Nishi	6.88	2.39	2.05	6.77	4.01	5.76	10.08	4.53	7.05	9.98	17.64	0																	
Aka	15.39	7.47	9.15	15.28	11.84	3.44	1.58	5.42	3.39	1.97	8.94	9.06	0																
Khowa	10.63	2.76	4.21	10.51	7.47	1.90	5.95	0.48	2.71	5.79	13.52	4.52	5.16	0															
Miji	17.50	9.53	11.12	17.39	14.10	5.56	1.06	7.08	4.46	1.19	6.64	11.07	2.55	6.94	0														
Sherduk	21.19	13.25	14.77	21.07	17.88	9.36	4.89	10.64	7.92	4.87	3.11	14.74	6.34	10.56	3.84	0													
D. Monpa	21.36	13.42	14.94	21.25	18.04	9.51	5.03	10.82	8.10	5.02	2.93	14.91	6.46	10.74	3.98	0.22	0												
K. Monpa	11.19	3.35	4.76	11.07	8.07	1.80	5.47	0.68	2.14	5.27	13.01	5.04	4.79	0.70	6.44	10.02	10.20	0											
T. Monpa	13.11	5.14	6.72	12.99	9.77	1.39	3.40	2.76	1.15	3.28	11.02	6.80	2.70	2.56	4.40	8.11	8.28	2.12	0										
Deori	8.81	0.96	2.45	8.70	5.64	3.30	7.69	1.96	4.57	7.58	15.31	2.78	6.73	1.88	8.70	12.39	12.56	2.47	4.31	0									
Mishing	15.02	22.97	21.36	15.14	18.70	27.00	31.46	25.46	28.18	31.33	39.07	21.69	30.41	25.56	32.48	36.10	36.28	26.09	28.08	23.78	0								
Chutia	2.63	5.73	4.46	2.54	1.25	9.65	14.17	8.52	11.19	14.11	21.83	4.75	13.00	8.48	15.21	18.97	19.13	9.06	10.85	6.63	17.50	0							
Lalung	3.90	4.46	2.76	3.78	2.81	8.47	12.86	6.82	9.55	12.70	20.44	3.68	11.91	6.92	13.85	17.46	17.64	7.45	9.46	5.20	18.64	2.77	0						
Ahom	2.35	10.19	8.58	2.45	6.18	14.23	18.69	12.71	15.43	18.56	26.30	9.02	17.65	12.79	19.70	23.34	23.52	13.32	15.30	11.00	12.78	4.97	5.89	0					
Moran	1.92	8.67	6.99	1.92	5.25	12.70	17.09	11.03	13.74	16.93	24.65	7.56	16.14	11.15	18.08	21.66	21.84	11.67	13.69	9.43	14.45	4.15	4.24	1.95	0				
Khamiyang	16.81	24.77	23.18	16.92	20.43	28.79	33.27	27.30	30.02	33.15	40.89	23.49	32.19	27.38	34.29	37.94	38.11	27.92	29.89	25.59	1.94	19.24	20.47	14.59	16.31	0			
D. Mishmi	2.87	10.82	9.30	2.99	6.46	14.82	19.32	13.45	16.18	19.23	26.97	9.65	18.21	13.49	20.35	24.05	24.22	14.05	15.96	11.67	12.24	5.26	6.73	1.36	3.20	13.99	0		
M. Mishmi	5.07	2.96	1.36	4.95	2.55	7.00	11.44	5.52	8.24	11.32	19.06	2.52	10.43	5.56	12.46	16.12	16.30	6.12	8.06	3.77	20.02	3.17	1.50	7.24	5.72	21.83	7.94	0	
I. Mishmi	13.21	5.25	6.89	13.09	9.77	1.23	3.29	3.15	1.83	3.28	10.95	6.91	2.30	2.87	4.33	8.13	8.29	2.53	0.69	4.47	28.21	10.88	9.65	15.43	13.88	30.01	16.05	8.20	0

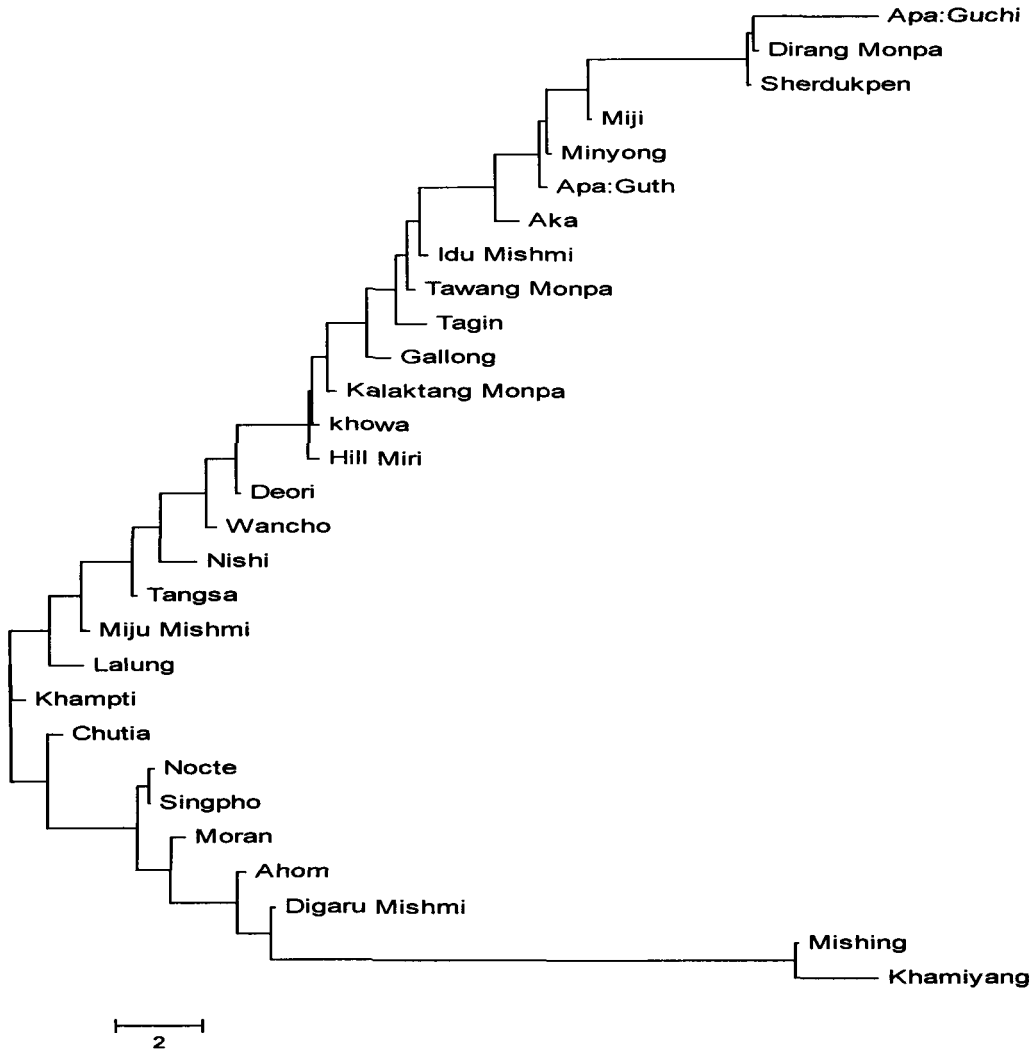


FIGURE 25. DENDROGRAM BASED ON FINGER PATTERNS AND PATTERN INTENSITY INDEX OF 29 MONGOLOID POPULATIONS OF ASSAM AND ARUNACHAL PRADESH INCLUDING MISHMI POPULATION (MALE).

The above dendrogram shows that in respect of the above mentioned traits Digaru Mishmi stands closer to Mishing, Khamiyang and Ahom. The Miju Mishmi remains quit apart from the Digaru Mishmi and Idu Mishmi. However, it is seen that Miju Mishmi is closer to the Tangsa and Lalung. The Idu Mishmi males are closer to the Aka and Tawang Monpa. However, the dendrogram constructed on the basis of finger pattern and pattern intensity index shows different relationship among the Mongoloid populations of Assam and Arunachal Pradesh than that of the anthropometric traits and genetic markers.

Table 113. Finger patterns and pattern intensity index of 29 Mongoloid (female) populations of Assam and Arunachal Pradesh.

Population	No of sample	Pattern frequency (%)			PII	Authors
		Whorl	Loop	Arch		
Nocte	103	36.03	58.07	5.83	13.01	Goswami and Das, 1990
Wancho	107	48.50	49.16	2.34	14.62	-do-
Tangsa	134	39.93	57.61	2.39	13.75	-do-
Singpho	95	42.95	52.95	4.00	13.78	-do-
Khampti	111	47.03	49.37	3.24	14.34	-do-
Gallong	122	43.36	52.05	4.51	13.88	-do-
Minyong	87	51.03	42.64	6.32	14.47	-do-
Hill Miri	118	54.32	42.12	3.47	15.08	-do-
Tagin	125	58.72	39.60	1.60	15.70	-do-
Apatani: Guth	110	64.44	33.32	1.80	16.22	-do-
Apatani: Guchi	95	68.84	30.00	1.05	16.77	-do-
Nishi	106	49.43	46.13	4.33	14.50	-do-
Aka	128	54.06	42.26	3.43	15.03	-do-
Khowa	83	50.60	46.39	2.89	14.75	-do-
Miji	204	56.01	39.78	4.21	15.23	-do-
Sherdukpen	151	54.90	43.44	1.52	15.32	-do-
Dirang Monpa	130	62.38	37.31	0.31	16.21	-do-
Kalaktang Monpa	130	48.00	42.69	9.31	13.87	-do-
Tawang Monpa	132	58.48	39.55	1.97	15.65	-do-
Deori	58	54.14	42.24	3.62	15.08	Das et al 1980b
Mishing	54	35.74	55.93	8.33	12.72	-do-
Chutia	58	41.55	57.76	0.69	14.09	-do-
Lalung	132	38.94	57.88	3.18	13.58	Chakravarti and Mukherjee1961
Ahom	52	32.88	62.50	4.62	13.28	Das et al 1980b
Moran	52	50.77	48.27	0.96	14.98	-do-
khamiyang	56	38.62	57.30	3.94	13.48	Das and Bhagabati 1962
Digaru Mishmi	107	44.58	51.21	4.21	14.04	Present study
Miju Mishmi	103	47.86	47.86	4.27	14.36	-do-
Idu Mishmi	144	49.44	46.45	4.10	14.53	-do-

Table 114 : Distance matrix based on finger patterns and pattern intensity index among the 29 Mongoloid (female) populations of Assam and Arunachal Pradesh.

	Nocte	Wancho	Tangsa	Singpho	Khampti	Gallong	Minyong	H. Miri	Tagin	Apa: Guth	Apa: Guchi	Nishi	Aka	Khowa	Miji	Sherduk	D. Monpa	K. Monpa	T. Monpa	Deori	Mishing	Chutia	Lalung	Ahom	Moran	Khamiyang	D. Mishmi	M. Mishmi	I. Mishmi
Nocte	0																												
Wancho	15.80	0																											
Tangsa	5.27	12.07	0																										
Singpho	8.83	6.97	5.78	0																									
Khampti	14.32	1.76	10.93	5.51	0																								
Gallong	9.62	6.33	6.87	1.12	4.74	0																							
Minyong	21.57	8.05	19.06	13.32	8.41	12.29	0																						
H. Miri	24.47	9.22	21.21	15.77	10.31	14.87	4.43	0																					
Tagin	29.68	14.06	26.11	20.89	15.38	20.07	9.60	5.44	0																				
Apa: Guth	38.03	22.54	34.60	29.29	23.80	28.43	17.03	13.56	8.51	0																			
Apa: Guchi	43.61	28.06	40.11	34.85	29.35	34.00	22.58	19.14	14.00	5.59	0																		
Nishi	18.07	3.74	15.05	9.44	4.18	8.50	4.32	6.41	11.74	19.97	25.55	0																	
Aka	24.18	8.94	20.93	15.48	10.02	14.59	4.24	0.30	5.71	13.85	19.43	6.12	0																
Khowa	18.98	3.52	15.52	10.18	4.68	9.37	5.11	5.70	10.71	19.12	24.67	1.89	5.42	0															
Miji	27.23	12.18	24.12	18.61	13.20	17.68	6.17	2.98	3.80	10.94	16.51	9.17	3.26	8.66	0														
Sherduk	24.37	8.65	20.69	15.55	10.05	14.78	6.28	2.44	5.43	13.94	19.42	6.76	2.41	5.42	4.68	0													
D. Monpa	34.15	18.43	30.44	25.33	19.83	24.54	14.01	9.97	4.53	4.73	9.80	16.27	10.24	15.17	7.93	9.79	0												
K. Monpa	19.82	9.55	18.32	12.61	9.09	11.50	4.30	8.71	13.68	20.49	25.92	6.25	8.53	7.90	10.02	10.53	17.95	0											
T. Monpa	29.48	13.90	25.96	20.70	15.19	19.86	9.24	5.15	0.45	8.64	14.16	11.49	5.42	10.51	3.37	5.32	4.83	13.29	0										
Deori	24.24	9.03	21.01	15.55	10.10	14.65	4.18	0.26	5.69	13.79	19.37	6.18	0.21	5.51	3.15	2.55	10.22	8.47	5.40	0									
Mishing	3.32	15.75	7.53	8.99	14.11	9.44	20.43	23.77	29.14	37.28	42.86	17.40	23.49	18.59	26.36	24.01	33.66	18.11	28.89	23.53	0								
Chutia	7.63	11.19	2.38	6.01	10.34	7.11	18.72	20.41	25.06	33.57	39.02	14.52	20.13	14.71	23.37	19.63	29.27	18.52	24.95	20.22	9.87	0							
Lalung	3.98	13.01	1.31	6.41	11.77	7.44	19.73	22.07	27.06	35.53	41.06	15.82	21.79	16.41	24.96	21.66	31.43	18.72	26.90	21.87	6.43	3.65	0						
Ahom	5.58	20.71	8.88	13.90	19.38	14.81	26.98	29.66	34.74	43.18	48.73	23.31	29.37	24.06	32.48	29.36	39.14	25.37	34.56	29.44	8.09	10.66	7.76	0					
Moran	18.46	2.82	14.43	9.68	4.55	9.11	7.79	7.53	11.80	20.31	25.76	4.24	7.28	2.71	10.50	6.39	16.03	10.48	11.70	7.40	18.55	13.26	15.47	23.21	0				
Khamiyang	3.33	12.95	2.07	6.15	11.61	7.11	19.38	21.90	26.98	35.41	40.96	15.58	21.62	16.29	24.75	21.60	31.38	18.18	26.80	21.69	5.48	4.44	1.01	7.78	15.50	0			
D. Mishmi	11.13	4.84	8.12	2.41	3.23	1.52	10.94	13.38	18.56	26.93	32.49	7.04	13.10	7.86	16.21	13.26	23.02	10.50	18.35	13.16	10.92	8.03	8.81	16.28	7.64	8.54	0		
M. Mishmi	15.76	2.43	12.72	7.10	2.01	6.17	6.44	8.71	13.97	22.27	27.84	2.34	8.42	3.42	11.51	8.81	18.47	7.24	13.74	8.48	15.21	12.28	13.48	20.98	4.47	13.24	4.70	0	
I. Mishmi	17.89	3.37	14.78	9.22	3.89	8.30	4.69	6.58	11.86	20.14	25.72	0.40	6.29	1.69	9.39	6.79	16.38	6.62	11.62	6.35	17.28	14.21	15.58	23.10	3.89	15.36	6.82	2.13	0

Table 114 shows the distance measures, calculated on the basis of the values of the finger pattern and pattern intensity index of 29 female populations of Northeast India including the Mishmi. When the Mishmis are compared with the other populations, it is seen that least distance is between Idu Mishmi and Nishi (0.40), followed by Digaru Mishmi and Galllong (1.52). The maximum distance is observed between Digaru Mishmi and Apatani (Guchi) i.e. 32.49, followed by Miju Mishmi and Apatani (Guth) i.e. 27.84. The distance between the Digaru and Miju Mishmi, Digaru and Idu Mishmi and Miju and Idu Mishmi is found to be 4.70, 6.82 and 2.13 respectively.

The dendrogram (Fig.26) has been constructed by following the method given by Nei *et al.* (1983). It shows that the female Idu Mishmi is closer to the Nishi, the Miju Mishmi is found to be closer to the Wancho and Khampti, and Digaru Mishmi is closer to Gallong. Other Mongoloid tribes of Assam and Arunachal Pradesh, however, stand separated in respect of finger pattern and pattern intensity index.

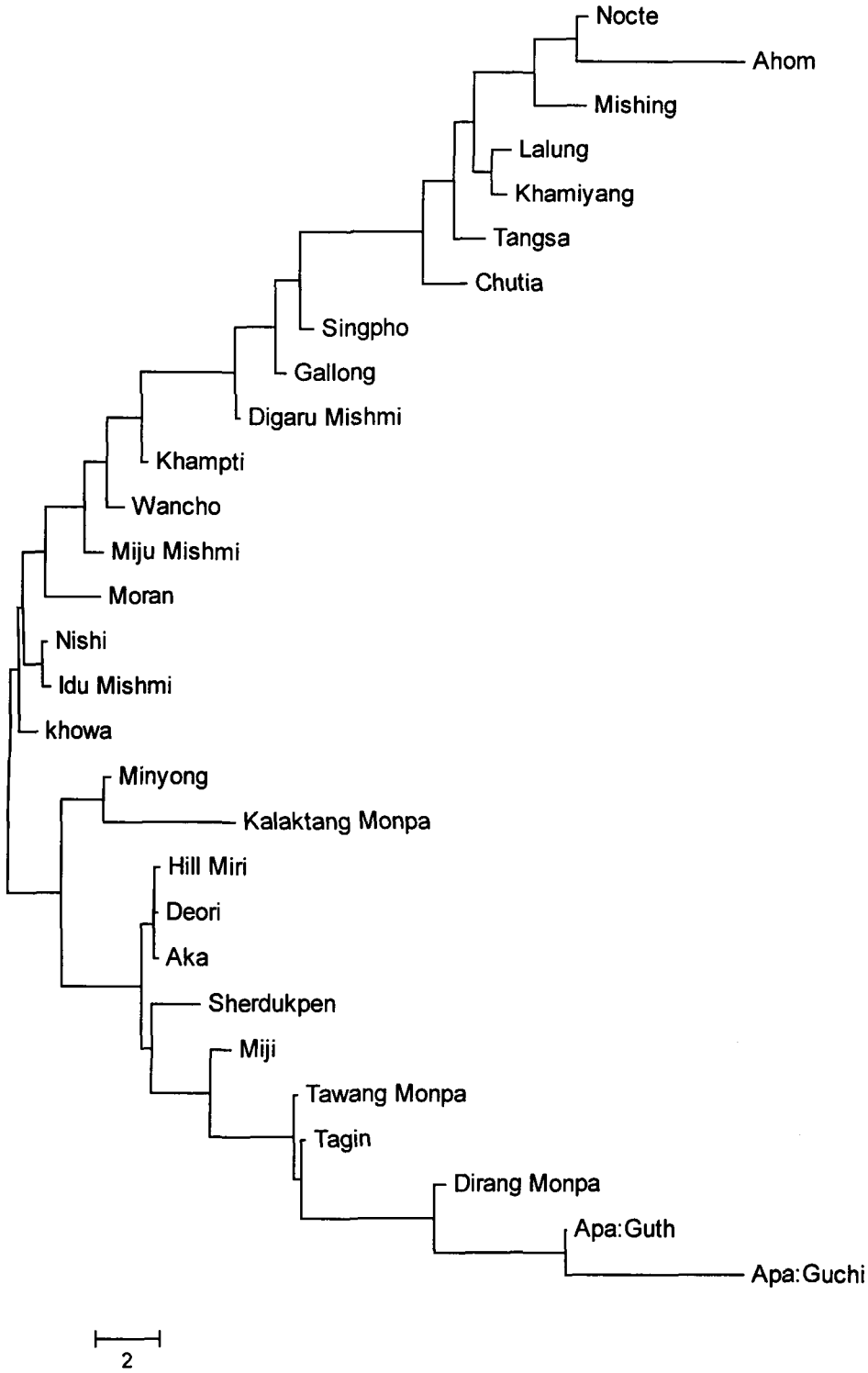


FIGURE 26. DENDROGRAM BASED ON FINGER PATTERNS AND PATTERN INTENSITY INDEX OF 29 MONGOLOID POPULATIONS OF ASSAM AND ARUNACHAL PRADESH INCLUDING MISHMI POPULATION (FEMALE).

CHAPTER - VIII
MORPHOLOGICAL AND BEHAVIOURAL TRAITS

In this chapter, we shall deal with various morphological and behavioural traits that we have studied among the Digaru, Miju and Idu Mishmis respectively. The traits, which have been employed for the present study, are as follows: 1. arm-folding, 2. hand-clasping, 3. tongue-rolling, 4. tongue-folding, 5. relative length of 1st and 2nd toe and 6. earlobe attachment. It is generally believed that such morphological and behavioural traits are not as valuable as the genetic markers like blood groups, PTC taste blindness, haemoglobin types, etc. from genetic point of view. But Salzano (1961) has pointed out that such traits may be utilized for several reasons in population genetic studies. With this view in mind, we have utilized such morphological and behavioural traits for the present study.

First, we shall deal with above mentioned morphological and behavioural traits among the Digaru Mishmi.

Table 115. Arm-folding by sex among the Digaru Mishmi.

Sex	Arm-folding				Total
	L>R		R>L		
	No.	%	No.	%	
Male	72	67.29	35	32.71	107
Female	72	69.23	32	30.77	104
Total	144	68.25	67	31.75	211

χ^2=0.0917, d. f. =1, P>0.05 Insignificant.

Arm-folding has been classified into two groups-L>R and R>L (as given in chapter III). Table 115 shows the frequencies of L>R and R>L in both sexes. It is found that the frequency of L>R is 69.23% in females and that in males is 67.29%. But, the χ^2 value (χ^2=0.0917, d. f. =1, P>0.05) shows that there is no significant difference between the two sexes in respect of this morphological trait. Pooling data on both sexes together, it is found that the frequencies of L>R and R>L are 68.25% and 31.75% respectively.

Table 116. Arm-folding by age-group.

Generations	Age groups (in yrs)	Arm-folding				Total
		L>R		R>L		
		No.	%	No.	%	
III	-24	39	66.10	20	33.90	59
II	25 – 48	78	66.67	39	33.33	117
I	49+	27	77.14	8	22.86	35

χ^2 (between all generation) =1.5383, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =1.3843, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0056, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =1.2805, d. f. =1, P>0.05 Insignificant.

The entire data on arm-folding have been classified into three age groups i.e., -24years, 25-48years and 49+ years. Each of these age group corresponds to a generation, with respect to demographic parameters. It is seen from the Table 116 that the frequencies of L>R and R>L in the IIIrd generation are 66.10% and 39.90% respectively, and in the IInd generation (i.e., age group 25-48 years), these frequencies are 66.67% and 33.33% respectively. In the Ist generation (i.e., age group 49+years), these two types have frequency of 77.14% and 22.86% respectively. However, the χ^2 value (χ^2=1.5383, d. f. =2, P>0.05) shows that there is no significant difference among these generations in respect to this morphological trait. Table 116 also shows that the values of χ^2 between any two generations are not statistically significant.

Table 117. Hand-clasping by sex among the Digaru Mishmi.

Sex	Hand-clasping				Total
	L>R		R>L		
	No.	%	No.	%	
Male	61	57.01	46	42.99	107
Female	61	58.65	43	41.35	104
Total	122	57.82	89	42.18	211

χ^2=0.0585, d. f. =1, P>0.05 Insignificant.

Table 117 shows the frequencies of different types of hand-clasping in the Digaru Mishmi. It is seen that the frequency of L>R (58.65%) in females is higher than that in males (57.01%), whereas the frequency of R>L is lower (41.35%) in females than in males (42.99%). However, the χ^2 value (χ^2=0.0585, d. f. =1, P>0.05) shows that in respect of this morphological

trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequencies of L>R and R>L are 57.82% and 42.18% respectively.

Table 118. Hand-clasping by age-group.

Generations	Age groups (in yrs)	Hand-clasping				Total
		L>R		R>L		
		No.	%	No.	%	
III	-24	41	69.49	18	30.51	59
II	25 – 48	63	53.85	54	46.15	117
I	49+	18	51.43	17	48.57	35

χ^2 (between all generation) =4.6393, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0633, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =3.9715, d. f. = 1, P<0.05 Significant.
χ^2 (between I and III) =3.0669, d. f. =1, P>0.05 Insignificant.

Table118 shows the distribution of different types of hand-clasping according to generation. It is found that in the third generation (i.e., age group -24 years), the frequencies of L>R and R>L are 69.49% and 30.15 % respectively. In the second generation (i.e., age group 25-48 years) these frequencies are 53.85% and 46.15% respectively, whereas in the first generation (i.e., age group 49+years), frequencies of these two types are 51.43% and 48.57% respectively. However, the χ^2 value (χ^2=4.6393, d. f. =2, P>0.05) shows that there is no significant difference in respect of hand-clasping among these generations, whereas when compared between generation I, II and III, it is seen that there is significant difference between generation II and generation III.

Table 119. Tongue-rolling by sex among the Digaru Mishmi.

Sex	Tongue rolling				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	66	61.68	41	38.32	107
Female	67	64.42	37	35.58	104
Total	133	63.03	78	36.97	211

χ^2=0.1700, d. f. =1, P>0.05 Insignificant.

Table 119 shows the type of tongue-rolling in the Digaru Mishmi. It is seen that 61.68% of males cannot roll their tongues, whereas 38.32% of them can do so. In case of the females, the

frequency of the former is 64.42% and that of the later is 35.58 %. However, the difference between the two sexes is insignificant respect of this morphological trait (χ^2 =0.1700, d. f. = 1, P>0.05).

Considering both males and females together, it is found that 63.03% of the individuals cannot roll their tongues, whereas 36.03% can do so.

Table 120. Tongue-rolling by age-group.

Generations	Age groups (in yrs)	Tongue rolling				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-24	37	62.71	22	37.29	59
II	25 – 48	75	64.10	42	35.90	117
I	49+	21	60.00	14	40.00	35

χ^2 (between all generation) =0.1982, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.1949, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0328, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =0.0684, d. f. =1, P>0.05 Insignificant.

Table 120 shows the frequency of tongue-rolling by generation. In the third generation (i.e., upto 24 years), the frequencies of presence and absence are 37.29% and 62.71% respectively, whereas in the second generation (i.e., 25-48 years), these frequencies are 35.90% and 64.10% respectively and in the first generation (i.e., 49+years), these are 40.00% and 60.00% respectively. However, the χ^2 value (χ^2=0.1982, d. f. =2, P>0.05) among all generations, in respect of their morphological trait, shows that there is no significant difference. Table 120 shows that in respect of this trait, no significant difference exists between any two generations.

Table 121. Tongue-folding by sex among the Digaru Mishmi.

Sex	Tongue folding				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	86	80.37	21	19.63	107
Female	87	83.65	17	16.35	104
Total	173	81.99	38	18.01	211

χ^2=0.3843, d. f. =1, P>0.05 Insignificant.

Table 121 shows the type of tongue-folding in the Digaru Mishmi. It is seen that 80.37% of males cannot fold their tongues, whereas 19.63% of them can do so. In case of the females, the frequency of the former is 83.65% and that of the later is 16.35 %. However, the differences between the two sexes is insignificant in respect of this morphological trait (χ^2 =0.3843, d. f. = 1, P>0.05)

Considering both males and females together, it is found that 81.99% of the individuals cannot fold their tongues, whereas 18.01% of them can do so.

Table 122. Tongue folding by age-groups.

Generations	Age groups (in yrs)	Tongue folding				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-24	49	83.05	10	16.95	59
II	25 – 48	96	82.05	21	17.95	117
I	49+	28	80.00	7	20.00	35

χ^2 (between all generation) =0.1391, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0754, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0270, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.1380, d. f. =1, P>0.05 Insignificant.

Table 122 shows the frequency of tongue-folding by generation. In the third generation (i.e., upto 24 years), the frequencies of presence and absence are 16.95% and 83.05% respectively, whereas in the second generation (i.e., 25-48 years), these frequencies are 17.95% and 82.05% respectively and in the first generation (i.e., 49+years), these are 20.00% and 80.00% respectively. However, the χ^2 value (χ^2=0.1391, d. f. =2, P>0.05) among these generations, in respect of this morphological trait, shows that there is no significant difference. Table 122 also shows that in respect of this trait no significant difference exists between any two generations.

Table 123. Relative length of 1st and 2nd toe by sex among the Digaru Mishmi.

Sex	Relative length of 1st and 2nd toe						Total
	I>II (T)		II>I (F)		I=II (O)		
	No.	%	No.	%	No.	%	
Male	52	48.60	28	26.17	27	25.23	107
Female	38	36.54	37	35.58	29	27.88	104
Total	90	42.65	65	30.81	56	26.54	211

χ^2=3.4534, d. f. =2, P>0.05 Insignificant.

On the basis of classification given by Minami (1952), the relative length of 1st and 2nd toe was studied. Table 123 shows the frequencies of T (I>II), F (II>I) and O (I=II) in both the sexes. It is found that the frequencies of T, F and O in males are 48.60%, 26.17% and 25.23% respectively, whereas the frequencies of these three types in females are 36.54%, 35.58% and 27.88% respectively. The χ^2 value (χ^2=3.4534, d. f. =2, P>0.05) shows that there is no significant difference between the two sexes in respect of this morphological trait. Pooling data on both sexes together, it is found that the frequencies of T, F and O are 42.65%, 30.18% and 26.54 % respectively.

Table 124. Relative length of 1st and 2nd toe by age-group.

Generations	Age groups (in yrs)	Relative length of 1st and 2nd toe						Total
		I>II (T)		II>I (F)		I=II (O)		
		No.	%	No.	%	No.	%	
III	-24	28	47.46	17	28.81	14	23.73	59
II	25 – 48	41	35.04	42	35.90	34	29.06	117
I	49+	21	60.00	6	17.14	8	22.86	35

χ^2 (between all generation) =8.1932, d. f. = 4, P>0.05 Insignificant.
χ^2 (between I and II) =7.4898, d. f. = 2, P<0.05 Significant.
χ^2 (between II and III) =2.5378, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and III) =1.8930, d. f. =2, P>0.05 Insignificant.

Table 124 shows the distribution of frequencies of different types of relative length of first and second toes according to generation. It is seen that in the third generation (i.e., age group -24 years), the frequencies of T (I>II), F (II>I) and O (I=II) are 47.46%, 28.81% and 23.73% respectively. In the second generation (i.e., 25-48 years), these frequencies are 35.04%, 35.90% and 29.06% respectively, whereas in the first generation (i.e., age group 49+years), these

frequencies are 60.00% and 17.14% and 22.86% respectively. The χ^2 value (χ^2=8.1932, d. f. =4, P>0.05) shows that there is no significant difference in respect of relative length of first and second toes among these generations. When compared between generations I, II and III in respect of this trait, generation I and II differs significantly.

Table 125. Earlobe attachment by sex among the Digaru Mishmi.

Sex	Earlobe attachment				Total
	Free		Attached		
	No.	%	No.	%	
Male	61	57.01	46	42.99	107
Female	57	54.81	47	45.19	104
Total	118	55.92	93	44.08	211

χ^2=0.1037, d. f. =1, P>0.05 Insignificant.

In the Table 125, the frequencies of free and attached earlobe have been set out by sex. It is found that the frequency of free earlobe is predominantly higher (57.01%) in males than in females (54.81%), whereas the frequency of attached earlobe in females (45.19%) is higher than that in males (42.99%). However, the χ^2 value (χ^2=0.1037, d. f. =1, P>0.05) shows that in respect of this morphological trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequency of free earlobe is 55.92% and that of attached earlobe is 44.08%.

Table 126. Earlobe attachment by age-group.

Generations	Age groups (in yrs)	Earlobe attachment				Total
		Free		Attached		
		No.	%	No.	%	
III	-24	34	57.63	25	42.37	59
II	25 – 48	67	57.26	50	42.74	117
I	49+	17	48.57	18	51.43	35

χ^2 (between all generation) =0.9224, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.8236, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0021, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.7259, d. f. =1, P>0.05 Insignificant.

When earlobe attachment is examined according to generation (Table 126), it is found that the frequencies of free and attached earlobes in the third generation (i.e., -24years) are 57.63% and 42.37% respectively. In the second generation (i.e., 25-48years), the frequencies of free and attached earlobes are 57.26% and 42.74% respectively, while in the first generation (i.e., 49+years), the frequency of free earlobe (48.57%) is lower than that of the attached one (51.43%). However, the χ^2 value (χ^2 =0.9224, d. f. = 2, P>0.05) indicates that there is no significant difference in the frequencies of earlobe attachment among these generations. Table 126 also shows the absence of statistical difference between any two generations.

Now, we shall deal with the morphological and behavioural traits among the Miju Mishmi.

Table 127. Arm-folding by sex among the Miju Mishmi.

Sex	Arm-folding				Total
	L>R		R>L		
	No.	%	No.	%	
Male	74	72.55	28	27.45	102
Female	68	65.38	36	34.62	104
Total	142	68.93	64	31.07	206

χ^2=1.2342, d. f. =1, P>0.05 Insignificant.

Arm-folding has been classified into two groups- L>R and R>L. Table 127 shows the frequencies of L>R and R>L in both the sexes. It is found that frequency of L>R is 72.55% in males and that in females is 65.38%, whereas the frequency of L>R in males is 27.45% and that in females is 34.52%. The χ^2 value (χ^2=1.2342, d. f. =1, P>0.05) shows that there is no significant difference between the two sexes in respect of this behavioural trait. Pooling data on both sexes together, it is found that the frequencies of L>R and R>L are 68.93% and 31.07% respectively.

Table 128. Arm-folding by age-group.

Generations	Age groups (in yrs)	Arm-folding				Total
		L>R		R>L		
		No.	%	No.	%	
III	-25	59	71.08	24	28.92	83
II	26 -50	72	69.23	32	30.77	104
I	51+	11	57.89	8	42.11	19

χ^2 (between all generation) =1.2647, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.9408, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0756, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =1.2492, d. f. =1, P>0.05 Insignificant.

Table 128 shows the distribution of different types of arm-folding according to generation. It is found that in the third generation (i.e., -25years), the frequencies of L>R and R>L are 71.08% and 28.92% respectively. In the second generation (i.e., 26-50years), the frequencies of L>R and R>L are 69.23% and 30.77% respectively, whereas in the first generation (i.e., 51+years), these are 57.79% and 42.11% respectively. However, the χ^2 value (χ^2 =1.2647, d. f. = 2, P>0.05) shows that there is no significant difference in respect of arm-folding among these generations. Table 128 also shows that in respect of this trait no significant difference exist between any two generations.

Table 129. Hand-clasping by sex among the Miju Mishmi.

Sex	Hand-clasping				Total
	L>R		R>L		
	No.	%	No.	%	
Male	65	63.73	37	36.27	102
Female	62	59.62	42	40.38	104
Total	127	61.65	79	38.35	206

χ^2=0.3679, d. f. =1, P>0.05 Insignificant.

Table 129 shows the frequencies of different types of hand-clasping in the Miju Mishmi. It is seen that the frequency of L>R in males (63.73%) is higher than that in females (59.62%), whereas the frequency of R>L in females (40.38%) is higher than in males (36.27%). However, the χ^2 value (χ^2=0.3679, d. f. =1, P>0.05) shows that in respect of this behavioural trait, there is

no significant difference between the two sexes. Pooling data on both sexes together, it is seen that the frequencies of L>R and R>L are 61.65% and 38.35% respectively.

Table 130. Hand-clasping by age-group.

Generations	Age groups (in yrs)	Hand-clasping				Total
		L>R		R>L		
		No.	%	No.	%	
III	-25	52	62.65	31	37.35	83
II	26 –50	63	60.58	41	39.42	104
I	51+	12	63.16	7	36.84	19

χ^2 (between all generation) =0.1041, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0450, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0838, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.0017, d. f. =1, P>0.05 Insignificant.

Table 130 shows the distribution of different types hand-clasping according to generation. It is found that in the third generation (i.e., -25years), the frequencies of L>R and R>L are 62.65% and 37.35% respectively, whereas in the second generation (i.e., 26-50years), the frequencies of these two types are 60.58% and 39.42% respectively, and in the first generation (i.e., 51+years), these frequencies are 63.16% and 36.84% respectively. However, the χ^2 value (χ^2 =0.1041, d. f. = 2, P>0.05) shows that there is no significant difference among these generations in respect of this behavioural trait. Table 130 also shows that the χ^2values between any two generations are not statistically significant.

Table 131. Tongue-rolling by sex among the Miju Mishmi.

Sex	Tongue rolling				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	62	60.78	40	39.22	102
Female	63	60.58	41	39.42	104
Total	125	60.68	81	39.32	206

χ^2=0.0009, d. f. =1, P>0.05 Insignificant.

Table 131 shows the types of tongue-rolling in the Miju Mishmi. It is seen that 60.78% of males cannot roll their tongues, whereas 39.22% of them can do so. In case of the females, the frequency of former is 60.58% and that of the later is 39.42%. However, the difference between

the two sexes is insignificant in respect of this morphological trait (χ^2=0.0009, d. f. =1, P>0.05). Considering both males and females together, it is found that 60.68% of the individuals cannot roll their tongues, whereas 39.32% of them can do so.

Table 132. Tongue-rolling by age-group.

Generations	Age groups (in yrs)	Tongue rolling				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-25	47	56.63	36	43.37	83
II	26 –50	65	62.50	39	37.50	104
I	51+	13	68.42	6	31.58	19

χ^2 (between all generation) =1.1932, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.2428, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.6629, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.8880, d. f. =1, P>0.05 Insignificant.

Table 132 shows the frequency of tongue-rolling by generation. In the third generation (i.e., -25years), the frequencies of presence and absence are 43.37% and 56.63% respectively, whereas in the second generation (i.e., 26-50years), these frequencies are 37.50% and 62.50% respectively, and in the first generation (i.e., 51+years), the frequencies of these two types are 31.58% and 68.42% respectively. However, the χ^2 value (χ^2 =1.1932, d. f. = 2, P>0.05) among these generations, in respect of this morphological trait, there is no significant difference. Table 132 also shows that in respect of this trait no significant difference exists between any two generations.

Table 133. Tongue-folding by sex among the Miju Mishmi.

Sex	Tongue folding				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	80	78.43	22	21.57	102
Female	92	88.46	12	11.54	104
Total	172	83.50	34	16.50	206

χ^2=3.7593, d. f. =1, P>0.05 Insignificant.

Table 133 shows the types of tongue-folding in the Miju Mishmi. It is seen that 78.43% of males cannot fold their tongues, whereas 21.57% of them can do so. In case of females, the

frequency of the former is 88.46% and that of the later is 11.54%. However, the χ^2 value shows that in respect of this morphological trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequencies of presence and absence are 16.50% and 83.50% respectively.

Table 134. Tongue-folding by age-groups.

Generations	Age groups (in yrs)	Tongue folding				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-25	62	74.70	21	25.30	83
II	26 –50	93	89.42	11	10.58	104
I	51+	17	89.47	2	10.53	19

χ^2 (between all generation) =7.8050, d. f. = 2, P<0.05 Significant.
χ^2 (between I and II) =0.0000, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =7.0557, d. f. = 1, P<0.05 Significant.
χ^2 (between I and III) =1.9325, d. f. =1, P>0.05 Insignificant.

Table 134 shows the distribution of frequency of tongue-folding according to generations. It is found that in the third generation (i.e., or –25years), the frequencies of presence and absence are 25.30% and 74.70% respectively. In the second generation (i.e., 26-50years), the frequencies of presence and absence are 10.58% and 89.42% respectively, whereas in the first generation (i.e., 51+years), the frequencies of these two types are 10.53% and 89.47% respectively. The χ^2 value (χ^2 =7.8050, d. f. = 2, P<0.05) shows that there is significant difference among these generations in respect of this trait. Moreover, when statistically compared between the generations I, II and III, in respect of this trait, a significant difference is seen between generation II and III.

Table 135. Relative length of 1st and 2nd toe by sex among the Miju Mishmi.

Sex	Relative length of 1st and 2nd toe						Total
	I>II (T)		II>I (F)		I=II (O)		
	No.	%	No.	%	No.	%	
Male	38	37.25	41	40.20	23	22.55	102
Female	34	32.69	46	44.23	24	23.08	104
Total	72	34.95	87	42.23	47	22.82	206

χ^2=0.5115, d. f. = 2, P>0.05 Insignificant.

Table 135 shows the types of relative length of 1st and 2nd toes by sex. It is seen that the frequencies of (T) I>II, (F) II>I and (O) I=II in males are 37.25%, 40.20% and 22.55% respectively, whereas in females, these frequencies are 32.69%, 44.23% and 23.08% respectively. The χ^2 value (χ^2=0.5115, d. f. = 2, P>0.05) shows that in respect of this morphological trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequencies of T, F and O are 34.95%, 42.23% and 22.82% respectively.

Table 136. Relative length of 1st and 2nd toe by age-group.

Generations	Age groups (in yrs)	Relative length of 1st and 2nd toe						Total
		I>II (T)		II>I (F)		I=II (O)		
		No.	%	No.	%	No.	%	
III	-25	29	34.94	32	38.55	22	26.51	83
II	26-50	33	31.73	50	48.08	21	20.19	104
I	51+	10	52.63	5	26.32	4	21.05	19

χ^2 (between all generation) =5.0897, d. f. = 4, P>0.05 Insignificant.
χ^2 (between I and II) =3.7146, d. f. = 2, P>0.05 Insignificant.
χ^2 (between II and III) =1.8982, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and III) =2.0844, d. f. =2, P>0.05 Insignificant.

Table 136 shows the distribution of different types of relative length of 1st and 2nd toes according to generation. It found that in the third generation (i.e., -25years), the frequencies of T, F and O are 34.94%, 38.55% and 26.51% respectively. In the second generation (26-50years), the frequencies of T, F and O are 31.73%, 48.08% and 20.19% respectively, whereas in the first generation (i.e., 51+years), these frequencies are 52.63%, 26.32% and 21.05% respectively. However, the χ^2 value (χ^2 =5.0897, d. f. = 4, P>0.05) shows that there is no significant difference among the generations in respect of this morphological trait. Table 136 also shows that in respect of this trait no significant difference exists between any two generations.

Table 137. Earlobe attachment by sex among the Miju Mishmi.

Sex	Earlobe attachment				Total
	Free		Attached		
	No.	%	No.	%	
Male	53	51.96	49	48.04	102
Female	57	54.81	47	45.19	104
Total	110	53.40	96	46.60	206

χ^2=0.1677, d. f. = 1, P>0.05 Insignificant.

In the Table 137, the frequencies of free and attached earlobe have been set out by sex. It is found that the frequency of free earlobe is predominantly higher (54.81%) in females than in males (51.96%), whereas the frequency of attached earlobe in males (48.04%) is higher than that in females (45.19%). However, the χ^2 value (χ^2=0.1677, d. f. = 1, P>0.05) shows that in respect of this morphological trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequencies of free earlobe is 53.40% and that of attached earlobe is 46.60%.

Table 138. Earlobe attachment by age-group.

Generations	Age groups (in yrs)	Earlobe attachment				Total
		Free		Attached		
		No.	%	No.	%	
III	-25	50	60.24	33	39.76	83
II	26 -50	51	49.04	53	50.96	104
I	51+	9	47.37	10	52.63	19

χ^2 (between all generation) =2.6337, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0179, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =2.3322, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =1.0506, d. f. =1, P>0.05 Insignificant.

When earlobe attachment is examined according to generation (Table 138), it is found that the frequencies of free and attached earlobe in the third generation are 60.24% and 39.76% respectively, whereas in the second generation, the frequencies of free and attached earlobe are 49.04% and 50.96% respectively. In the first generation, the frequencies of these are 47.37% and 52.36% respectively. However, the χ^2 value (χ^2 =2.6337, d. f. = 2, P>0.05) indicates that there is no significant difference in the frequencies of earlobe attachment among these generations. Table 138 also shows that there is no significant difference between any two generations in respect of this trait.

Lastly, we shall deal with the morphological and behavioural traits among the Idu Mishmi.

Table 139. Arm-folding by sex among the Idu Mishmi.

Sex	Arm-folding				Total
	L>R		R>L		
	No.	%	No.	%	
Male	95	61.69	59	38.31	154
Female	82	57.34	61	42.66	143
Total	177	59.60	120	40.40	297

χ^2=0.5815, d.f. = 1, P>0.05 Insignificant.

Table 139 shows the frequencies of different types of arm-folding in the Idu Mishmi. It is seen that the frequency of L>R is 61.69% in males and that in females is 57.34%, whereas the frequency of R>L in females is 42.66% and that in males is 38.31%. The χ^2 value (χ^2=0.5815, d. f. = 1, P>0.05) shows that there is no significant difference between the two sexes in respect of this morphological trait. Pooling data on both on both sexes together, it is found that the frequencies of L>R and R>L are 59.60% and 40.40% respectively.

Table 140. Arm-folding by age-group.

Generations	Age groups (in yrs)	Arm-folding				Total
		L>R		R>L		
		No.	%	No.	%	
III	-25	67	62.04	41	37.96	108
II	26 -50	99	58.24	71	41.76	170
I	51+	11	57.89	8	42.11	19

χ^2 (between all generation) =0.4208, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0008, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.3968, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.1170, d. f. =1, P>0.05 Insignificant.

Table 140 shows the distribution of different types of arm-folding according to generations. It is found that in the third generation (i.e., -25years), the frequencies of L>R and R>L are 62.04% and 37.96% respectively. In the second generation (26-50years), the frequencies of L>R and R>L are 58.24% and 41.76% respectively, and in the first generation (i.e., 51+years), the frequencies of these types are 57.89% and 42.11% respectively. However, the χ^2 value (χ^2 =0.4208, d. f. = 2, P>0.05) shows that there is no significant difference in respect of arm-folding

among these generations. Table140 also shows that in respect of this behavioural trait, there is no significant difference between any two generations.

Table 141. Hand-clasping by sex among the Idu Mishmi.

Sex	Hand-clasping				Total
	L>R		R>L		
	No.	%	No.	%	
Male	96	62.34	58	37.66	154
Female	86	60.14	57	39.86	143
Total	182	61.28	115	38.72	297

χ^2=0.1509, d. f. =1, P>0.05 Insignificant.

Table 141 shows the distribution of frequencies of different types of hand-clasping in the Idu Mishmi. It is seen that the frequency of L>R in males (62.34%) is higher than that in females (60.14%), whereas the frequency of R>L in females (39.86%) is higher than that in males (37.66%). But, the χ^2 value (χ^2=0.1509, d. f. =1, P>0.05) shows that there is no significant difference between two sexes in respect of this behavioural trait. Pooling data on both sexes together, it is found that the frequencies of L>R and R>L are 61.28% and 38.72% respectively.

Table 142. Hand-clasping by age-group.

Generations	Age groups (in yrs)	Hand - clasping				Total
		L>R		R>L		
		No.	%	No.	%	
III	-25	67	62.04	41	37.96	108
II	26 –50	99	58.24	71	41.76	170
I	51+	16	84.21	3	15.79	19

χ^2 (between all generation) =4.9007, d. f. =2, P>0.05 Insignificant.
χ^2 (between I and II) =4.8401, d. f. = 1, P<0.05 Significant.
χ^2 (between II and III) =0.3968, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =3.5085, d. f. =1, P>0.05 Insignificant.

Table 142 shows the distribution of different types of hand-clasping according to generation. It is seen that in the third generation (i.e., -25years), the frequencies of L>R and R>L are 62.04% and 37.96% respectively. In the second generation (i.e., 26-50years), the frequencies of L>R and R>L are 58.24% and 41.76% respectively. In the first generation (i.e., 51+years), the frequencies of these are 84.21% and 15.79% respectively. However, the χ^2value (χ^2 = 4.9007, d.

f. =2, P>0.05) shows that there is no significant difference among these generations in respect of this trait. But, when compared between the generations, it is observed that there is significant difference between generation I and generation II (χ^2 =4.8401, d. f. = 1, P<0.05).

Table 143. Tongue-rolling by sex among the Idu Mishmi.

Sex	Tongue rolling				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	112	72.73	42	27.27	154
Female	131	91.61	12	8.39	143
Total	243	81.82	54	18.18	297

χ^2=17.7692, d. f. =1, P<0.05 Significant.

Table 143 shows the types of tongue-rolling in the Idu Mishmi. It is seen that 72.73% of males cannot roll their tongues, whereas 27.27% of them can do so. In case of females, it is found that 91.61% of them cannot roll their tongues while only 8.39% can do so. The χ^2 value (χ^2=17.7692, d. f. =1, P<0.05) shows that in respect of this trait, there is significant difference between the sexes. Considering both males and females together, it is found that 81.82% of the individuals cannot roll their tongues, whereas 18.18% of them can do so.

Table 144. Tongue-rolling by age-group.

Generations	Age groups (in yrs)	Tongue rolling				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-25	88	81.48	20	18.52	108
II	26 -50	138	81.18	32	18.82	170
I	51+	17	89.47	2	10.53	19

χ^2 (between all generation) =0.8038, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.7975, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =0.0040, d. f. =1, P>0.05 Insignificant.
χ^2 (between I and III) =0.7206, d. f. =1, P>0.05 Insignificant.

Table 144 shows the frequency of tongue-rolling according to generation. In the third generation (i.e., -25years), the frequencies of presence and absence are 18.52% and 81.48% respectively. In the second generation (i.e., 26-50years), the frequencies of presence and absence are 18.82% and 81.18% respectively. And in the first generation (i.e., 51+years), the frequencies

of these are 10.53% and 89.47% respectively. However, in respect of this trait, there is no significant difference among these generations (χ^2 =0.8038, d. f. = 2, P>0.05). Table 144 also shows that in respect of this trait no significant difference exists between any two generations.

Table 145. Tongue-folding by sex among the Idu Mishmi.

Sex	Tongue folding				Total
	Absent (-ve)		Present (+ve)		
	No.	%	No.	%	
Male	127	82.47	27	17.53	154
Female	118	82.52	25	17.48	143
Total	245	82.49	52	17.51	297

χ^2=0.0001, d. f. =1, P>0.05 Insignificant.

Table 145 shows the different types of tongue-folding in the Idu Mishmi. It is observed that 82.47% of males cannot fold their tongues, whereas 17.53% of them can do so. In case of females, the frequency of the former is 82.52% and that of the later is 17.48%. However, the difference between the two sexes is insignificant in respect of this morphological trait (χ^2=0.0001, d. f. =1, P>0.05). Considering both males and females together, it is observed that 82.49% of the individuals cannot fold their tongues, whereas 17.51% of them can do so.

Table 146. Tongue folding by age-groups.

Generations	Age groups (in yrs)	Tongue folding				Total
		Absent (-ve)		Present (+ve)		
		No.	%	No.	%	
III	-25	83	76.85	25	23.15	108
II	26 -50	145	85.29	25	14.71	170
I	51+	17	89.47	2	10.53	19

χ^2 (between all generation) =3.9442, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and II) =0.2438, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =3.1910, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =1.5377, d. f. =1, P>0.05 Insignificant.

Table 146 shows the frequency of tongue folding by generation. In the third generation, the frequencies of presence and absence are 23.15% and 76.85% respectively. In the second generation, the frequencies of presence and absence are 14.71% and 85.29% respectively. In the first generation, the frequencies of these are 10.53% and 89.47% respectively. However, the

difference among these generations is insignificant in respect of this morphological trait. Table 146 also shows that in respect of this trait no significant difference exists between any two generations.

Table 147. Relative length of 1st and 2nd toe by sex among the Idu Mishmi.

Sex	Relative length of 1st and 2nd toe						Total
	I>II (T)		II>I (F)		I=II (O)		
	No.	%	No.	%	No.	%	
Male	75	48.70	40	25.97	39	25.32	154
Female	69	48.25	41	28.67	33	23.08	143
Total	144	48.48	81	27.27	72	24.24	297

χ^2=0.3554, d. f. =2, P>0.05 Insignificant.

Table 147 shows the frequencies of T, F and O of relative length of 1st and 2nd toes in both the sexes. It is observed that the frequencies of T, F and O in males are 48.70%, 25.97% and 25.32% respectively, whereas the frequencies in females are 48.25%, 28.67% and 23.08% respectively. There is no significant difference between two sexes in respect of this morphological trait (χ^2=0.3554, d. f. =2, P>0.05). Pooling data on both sexes together, it is found that the frequencies of T, F and O are 48.48%, 27.27% and 24.24% respectively.

Table 148. Relative length of 1st and 2nd toe by age-group.

Generations	Age groups (in yrs)	Relative length of 1st and 2nd toe						Total
		I>II (T)		II>I (F)		I=II (O)		
		No.	%	No.	%	No.	%	
III	-25	53	49.07	33	30.56	22	20.37	108
II	26 -50	79	46.47	43	25.29	48	28.23	170
I	51+	12	63.16	5	26.32	2	10.53	19

χ^2 (between all generation) =4.9313, d. f. = 4, P>0.05 Insignificant.
χ^2 (between I and II) =3.0213, d. f. = 2, P>0.05 Insignificant.
χ^2 (between II and III) =2.3855, d. f. = 2, P>0.05 Insignificant.
χ^2 (between I and III) =1.5518, d. f. =2, P>0.05 Insignificant.

Table 148 shows the distribution of different types of relative length of 1st and 2nd toes according to generation. It is seen that in the third generation, the frequencies of T, F and O are 49.07%, 30.56% and 20.37% respectively. In the second generation, the frequencies of T, F and O are 46.47%, 25.29% and 28.23% respectively. In the first generation, the frequencies are

63.16%, 26.32% and 10.53% respectively. The χ^2 value (χ^2 =4.9313, d. f. = 4, P>0.05) shows that there is no significant difference among these generations in respect of this morphological trait. Table 148 further shows that in respect of this trait no significant difference exists between any two generations.

Table 149. Earlobe attachment by sex among the Idu Mishmi.

Sex	Earlobe attachment				Total
	Free		Attached		
	No.	%	No.	%	
Male	94	61.04	60	38.96	154
Female	92	64.34	51	35.66	143
Total	186	62.63	111	37.37	297

χ^2=0.3443, d. f. = 1, P>0.05 Insignificant.

In the Table 149, the frequencies of free and attached earlobe have been set out by sex. It is found that the frequency of free earlobe is predominantly higher in females (64.34%) than in males (61.04%), whereas frequency of attached earlobe is higher in males (38.96%) than that in females (35.66%). However, the χ^2 value (χ^2=0.3443, d. f. = 1, P>0.05) shows that in respect of this morphological trait, there is no significant difference between the two sexes. Pooling data on both sexes together, it is found that the frequencies of free and attached earlobe are 62.63% and 37.37% respectively.

Table 150. Earlobe attachment by age-group.

Generations	Age groups (in yrs)	Earlobe attachment				Total
		Free		Attached		
		No.	%	No.	%	
III	-25	74	68.52	34	31.48	108
II	26 –50	101	59.41	69	40.59	170
I	51+	11	57.89	8	42.11	19

χ^2 (between all generation) =2.5342, d. f. =2, P>0.05 Insignificant.
χ^2 (between I and II) =0.0163, d. f. = 1, P>0.05 Insignificant.
χ^2 (between II and III) =2.3484, d. f. = 1, P>0.05 Insignificant.
χ^2 (between I and III) =0.8239, d. f. =1, P>0.05 Insignificant.

Table 150 shows the frequencies of earlobe attachment according to generation. It is found that the frequencies of free and attached earlobe in the third generation are 68.52% and

31.48% respectively. In the second generation, the frequencies of free and attached earlobes are 59.41% and 40.59% respectively. And in the first generation, the frequencies of free and attached earlobes are 57.89% and 42.11% respectively. However, the χ^2 value (χ^2 =2.5342, d. f. =2, P>0.05) indicates that in respect of this trait, there is no significant difference among these generations. Table 150 also indicates that in respect of this trait there is no significant difference between any two generations.

Table 151: Arm-folding by population.

Population	L>R		R>L		Total
	No.	%	No.	%	
Digaru Mishmi	144	68.25	67	31.75	211
Miju Mishmi	142	68.93	64	31.07	206
Idu Mishmi	177	59.60	120	40.40	297

χ^2 (between all populations) =6.1701, d. f. = 2, P<0.05 Significant.
χ^2 (between Digaru and Miju) =0.0227, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =4.5700, d. f. = 1, P<0.05 Significant.
χ^2 (between Digaru and Idu) =3.9686, d. f. =1, P<0.05 Significant.

Table 151 shows the frequencies of arm-folding by population. It is observed that in the Digaru Mishmi, the frequencies of L>R and R>L are 68.25% and 31.75%; in the Miju Mishmi, 68.93% and 31.07% and in the Idu Mishmi, 59.60% and 40.40% respectively. Significant difference (χ^2 =6.1701, d. f. =2, P<0.05) in respect of this morphological trait is found among the three Mishmi subpopulations. Significant difference was also observed when Idu was compared with Miju and the Digaru Mishmi [χ^2 (between Miju and Idu) =4.5700, d. f. =2, P<0.05, χ^2 (between Digaru and Idu)=3.9686, d. f. =2, P<0.05] but Digaru shows resemblance with the Miju Mishmi in this trait.

Table 152: Hand-clasping by population.

Population	L>R		R>L		Total
	No.	%	No.	%	
Digaru Mishmi	122	57.82	89	42.18	211
Miju Mishmi	127	61.65	79	38.35	206
Idu Mishmi	182	61.28	115	38.72	297

χ^2 (between all populations) =0.8173, d. f. = 2, P>0.05 Insignificant.
χ^2 (between Digaru and Miju) =0.6358, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =0.0071, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Digaru and Idu) =0.6144, d. f. =1, P>0.05 Insignificant.

Table 152 shows the frequencies of hand-clasping according to population. It is found that in the Digaru Mishmi, the frequencies of L>R and R>L are 57.82% and 42.18% respectively. In the Miju Mishmi, the frequencies of L>R and R>L are 61.65% and 38.35% respectively, whereas in the Idu Mishmi, the frequencies of L>R and R>L are 61.28% and 38.72% respectively. It is found that there is no significant difference (χ^2 =0.8173, d. f. = 2, P>0.05), in respect of hand-clasping, among the three Mishmi populations. Again, when compared between the populations, no significant difference has been found.

Table153: Tongue-rolling by population.

Population	Absent (-ve)		Present (+ve)		Total
	No.	%	No.	%	
Digaru Mishmi	133	63.03	78	36.97	211
Miju Mishmi	125	60.68	81	39.32	206
Idu Mishmi	243	81.82	54	18.18	297

χ^2 (between all populations) =33.2488, d. f. = 2, P<0.05 Significant.
χ^2 (between Digaru and Miju) =0.2447, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =27.6797, d. f. = 1, P<0.05 Significant.
χ^2 (between Digaru and Idu) =22.6341, d. f. =1, P<0.05 Significant.

Table 153 shows the frequencies of tongue-rolling by population. It is found that in the Digaru Mishmi 36.97% of individuals can roll their tongue, whereas 63.03% cannot do so. In the Miju Mishmi, the frequencies are 39.32% and 60.68% respectively. Again, in the Idu Mishmi the frequencies are 18.18% and 81.82% respectively. It is also found that there is significant difference between all the populations (χ^2 =33.2488, d. f. = 2, P<0.05). It is also seen that there are significant difference when Idu Mishmi is compared with Digaru and Miju Mishmi [χ^2 (between Miju and Idu Mishmi) =27.6797, d. f. = 1, P<0.05, χ^2 (between Digaru and Idu) =22.6341, d. f. =1, P<0.05]. There is no significant difference between Digaru and Miju Mishmi.

Table 154: Tongue-folding by population.

Population	Absent (-ve)		Present (+ve)		Total
	No.	%	No.	%	
Digaru Mishmi	173	81.99	38	18.01	211
Miju Mishmi	172	83.50	34	16.50	206
Idu Mishmi	245	82.49	52	17.51	297

χ^2 (between all populations) =0.1715, d. f. = 2, P>0.05 Insignificant.
χ^2 (between Digaru and Miju) =0.1652, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =0.0864, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Digaru and Idu) =0.0212, d. f. =1, P>0.05 Insignificant.

Table 154 shows the frequencies of tongue-folding by population. In the Digaru Mishmi, it is seen that 18.01% of total individuals can fold their tongue, while 81.99% cannot do so. In the Miju Mishmi, 16.50% can fold their tongue, while 83.50% cannot do so. Again, in the Idu Mishmi 17.51% can fold their tongue, while 82.49% cannot do so. It is seen that there is no significant difference between the three Mishmi populations (χ^2 =0.1715, d. f. = 2, P>0.05). It is also seen than there is no significant difference among the populations.

Table 155: Relative length of first and second toe by population.

Population	I>II (T)		II>I (F)		I=II (O)		Total
	No.	%	No.	No.	%	No.	
Digaru Mishmi	90	42.65	65	30.81	56	26.54	211
Miju Mishmi	72	34.95	87	42.23	47	22.82	206
Idu Mishmi	144	48.48	81	27.27	72	24.24	297

χ^2 (between all populations) =14.4545, d. f. = 4, P<0.05 Significant.
χ^2 (between Digaru and Miju) =5.9115, d. f. = 2, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =13.4432, d. f. = 2, P<0.05 Significant.
χ^2 (between Digaru and Idu) =1.7048, d. f. =2, P>0.05 Insignificant.

Table 155 shows the frequencies of relative length of first and second toes by population. It is seen that in the Digaru Mishmi, the frequencies of T, F and O are 42.65%, 30.81% and 26.54% respectively. In the Miju Mishmi, these frequencies are 34.95%, 42.23% and 22.82% respectively, and in the Idu Mishmi, 48.48%, 27.27% and 24.24% respectively. When compared between the populations, it is seen that there is significant difference between the three Mishmi populations (χ^2 =14.4545, d. f. = 4, P<0.05). It is also seen that there is significant difference between Miju Mishmi and Idu Mishmi (χ^2 =13.4432, d. f. = 2, P<0.05).

Table 156: Earlobe attachment by population.

Population	Free		Attached		Total
	No.	%	No.	%	
Digaru Mishmi	118	55.92	93	44.08	211
Miju Mishmi	110	53.40	96	46.60	206
Idu Mishmi	186	62.63	111	37.37	297

χ^2 (between all populations) =4.7729, d. f. = 2, P>0.05 Insignificant.
χ^2 (between Digaru and Miju) =0.2684, d. f. = 1, P>0.05 Insignificant.
χ^2 (between Miju and Idu) =4.2772, d. f. = 1, P<0.05 Significant.
χ^2 (between Digaru and Idu) =2.3058, d. f. =1, P>0.05 Insignificant.

Table 156 shows the frequencies of earlobe attachment by population. It is seen that in the Digaru Mishmi, 55.92% have free earlobe and 44.08% have attached earlobe. In the Miju Mishmi, the frequencies of free and attached earlobe are 53.40% and 46.60% respectively. Again, in the Idu Mishmi, there are 62.63% and 37.37% respectively. It is found that there is no significant difference among the three Mishmi populations (χ^2 =4.7729, d. f. = 2, P>0.05). When compared between the populations, it is seen that there is significant difference between Miju Mishmi and Idu Mishmi (χ^2 =4.2772, d. f. = 1, P<0.05).

CHAPTER - IX
DISCUSSION

The main aim of the physical anthropology is to understand the processes of human evolution and the nature and extent of human variations at both micro and macro-levels. Till the middle of the 20th century, the physical anthropologists were mostly engaged in the taxonomic researches. They mostly used anthropometric and anthroposcopic techniques in their field of study. But since the middle of the 20th century, along with the advent of the science of genetics, the physical anthropologists have diverted their attention to understand the genetic basis of human variations and the processes of microevolution (Washburn, 1953; Laughlin, 1960). According to Wright (1931), evolutions of the present populations refer to the changes in gene frequencies in subsequent generations. Many evolutionary forces, like selection, drift; mutation, etc. are greatly responsible for changes in gene frequencies. It is on the basis that of population genetics is now considered as the backbone of the physical anthropology (Kirk 1978).

From the physical anthropological point of view, the main interest in studying population genetics is to understand the processes of human microevolution and variation. In doing so, physical anthropologists have used genetic markers, dermatoglyphic and anthropometric data with a view to understanding the phylogenetic position of human populations. The differences or dissimilarities between populations within a major racial group in respect of genetic and anthropometric traits are considered the on-going process of human evolution. On the other hand, the on-going process of human evolution is subject to a number of evolutionary forces like mutation, natural selection, genetic drift and gene flow, which act differently in different populations. Understanding of the operation of these evolutionary forces in human populations is of great importance to the human evolutionists, biologists and physical anthropologists. Thus, a large number of studies have been carried out on the evolutionary mechanisms operating in different human populations. In such studies, different demographic, morphological and genetic traits, have been used extensively by many scholars (Crawford, 1973; Harrison, 1977).

With this end in view we have undertaken a study on the Mishmis of Arunachal Pradesh for the present study. The purpose of the present study are to describe the demographic and genetic structure of the population, to find out the effects of evolutionary forces, acting on it and to assess its relationship within the Mishmi subgroups and other neighbouring Mongoloid populations of Northreast India specially from Arunachal Pradesh and Assam. The Mishmi is divided into three endogamous subgroups viz. Idu Mishmi, Digaru Mishmi, and the Miju Mishmi. Idu Mishmi is also locally called as Chulikata, Digaru Mishmi is called as Taraon Mishmi and the Miju Mishmi is known as Kaman Mishmi. The Idus are in Dibang Valley. The Taraons are on the bank of the Lohit river from Hayuliang downwards till it reaches the foothills region and in the Dalai valley. The Kaman Mishmi occupies the valleys of the upper Lohit, the Kamlang and the Lati. All Mishmis are settled in Dibang valley, Lohit Valley and the Anjaw districts of Arunachal Pradesh. All the three Mishmi dialects have an affinity to each other in spite of the dialectical variations (Grewal, 1997). According to J P Mills (1952), the Chulikata Mishmi (Idu), found in the north and west of the (undivided) Lohit (District), were the first to come from Burma. They were followed by the ancestors of the Digaru Mishmi, a little over 500 years ago in small batches over the passes, following the courses of Dibang and its tributaries, and have lived as close neighbours of the Chulikata for a long time. The Miju, who came last, preserved the tradition of having migrated from the direction of 'Hakamtilong' or the Kachin country seem to stand a little apart.

In the present study we have taken demography, anthropometry, four genetic markers viz. ABO, Rh blood groups, PTC (phenylthiocarbamide) taste blindness and colour blindness, dermatoglyphics and morphological traits with a view to understand the genetic composition of the Mishmi subgroups as well as their genetic relationship with other neighbouring Mongoloid populations. In view of the present findings on the Mishmis of Arunachal Pradesh, it is necessary to look into three important aspects. The first aspect is related to inter-sub group variation within

the Mishmi populations. The second is concerned with the relationship of all the Mishmi subgroups with other neighbouring Mongoloid populations, and the third is related to the possible role of evolutionary forces like selection and genetic drift in all the Mishmi subgroups. These may be summarized as follows:

On the basis of the genetic data presented in the previous chapters, the Mishmi subgroups of the present study, i.e., the Digaru Mishmi, the Miju Mishmi and the Idu Mishmi are by and large similar (in respect of all the genetic markers considered for the present study i.e., the ABO and Rh (D) blood groups Rh factor, colour blindness as well as the PTC taste blindness sensitivity). Anthropometry and dermatoglyphic traits show that they stand quite apart upto a certain extent. In respect of anthropometry Miju Mishmi stands closer to the Digaru Mishmi but apart from the Idu Mishmi. Though the two dendrograms drawn for the two sexes show two different pictures, however, in respect of this, males are closer to each other. The point to note that we have drawn different dendrograms i.e. based on anthropometric traits, genetic markers and dermatoglyphic traits, and each of the these dendrograms shows different types of relationships among the Mishmi subgroups and also with other populations compared. The anthropometric characters are influenced to a certain extent by the environment and the dermatoglyphic characteristics are polygenetic in nature. Therefore, the dendrograms drawn in respect of the anthropometric and the dermatoglyphic traits show that the different results i.e. three sub groups of the Mishmi stand apart from each other.

We shall examine all the findings on the three Mishmi subgroups in the light of the data available on other neighbouring Mongoloid populations of Northeast India especially from Arunachal Pradesh and Assam.

In the preceding chapters we have presented our findings on the three different Mishmi subgroups. In the present chapter we shall examine all the findings on the three Mishmi

subgroups in the light of the data available on other Mongoloid populations of Northeast India especially from Arunachal Pradesh and Assam.

The demographic structures of the Mishmi subgroups have been discussed in chapter III. It is observed that all the three subgroups of the Mishmi appear to be of progressive type according to the Sundberg's classification of population. In all the three Mishmi populations the overall sex ratio is found to be very near to the ideal sex ratio of 1:1, though they are slightly tilted in favour of females. The sex ratio in Assam is 923 females per 1000 males (1:0.92) and in Arunachal Pradesh is 901 females per 1000 males (1:0.90) and the overall sex ratio in India is 927 females per 1000 males (1:0.93), (North Eastern Council, 1995). It shows that sex ratio among the Digaru Mishmi is certainly near to the ideal one (1:1.04) than what has been reported for various populations and states of India. However, the sex ratio of the Miju Mishmis (1:08) and that the Idu Mishmi (1:1.10) have found to be higher than all other populations compared.

Marriage among the Mishmi is found to be very stable in general. It is observed that only 7.57% of all married individuals have changed their mates. The frequency of male married individuals who have changed their mates is found about three times higher than the females. In comparison to the Semsa of North Cachar Hills of Assam (12.04%), this frequency is slightly less. When compared among the three subgroups of the Mishmi, it is found that the marriage is most stable among the Idu Mishmi and least stable among the Miju Mishmi. Comparison between the sexes among the Mishmi populations have shown that changing of the mate is very rare among the females, where 5.46% of Digaru, 6.15% of Miju and only 0.83% of the Idu females have changed their mates whereas among the males it is 12.68%, 17.00% and 6.12% respectively. Polygyny is common among the Miju Mishmi (Zahid Hussain, 1995) and monogamy among the Idu Mishmi (Datta Choudhury, 1995). However, polygyny is permitted among all the Mishmi subgroups. This holds good with the present findings on the multiple marriages. Divorce is found among all the Mishmi populations. Adultery, impotency, sterility

and maladjustment are the main grounds on which divorce is sought. Widows and widowers are permitted to remarry. In general, the Mishmi communities are divided into many clans and sub-clans, which are strictly exogamous. The main function of these clans is to regulate the marriage alliances. Violation of the clan exogamy is punishable.

Regarding the fertility of the Mishmi populations, it is seen that there is not a single Mishmi woman above 45 years who is unmarried. It is further observed that the average live birth among the Digaru, Miju and the Idu Mishmi are 4.01, 4.64 and 3.86 respectively. So, there is not much variation among the three Mishmi populations in respect of the average number of live birth. The Mean number of live births for Digaru Mishmi woman married once is 3.35±0.15 and married more than once, is 2.60±0.60. The completed fertility size among the Digaru Mishmi is found to be 4.19 surviving children per mother and the average number of live births per mother is 6.12. The mean number of live births for Miju Mishmi woman married once is 4.20±0.23 and married more than once is 4.88±0.64. The completed fertility size among them is found to be 4.13 surviving children per mother and the average number of live births per mother is 6.48. The mean number of live births for Idu Mishmi women married once is 3.31±0.21 and for women married more than once 4±0.00. The completed fertility size among them is 4.03 surviving children per mother and the average number of live births per mother 4.86. The completed fertility size among the Semsa is 4.76 (Limbu, 1996), among the Kota is 3.67 (Ghosh, 1976) and Basu (1969) has reported among the Pahira is 6.38 and 6.18 live births per mother in the South Pahira I & II respectively. So, it shows that, in comparison to Semsa and the Pahira, the completed fertility size is lesser but they are considerably greater compared to the Kota of Nilgiri Hills. Khongsdier (1992) has reported the completed family size among the Pnar of Jaintia hills to be 6.98 live births per mother. So, it shows that the completed fertility size among the Mishmi populations is not as high as found among the Pnar populations of Jaintia Hills. Khongsdier (1993) has also reported that the completed fertility size between the two sections of

the War Khasi, among the Christian War Khasi the completed family size is 6.69 live births per mother and that of the non-Christian War Khasi 6.61 live births per mother. So, the completed fertility size among the Mishmi populations in general is slightly lower than those sections of the War Khasi. It may also be noted that Roberts (1956) has reported the completed fertility among the Dinka is about 5.38 children per family, which is lower than that found among the Mishmi of Arunachal Pradesh. It has been observed that the completed fertility size of the Mishmi populations is lower compared to other populations but not as low as the Kota of Nilgiri Hills.

The child-woman ratio (fertility ratio) among the Digaru, Miju and Idu Mishmi are found to be 43.07, 27.49 and 37.43 respectively, which are lower than the Semsa (50.23) as reported by Limbu (1996) as well as the Pahira of Ajodhya hills (Basu, 1969) in which the North Pahira show 74.24, the South Pahira I 68.57 and the South Pahira II 74.24. The fertility ratio among the Kota of Nilgiri Hills (Ghosh, 1976) is found to be 62.17. Khongsdier (1992) reported that the fertility ratio among the Pnar of Jaintia Hills is as high as 86.96. Roberts (1956) has reported that the fertility ratio among the Dinka is 78.0. So, it shows that in comparison with the above data compared on child women ratio from different populations compared, the Mishmi populations have very low value. The reason for such low child-women ratio is that the infant and child mortality rate especially among the Digaru and the Miju Mishmi is very high.

The overall mortality rate, based on live births, is found to be 22.77%, 23.37% and 10.80% among the Digaru Mishmi, Miju Mishmi and Idu Mishmi respectively. The child-women mortality rate (i.e., death before 15 years of age) is found to be 21.12%, 21.74% and 8.29% among the Digaru, Miju and the Idu Mishmi populations. Among the Semsa (Limbu, 1996) the overall mortality rate, based on all live births, is reported to be 35.73% and the child mortality rate (i.e., death before 15 years of age) is found to be about 31.60%, which is higher than that of the Mishmi populations. Khongsdier (1993) has reported that the child mortality rate among the Christian War Khasis are 10.57% and among the Non-Christian War Khasi is

12.19%. Das and Das (1982) have reported that the child mortality rates among the Mongoloid, Muslim and Hindu populations of Assam are 11.43%, 14.24% and 15.49% respectively. Barua (1982) has reported that the child mortality rate among the Hajong of Meghalaya is 15.6%, which is less than that of the Digaru and the Miju Mishmi but more than that of the Idu Mishmi.

The frequency of reproductive wastage (stillbirth and abortion together), based on the total number of pregnancies, is found to be 1.68%, 1.74% and 1.44% among the Digaru, Miju and the Idu Mishmi respectively. Among all the Mishmi populations, the frequency of reproductive wastage is found to be very low compared to other populations. Among the Semsa of North Cachar Hills of Assam the reproductive wastage is observed by Limbu (1996) is to be 5.90%, among the Kota of Nilgiri Hills, (Ghosh, 1976) reported to be 8.34%, Christian War Khasi and non- Christian War Khasis as reported by Khongsdier (1993) are 7.68% and 8.09% respectively. Das and Das (1982) have found that the frequency of reproductive wastage is 2.87% among the Assamese Hindu castes, where as it is 2.55% among the Mongoloid populations and 1.64 % among the Muslims of Assam. So, among all the Mishmi populations, the fertility as well as the mortality and the reproductive rates are very low.

From the evolutionary point of view the change due to random drift is very important. Wright (1940) has said that the differentiation due to drift for a gene frequency depends upon the coefficient of breeding isolation (N_{em}) and the admixture rate (m). Roberts (1956) says, "For a gene frequency in the total population of 0.5, there is very great differentiation of local gene frequencies where N_{em} is less than 0.5; there is an important differentiation where N_{em} is less than 5, but differentiation is slight if N_{em} is greater than 50." In case of the all the Mishmi populations, the value of N_{em} is found to be zero, which indicates that differentiation in gene frequencies due to random genetic drift is appreciably great.

The variance due to drift (σ^2_{dq} , where q=0.5) among all the Mishmi populations is found to be 0.001168, 0.001126 and 0.000776 among the Digaru, Miju and the Idu Mishmi respectively. But variance due to random genetic drift has been calculated on the basis of the assumption that there would be no mutation, selection and admixture in the population. It is extremely difficult to rule out that either mutation or selection or both are not acting on this population. So, it is extremely difficult to make any critical estimate on this result.

The index of opportunity for selection is operating in this population has been calculated according to the formula given by Crow (1958) as well as by the modified formula of Johnston and Kensinger (1971). According to Crow's formula of 1958, the index of total selection intensity (I) is 0.3479, 0.4516 and 0.2067 among the Digaru, Miju and the Idu Mishmi populations respectively. The mortality (I_m) in these populations are 0.4252, 0.4950 and 0.2535 respectively and fertility (I_f) being 0.0902, 0.1613 and 0.1003 among the Digaru, Miju and the Idu Mishmi respectively. In all the populations it shows that selection is operating through differential mortality than through differential fertility. The selection is operating moderately in this population.

Sengupta and Kalita (1996) have compiled all results of selection intensity, calculated according to Crow's formula, on the so far studied populations of North-East India. It is seen that the Index of total selection intensity varies between 1.070 among the Gallong of Arunachal Pradesh (Chakravarty and Ahmed, 1989) and 0.1824 among the urban Ahom of Assam (Sengupta and Kalita, 2001). The fertility component varies between 0.3100 among the Bengali Muslim of Cachar (Chakravarty, 1976a) and 0.1130 among the Khampti (Sarkar *et al.*, 1994). Considering the range for the North-East Indian population, the Mishmis stand in the middle.

In the present study we have also calculated the total selection intensity among the Mishmi populations according to the formula given by Johnston and Kensinger (1971). The total

intensity (I) is found to be lower in the Crow's formula compared to formula given by Johnston and Kensinger (1971). The Index of selection due to embryonic mortality (I_{me}) among the Digaru, Miju and the Idu Mishmi are recorded as 0.1162, 0.0652 and 0.0553 respectively, which is higher than the Semsa of North Cachar Hills District of Assam as found by Limbu (1996),

Anthropometry:

We have considered 13 anthropometric measurements on the Mishmi populations. The anthropometric measurements have revealed that the Digaru and the Idu Mishmi are short in stature with dolichocephalic, platyrrhine, having broad chest and very broad face. The Miju Mishmi shows similarity to the above two Mishmi populations excepting mesocephalic head. It is seen that the Idu Mishmi differs significantly from the Digaru Mishmi in respect of the height vertex, chest girth, nasal height, nasal breadth and the bigonial breadth. When compared between the Miju and the Digaru Mishmi, they differ significantly in the following characters: height vertex, sitting height vertex, head breath, bizygomatic breadth and the mid-arm-circumference. Idu Mishmi differs significantly from the Miju Mishmi in respect of height vertex, sitting height vertex, head breadth, least frontal breadth, nasal breadth, nasal height, bigonial breadth and the mid-arm-circumference. The dendrogram constructed by following the method given by Nei *et al.* (1983) shows that in respect of the anthropometric characters, the Miju Mishmi remains apart from the remaining Mongoloid populations of Arunachal Pradesh and Assam considered for the present study. However, they show closeness to the Monpas. The Digaru Mishmi also remains apart from most of the Mongoloid populations compared. However, this population shows some closeness to the Kalaktang Monpa, Khampti, Gallong, Miju Mishmi, Tawang and the Dirang Monpas. When compared within the three Mishmi subgroups, the Miju Mishmi is seen in the same cluster but the Idu Mishmi is in different cluster. The distance Matrix calculated by Nei's distance method shows that the Idu Mishmi is closer to the Miju Mishmi but stands apart from

the Monpa and the Gallong. Digaru Mishmi shows closeness with the other two Mishmi subgroups.

Genetic Markers

In the present study we have taken four genetic markers viz. ABO, Rh blood groups, phenylthiocarbamide taste blindness and colour blindness with a view to understanding the genetic composition of the Mishmi subgroups as well as their genetic relationship with other Mongoloid populations of Arunachal Pradesh and Assam. Only in respect of the Rh blood group, all the subgroups of the Mishmi are in genetic equilibrium but not in respect of ABO blood group and phenylthiocarbamide taste blindness. None of the subjects were found to be colourblind.

Among the Digaru, Miju and the Idu Mishmi, the ABO blood group incompatibility matings are found to be 28.72%, 38.05% and 35.99% respectively. However, the frequency of Rh- blood group is less than 1%, so incompatible mating in respect of Rh system which cannot be significant among the Mishmis. So, the selection put pressure only through ABO blood group system and not through the Rh-system.

The phenotypic frequencies between I and II, I and III and II and III generations, in respect of ABO and non-taster allele t, have been calculated and in all the subgroups of the Mishmi and no significant differences in respect of these genetic markers between generations is observed. Though genetic drift does not seem to be operating in these populations, but other evolutionary forces like selection, etc may play important role in regulating the gene frequencies in the present populations.

According to J.P. Mills (1952), all the three subgroups of the Mishmi have come to the present Lohit valley and the Dibang valley districts of Arunachal Pradesh about 500 years ago from the Kachin country. The genetic markers viz. ABO blood groups and PTC taste blindness

have been taken into consideration to find out if there is any genetic relationship among these three subgroups as well as with other Mongoloid populations of Arunachal Pradesh and Assam. The dendrogram (Fig. 16) shows that the three Mishmi subgroups are closer to each other than remaining Mongoloid populations compared for the present study. So, on the basis of the above genetic markers considered, the three sub populations of Mishmi resemble each other which supports the statement of J.P. Mills (1952).

Dermatoglyphics

The finger patterns show that frequency of loop is highest among the Digaru Mishmi whereas whorl is highest among the Idu and the Miju Mishmis. The findings on the three Mishmi subgroups have been compared among themselves as well as with the other Mongoloid populations of Arunachal Pradesh and Assam. The dendrogram constructed in respect of the finger pattern and the pattern intensity index shows that the three Mishmi (male) subgroups stand apart from each other. The Digaru Mishmi males are closer to Mishing, Khamyang, Ahom, Moran, Singpho, Nocte etc, the Miju Mishmi is closer to the Lalung, Tangsa, Nishi, Wancho, Khampti, Chutia etc. and the Idu Mishmi is closer to the Tawang Monpa, Tagin, Aka, Gallong etc.

The Dendrogram on the finger patterns and the pattern intensity index (Fig. 26) of female Mishmi show that they resemble more to each other than as shown by the males. This dendrogram further shows that the Digaru Mishmi is closer to the Gallong, Singpho, Khampti, Wancho etc.; the Miju Mishmi is closer to the Moran, Wancho, Khampti, etc.; and the Idu Mishmi is closer to the Nishi, Khowa, Moran, Minyong etc.

Though the two dendrograms drawn for two sexes show two different pictures, however, in respect of this trait, male Mishmis are closer to each other. The point to note that we have different dendrograms based on anthropometric traits, genetic markers and dermatoglyphic traits,

and each of the these dendrograms show different types of relationships among the Mishmi subgroups and also with other populations compared.

Morphological and behavioural traits

We have considered two different morphological and four behavioural traits in this study. Though this trait is less important for population genetical study, but Salzano (1961), has suggested that such morphological and behavioral traits are of some value in population genetical study. So, we have considered such data for the present study. The frequency of L>R is observed to be greater than the R>L, in respect of both arm-folding as well as hand-clasping. Significant difference was observed in arm-folding but not in hand-clasping within the Mishmi population. Most of the Mishmi individuals neither can roll nor fold their tongues and no significant difference was seen among these populations in respect of this trait. In respect of the Relative length of the first and the second toe, the frequency of I>II (T), II>I (F) and I=II (O) is highest among the Digaru Mishmi, followed by the Idu Mishmi. In case of the Miju Mishmi the frequency of II>I (F) is highest followed by I>II (T). I=II (O) is present in the least frequency. In respect of relative length of first and second toes, Digaru Mishmi shows insignificant difference with both the Miju Mishmi and the Idu Mishmi. Miju shows significant difference with the Idu. Among all the three Mishmi populations the frequency of free earlobe is greater than the attached one and no significant difference was observed among the three Mishmi populations in respect of this trait. Between the Miju and the Idu Mishmi a significant difference was seen. We have also used this data to find out variations between generations and it is seen that in respect of these morphological and the behavioural traits no significant difference is noticed between the generations. It reveals that the effect of genetic drift, on the basis these morphological and behavioural traits are not significant in these populations.

When compared with other mongoloid populations of Northeast India, in respect of hand clasping, Digaru Mishmi shows significant difference from all other populations excepting the Minyong and the Pasi .In this trait the Miju Mishmi and the Idu Mishmi show resemblance only with the Pasi. In respect of arm-folding the Digaru Mishmi and the Miju Mishmi show significant difference with all other populations compared excepting the Ahom whereas the Idu Mishmi shows resemblance only with the Minyong of Arunachal Pradesh. In respect of Tongue-rolling the Digaru Mishmi shows significant difference with all other mongoloid populations excepting the Chutia, and the Moran whereas Idu differs with all the mongoloid populations compared. In respect of tongue folding all the Mishmi subgroups show significant difference with all other populations compared.

Demographic data suggest that the Effect of the evolutionary forces like selection etc. may be playing important role in regulating the gene frequencies in the Mishmi populations. This has been further elucidated through the finding of incompatible matings in respect of ABO blood group system. Dendrogram constructed on the basis of ABO blood group and PTC taste blindness, Mishmi subgroups resemble to each other. But the χ^2 test shows significant difference among them. However, on the basis of all morphological, behavioural, dermatoglyphic and anthropometric traits, the three Mishmi subgroups do not resemble each other and each of them shows different types of relationship among themselves.

According to J. P. Mills (1952), all the three subgroups of the Mishmi have come to the present Lohit valley and Dibang valley Districts of Arunachal Pradesh about 500 years ago from the Kachin country in different batches and have lived in isolations. Each of the batch of the Mishmi formed separate Mishmi subgroups which did not represent the random sample of the original stock. Consequently in whatever proportions of the genes the original settlers of the three Mishmi subgroups initially carried with them, are maintained more or less in the same frequencies for the last 500 years as no admixture was found. So, there is possibility that present

Mishmi subgroups evolved from the original splinter groups, and whatever changes occur must have been due to effect of selection. These subgroups survive through the time to form the present populations. As the three Mishmi populations maintained isolation for several generations, in the process of time they must have formed separate populations culturally, as well as genetically.

CHAPTER - X
SUMMARY

Since the middle of the 20th century, along with the advent of the science of genetics, the physical anthropologists have diverted their attention from taxonomic researches to understand the genetic basis of human variations and the processes of microevolution. The differences and similarities between populations within a major racial group in respect of genetic and anthropometric traits are considered the ongoing process of evolution. On the other hand, the ongoing process of human evolution is subject to a number of evolutionary forces which act differently in different populations. Understanding of the operation of these evolutionary forces in human populations is of great importance to the evolutionists, biologists and physical anthropologists.

With this end in view we have undertaken a study on population genetics among the Mishmis of Arunachal Pradesh with the following objectives:

1. To describe the demographic and genetic structure of the population;
2. To find out the effects of evolutionary forces, acting on it; and
3. To assess its relationship with other neighbouring Mongoloid populations.

The Mishmi is a schedule tribe of Arunachal Pradesh which is divided into three endogamous subgroups viz. Idu Mishmi, also known as Chulikata; Digaru Mishmi, locally known as Taraon; and the Miju Mishmi known as Kaman. The Idus inhabit the Dibang Valley district. The Digarus and the Miju are settled in Lohit district of Arunachal Pradesh.

All the three Mishmi dialects have an affinity to each other in spite of their dialectical variations (Grewal, 1997). These dialects belong to Tibeto-burman family of speeches. The Mishmi are dived into clans and larger clans are again subdivided into sub-clans. The Mishmis follows clan exogamy. Traditionally, Mishmis believe in animism. The main economic resources of the Mishmi are land, forest and water. They are primarily farmers and practice jhum, terrace and wet form of cultivation. Monogamy is the norm of marriage. It is, however, permissible for a man to marry more than one woman if he can afford it.

According to J. P. Mills (1952), the Chulikata Mishmi (Idu), was the first to come from Burma. They were followed by the ancestors of the Digaru Mishmi, a little over 500 years ago and have lived as close neighbours of the Chulikata for a long time. The Miju, who came last, seem to stand a little apart.

The findings of the present study may be briefly summarized as follows:

Demography

1. According to the Sundberg's classification of population, the Digaru Mishmi, Miju Mishmi and Idu Mishmi are of Progressive type.
2. It is seen that among the Digaru Mishmi, nearly 19.51% of males and 17.07% of females belong to the age group 0-14 years, whereas about 23.96% of males and 28.98% of females belong to the reproductive age group 15-49 years. In the post-reproductive age group, i.e., 50+ years, 5.59% and 4.88% are males and females respectively.

   Among the Miju Mishmi, nearly 17.89% of males and 17.89% of females belong to the age group 0-14 years, whereas about 24.19% of males and 29.13% of females belong to the reproductive age group 15-49 years. In the post-reproductive age group, i.e., 50+ years, 5.96% and 4.94% are males and females respectively.

   Among the Idu Mishmi, nearly 19.39% of males and 18.50% of females belong to the age group 0-14 years, whereas about 24.20% of males and 30.43% of females belong to the reproductive age group 15-49 years. In the post-reproductive age group, i.e., 50+ years, 3.91% and 3.56% are males and females respectively.
3. The sex ratio among the Digaru Mishmi is found to be 1:1.04, among the Miju Mishmi is 1:1.08, and among the Idu Mishmi is 1:1.10. It shows that in all these three Mishmi populations, the number of females is higher than that of males.

4. It is seen among the Digaru Mishmi that in the pre-reproductive age group, i.e., 0-14 years, the sex ratio is 1:0.88 which means that number of males are slightly more than that of females. But in the reproductive age group i.e., 15 - 49years, it is seen that the sex ratio (1:1.21) is tilted in favour of females, whereas in the post-reproductive age group i.e., 50+years, the sex ratio (1:0.87) is again tilted in favour of males. It shows that the average longevity is slightly higher in males than in females.

   Among the Miju Mishmi, the sex ratio in the pre-reproductive age group, i.e., 0-14years, is 1:1, which is ideal sex ratio and shows that the number of males are equal to the number of females. But, in the reproductive age group i.e., 15-49 years, it is seen that the sex ratio (1:1.20) is tilted in favour of females. Again, in the post-reproductive age group i.e., 50+years, the sex ratio (1:0.83) is slightly tilted in favour of males. It shows that the average longevity is slightly higher in males than in females.

   Among the Idu Mishmi, the sex ratio in the pre-reproductive age group is 1:0.95, which indicates that the number of males is higher than that of females whereas in the reproductive age group the sex ratio (1:1.26) is tilted in favour of females. In the post-reproductive age group, the sex ratio (1:0.91) again seems to be tilted in favour of males. It indicates that the average longevity is higher in males than in females.

5. The population pyramids shows the distribution of the three Mishmi populations by age groups. The population pyramid for Digaru Mishmi shows that, in general, the base is broader and shrunk as we move to higher age group. So, it indicates that the present population is progressive.

   The pyramid for Miju Mishmi indicates that at age group 0-4 years, it is broad and it is broader at the age group 5-9 years. In general, the base of the pyramid is broader and gradually shrunk as we move on to higher age groups. Therefore, it shows that the

population is progressive in nature. The pyramid for Idu Mishmi too indicates that the population is progressive.

6. In the Digaru Mishmi, the mean age at marriage for males and females is found to be 25.84±0.25years and 20.73±0.25years respectively; in Miju Mishmi, they are 25.56±0.48years and 19.86±0.26years respectively; and it is 25.56±0.45years and 20.07±0.23years respectively in the Idu Mishmi males and females.

7. The mean age at first child birth for males and females is 26.87±0.33years and 21.40±0.22years in the Digaru Mishmi; 27.86±0.40years and 22.09±0.17years in the Miju males and females; and it is 27.88±0.37years and 22.17±0.15years respectively in Idu males and females.

8. Following the method, suggested by Glass (1956), we have taken 24years as a generation length for the Digaru Mishmi and 25 years for both Miju Mishmi and Idu Mishmi.

9. It is found that among the Digaru Mishmi the frequency of multiple marriages in the third generation i.e., upto 24 years, is found to be nil in both males and females, whereas in the second generation (i.e., 25-48 years), 6.52% of males and 5.09% of females have married more than once. In the first generation i.e., 49+ years, 31.58% of males and 11.43% of females have married more than once. So, it shows that males have greater tendency to change their mates than their female counterparts.

   Among the Miju Mishmi, the frequency of multiple marriages in the third generation i.e., upto 25 years, not a single case of multiple marriage has been found, whereas in the second generation (i.e., 26-50 years), 11.67% of males and 6.52% of females have married more than once. In the first generation i.e., 51+ years, 26.32% of males and 6.67% of females have married more than once. So, it shows that males have greater tendency to change their mates than their female counterparts.

Among the Idu Mishmi, not a single case of multiple marriages in both the sexes was found in the third generation i.e., upto 25 years. In the second generation (i.e., 26-50 years) only 4.37% of males are found to have married more than once while no such case is found in the females. In the first generation i.e., 51+ years, 12.50% of males and 5% of females have married more than once. So, it indicates that the males have greater tendency to change their mates than their female counterparts.

10. Using binomial test of proportion, in respect of multiple marriages, it is seen that there is significant difference between male and female in all the three Mishmi populations.

11. Completed fertility size among the Digaru, Miju and Idu Mishmi are 6.12, 6.48 and 4.86 respectively. The average number of surviving offspring per mother, aged 45+ years, among the Digaru, Miju and Idu Mishmi are 4.19, 4.13 and 4.03 respectively.

12. The child-woman ratio among the Digaru Mishmi is found to be 43.07; among Miju Mishmi is 27.49 and; among the Idu Mishmi, the ratio is 37.43.

13. The overall average live-birth per mother among the Digaru Mishmi is 4.01, among the Miju Mishmi is 4.64 and among the Idu Mishmi is 3.86.

14. The overall mortality rate among the Digaru Mishmi is 22.77%; among the Miju Mishmi is 23.37%; and among the Idu Mishmi is 10.80%.

15. The overall child mortality rate (i.e., those died before 15years of age) among the Digaru Mishmi is found to be 21.12%. 10.56% died before completing one year, 5.12% died between 1 and 4 years, 3.30% died between 5 and 9 years and 2.14% died between 10 and 14 years.

    The overall child mortality rate among the Miju Mishmi is 21.74%. 13.22% died before completing one year, 6.16% died between 1 and 4 years, 1.09% died between 5 and 9 years and 1.27% died between 10 and 14 years. Probably this is the reason for shrinking of the base of the pyramid for Miju Mishmi.

The overall child mortality rate among the Idu Mishmi is 8.29%. 6.28% died before completing one year, 0.50% died between 1 and 4 years, 0.50% died between 5 and 9 years and 1% died between 10 and 14 years.

16. Among the all three Mishmi populations, the breeding size, effective population size, coefficient of breeding isolation and variance due to drift have been calculated on the basis of all these demographic information.

16a. Out of total Digaru Mishmi individuals of 697, only 267 i.e., 38.31% actually constitute the breeding size. Out of total population of 587 of which 212 individuals i.e., 36.16% actually constitute the breeding size in Miju Mishmi and out of total Idu Mishmi population of 562, only187 individuals i.e., 33.27% actually constitute the breeding size.

16b. The effective population size among the Digaru Mishmi is 214. It means that 30.70% of the total population size and 80.15% of the breeding size constitute the effective population size.

The effective population size among the Miju Mishmi is 111. It means that 18.91% of the total population size and 52.36% of the breeding size constitute the effective population size.

The effective population size among the Idu Mishmi is 161. It means that 28.65% of the total population and 86.10% of the breeding size constitute effective population size.

16c. According to the formula given by Wright (1940), the variance due to random genetic drift in a population per generation, in absence of migration, selection and mutation, has been calculated among all the Mishmi populations. It is found that among the Digaru Mishmi, the variance due to random genetic drift per generation is 0.001168 with an initial gene frequency of 0.5. Among the Miju

Mishmi, the variance due to random genetic drift per generation is 0.001126 with an initial gene frequency of 0.5. Among the Idu Mishmi, the variance due to random genetic drift per generation is 0.000776 with an initial gene frequency of 0.5.

17. One of the most powerful evolutionary forces is selection, which brings about changes in the genetic make up of the population. The total selection intensity among all the three Mishmi populations has been estimated by using the formula of Crow (1958) and also by the modified formula of Johnston and Kensinger (1971).

17a. According to Crow's formula, among the Digaru Mishmi, the total selection intensity (I) is 0.4687 and its fertility component (I_f) and mortality component (I_m) are 0.0902 and 0.3472 respectively. Among the Miju Mishmi, the total selection intensity (I) is 0.6363 and its fertility component (I_f) and mortality component (I_m) are 0.1613 and 0.4090 respectively. The total selection intensity (I) is 0.2313 and its fertility component (I_f) and mortality component (I_m) are 0.1003 and 0.1191 respectively among the Idu Mishmi.

17b. According to Johnston and Kensinger's modified formula, among the Digaru Mishmi, the total selection intensity (I) is 0.4084. Its fertility and mortality components (I_f and I_m) are the same as found earlier. But its embryonic component (I_{me}) is 0.1162. Among the Miju Mishmi, the total selection intensity (I) is 0.3991 and its embryonic component (I_{me}) is 0.0652 and among the Idu Mishmi, the total selection intensity (I) is 0.2356 and the embryonic component (I_{me}) is 0.0553.

18. The age-specific fertility rate is higher in Miju, followed by Idu and Digaru Mishmi. In the Digaru Mishmi, the age-specific fertility rate increases upto the mothers aged

20-24years, whereas, in the Miju and Idu, it increases upto the mothers aged 25-29years.

Anthropometry

1. Altogether 13 anthropometric measurements have been taken on the adult Mishmi males as well as females, aged between 20 years and 62 years. The detail results of all these measurements and the indices have been given in the tables. On the basis of these anthropometric measurements it found that the Digaru Mishmi males are mostly of short statured people with dolichocephalic type of head, platyrrhine nose and broad chest. The jugo-frontal and jugo-mandibular indices indicate that they have got very broad face. Digaru Mishmi females are mostly of below medium statured, dolichocephalic, platyrrhine and have broad chest. The jugo-frontal and jugo-mandibular indices indicate that they have got very broad face.

   Miju Mishmi males are mostly of short statured, mesocephalic, platyrrhine and with medium chest. The jugo-frontal and jugo-mandibular indices show that they have got very broad face. Miju Mishmi females are generally below medium statured, mesocephalic, mesorrhine and have broad chest. The jugo-frontal and jugo-mandibular indices show that they have very broad face.

   In general, Idu Mishmi males are short statured, mesocephalic, platyrrhine and have medium chest. The jugo-mandibular and jugo-frontal indices show that they have very broad face. In general, Idu Mishmi females are short statured mesocephalic, platyrrhine and have broad chest. The jugo-frontal and jugo-mandibular indices indicate that they have very broad face.

2. The distances measures calculated on the basis of the values for 12 anthropometric measurements among 22 populations include all the Mishmi subgroups. The distance

measures, calculated on the basis of the values for 12 anthropometric measurements among all the Mishmi subgroups shows that the least distance is observed between the Digaru and Miju Mishmi (3.44) followed by the Digaru and Idu Mishmi (3.91). Miju and Idu Mishmi show the maximum distance i.e. 6.11

Having based on these distances a dendrogram has been constructed which shows that the Miju Mishmi is closer to the Dirang and Tawang Monpas. The Digaru Mishmi shows closeness with the Khampti, Gallong, Miju Mishmi and all the Monpa subgroups, whereas the Idu Mishmi stands closer to the Tangsa.

Genetic Markers

In the present study we have used four genetic markers viz., ABO and Rh blood groups, PTC taste blindness and colour blindness.

1. It is seen that among the Digaru Mishmi, the frequencies of A, B, AB and O blood groups are 23.36%, 16.82%, 0.93% and 58.88% in males and 39.42%, 9.62%, 47.12% and 3.85% in females respectively. The gene frequencies p, q and r are 0.1305, 0.0936 and 0.7759 in males, and 0.2424, 0.0696 and 0.6840 in females respectively.

   Among the Miju Mishmi, the frequencies of A, B, AB and O blood groups are 27.45%, 22.55%, 3.92% and 46.08% in males, and 26.92%, 19.23%, 7.96% and 46.15% in females respectively. The gene frequencies p, q and r are 0.1722, 0.1430 and 0.6848 in males, and 0.1900, 0.1441 and 0.6659 in females respectively.

   Among the Idu Mishmi, the frequencies of A, B, AB and O blood groups are 22.73%, 25.32%, 0.65% and 51.30% in males, and 27.97%, 22.38%, 1.40% and 48.25% in females respectively. The gene frequencies p, q and r are 0.1259, 0.1410 and 0.7331 in males, and 0.1611, 0.1282 and 0.7107 in females respectively.

2. Among the Digaru Mishmi, the frequencies of Rh^+ and Rh^- blood groups are 100% and 0.00% in males, and 99.04% and 0.96% in females respectively. The frequencies of D and d genes in females are 0.902 and 0.098 respectively.

   Among the Miju Mishmi, the frequencies of Rh^+ and Rh^- blood groups are 95.10% and 4.90% in males, and 94.23% and 5.77% in females respectively. The frequencies of D and d genes are 0.7786 and 0.2214 in males and 0.7598 and 0.2402 in females respectively.

   Among the Idu Mishmi, the frequencies of Rh^+ and Rh^- blood groups are 92.86% and 7.14% in males, and 100% and 0.00% in females respectively. The frequencies of D and d genes in males are 0.7328 and 0.2672 respectively.

3. The frequencies of tasters and non-tasters in Digaru Mishmi are 54.21% and 45.29% in males and 54.81% and 45.19% in females respectively. The frequencies of T and t genes are 0.3233 and 0.6767 in males, and 0.3278 and 0.6722 in females respectively. The frequencies of tasters and non-tasters in Miju Mishmi are 48.04% and 51.96% in males and 48.08% and 51.92% in females respectively. The frequencies of T and t genes are 0.2792 and 0.7208 in males and 0.2794 and 0.7206 in females respectively. The frequencies of tasters and non-tasters in Idu Mishmi are 61.69% and 38.31% in males and 60.84% and 39.16% in females respectively. The frequencies of T and t genes in males are 0.3810 and 0.6190 and in females, they are 0.3742 and 0.6258 respectively.

4. Among all the three Mishmi populations, not a single colour blind individual is found.

5. Among the Digaru Mishmi, about 28.72% of all matings are found to be incompatible on the basis of ABO blood groups.

Among the Miju and the Idu Mishmi, about 38.05% and about 35.99% of all matings are incompatible.

6. It may be postulated that selection finds an ample opportunity to play its role through ABO incompatibility.

7. As per suggestions of Glass (1956), the intergeneration differences in respect of both ABO blood groups and PTC taste blindness have been worked out among the Digaru Mishmi, Miju Mishmi and Idu Mishmi respectively. It is found that no significant difference between generations is noticeable. Under such circumstances, Glass (1956) has suggested that drift in a given population might have occurred more than three generations ago.

8. Inter-population differences have been worked out in respect of ABO blood group, Rh blood group and PTC taste blindness. It is observed that in respect of ABO blood group the inter-population differences, when tested by χ^2, are found to be statistically significant [χ^2 (between all populations) = 20.0843, d. f. = 6, $P<0.05$; χ^2 (between Digaru and Miju) =8.2084, d. f. = 3, $P<0.05$; χ^2 (between Miju and Idu) =10.4721, d. f. =3, $P<0.05$; χ^2 (between Digaru and Idu) =10.4771, d. f. =3, $P<0.05$].

In respect of Rh blood group, inter-population differences are found to be statistically significant (χ^2 =8.2960, d. f. =2, $P<0.05$). Again, when compared between the populations, it found that the differences between Digaru and Miju, and between Digaru and Idu are statistically significant [χ^2 (between Digaru Mishmi and Miju Mishmi) =8.8302, d. f. = 1, $P<0.05$, χ^2 (between Digaru Mishmi and Idu Mishmi) =5.5793, d. f. =1, $P<0.05$, χ^2 (between Miju Mishmi and Idu Mishmi) =0.7785, d. f. =1, $P>0.05$].

In respect of PTC taste blindness, the χ^2 value (χ^2 =8.7191, d. f. =2, P<0.05) shows that there is significant difference among the three Mishmi populations. Again, when compared between the two populations, significant difference observed between Miju Mishmi and Idu Mishmi (χ^2 =8.6233, d. f. =1, P<0.05).

9. Taking into consideration of the two traits i.e., ABO blood group and PTC taste blindness, the Mishmi populations has been compared with 20 other populations of Assam and Arunachal Pradesh. The dendrogram shows that the three Mishmi subgroups stand very close to each other in respect of these two traits.

Dermatoglyphics

1. Combining both hands together, it is seen that among the Digaru Mishmi, the frequencies of whorl, loop and arch are 45.71%, 51.15% and 3.14% in males, and 44.58%, 51.21% and 4.21% in females respectively.

   Among the Miju Mishmi, the frequencies of whorl, loop and arch are 51.76%, 46.18% and 2.06% in males, and 47.86%, 47.86% and 4.27% in females respectively.

   Among the Idu Mishmi, the frequencies of whorl, loop and arch are 57.40%, 40.26% and 2.34% in males, and 49.44%, 46.45% and 4.10% in females respectively.

2. It is seen that there is significant difference, in respect of dermatoglyphic trait, among the three Mishmi populations. When compared between the populations, it is seen that there is significant difference between Digaru and Miju Mishmi, and Digaru and Idu Mishmi.

3. Among the Digaru Mishmi, these Furuhata's index, Dankmeijer's index and Pattern intensity index are found to be 89.38, 6.87 and 14.26 in males and 87.04, 9.43 and 14.04 in females respectively. Among the Miju Mishmi, these are found to be 112.10, 3.98 and 14.97 in males and 100.00, 8.92 and 14.36 in females respectively and

among the Idu Mishmi, these are 142.58, 4.07 and 15.51 in males and 106.43, 8.29 and 14.53 in females respectively.

4. Combining both hands together, it is found that among the Digaru Mishmi, the frequencies of the mainline formulae 11-9-7, 9-7-5 and 7-5-5 are 16.19%, 32.86% and 2.38% in males and 10.75%, 26.64% and 1.40% in females respectively. Among the Miju Mishmi, the frequencies are 11-9-7, 9-7-5 and 7-5-5 are 15.20%, 30.39% and 16.67% in males and 11.65%, 27.67% and 29.61% in females respectively. Among the Idu Mishmi, 11-9-7, 9-7-5 and 7-5-5 are 7.79%, 21.43% and 27.27% in males and 7.64%, 17.71% and 32.99% in females respectively.

5. Among the Digaru Mishmi, the axial triradii t appears in highest frequency i.e. 68.10% in males and 50% in females. It is followed by t', t", tt' and tt". It is seen that tt" is absent in males and t-line is missing in 0.47% of females. Among the Miju Mishmi, the axial triradii t appears in highest frequency i.e. 53.45% and 54.85% in both hands of males and females respectively. It is followed by t', t", tt', tt" and t't". It is seen that tt" is absent in females. Among the Idu Mishmi, the axial triradii t' is highest in both hands of males (49.68%) and females (68.40%). It is followed by t", tt" and tt'. It is seen that tt't" is found only in males (0.65%).

6. The occurrence of ulnar termination of 'c' line is common in both hands of both sexes in all the three Mishmi populations.

7. Among the Digaru Mishmi, the mean atd angle with its s. e. in right and left hands of males is 44.06±0.43 and 44.25±0.50 respectively and in females 46.60±0.71 and 46.02±0.54 respectively. Among the Miju Mishmi males, they are 43.45±0.56 and 43.07±0.50 respectively and in females 44.70±0.45 and 44.99±0.44 respectively and among the Idu Mishmi males, they are 45.28±0.40 and 45.64±0.37 respectively and in females 46.12±0.38 and 46.98±0.41 respectively.

8. The distance measures calculated on the basis of the values for finger pattern and pattern intensity index among the Mishmi males shows that the least distance is between Digaru and Miju Mishmi (7.94) followed by Miju and Idu Mishmi (8.20). The maximum distance is noted between the Digaru and Idu Mishmi (16.05).

   The distance measures calculated on the basis of the values for finger pattern and pattern intensity index among the Mishmi females shows that the least distance is seen between Miju and Idu Mishmi (2.13) followed by the Digaru and the Miju Mishmi (4.70). The maximum distance is observed between the Digaru and Idu Mishmi (6.82).

9. Two dendrogram have been drawn on the basis of finger pattern and pattern intensity index for male and female separately. The dendrogram for male shows that in respect of the above mentioned traits Digaru Mishmi stands closer to Mishing, Khamiyang and Ahom. The Miju Mishmi remains quit apart from the Digaru Mishmi and Idu Mishmi. However, it is seen that Miju Mishmi is closer to the Tangsa and Lalung. The Idu Mishmi males are closer to the Aka and Tawang Monpa. However, the dendrogram constructed on the basis of finger pattern and pattern intensity index shows different relationship among the Mongoloid populations of Assam and Arunachal Pradesh than that of the anthropometric traits and genetic markers.

   The dendrogram for female shows that the female Idu Mishmi is closer to the Nishi; the Miju Mishmi is found to be closer to the Wancho and Khampti; and Digaru Mishmi is closer to Gallong. Other Mongoloid tribes of Assam and Arunachal Pradesh, however, stand separated in respect of finger pattern and pattern intensity index.

Morphological and behavioural traits

Arm-folding:

1. The frequencies of L>R and R>L among the Digaru Mishmi are 68.25% and 31.75% respectively. The frequencies of L>R and R>L among the Miju Mishmi are 68.93% and 31.07% respectively. The frequencies of L>R and R>L among the Idu Mishmi are 59.60% and 40.40% respectively.
2. It is seen that among all the three Mishmi populations there is no significant difference, in respect of arm-folding, among the three generations. It is also seen that there is no significant difference between any two generations in respect of this trait.
3. It is seen that there is significant difference, in respect of this morphological trait, among the three Mishmi populations. When compared between the populations, there is significant difference between Digaru Mishmi and Idu Mishmi; and between Miju Mishmi and Idu Mishmi.

Hand-clasping:

1. The frequencies of L>R and R>L among the Digaru Mishmi are 57.82% and 42.18% respectively. The frequencies of L>R and R>L among the Miju Mishmi are 61.65% and 38.35% respectively. The frequencies of L>R and R>L among the Idu Mishmi are 61.28% and 38.72% respectively.
2. It is seen that among all the three Mishmi populations, there is no significant difference, in respect of hand-clasping, among the three generations. It is also seen that there is no significant difference between any two generations in respect of this trait excepting the Idu Mishmi .

3. It is found that there is no significant difference, in respect of hand-clasping, among the three Mishmi populations. Again, when compared between the populations, no significant difference has been found.

Tongue-rolling :

1. It is found that among Digaru Mishmi, 36.97% of all individuals can roll their tongue, whereas 63.03% cannot do so. Among Miju Mishmi, 39.32% of all individuals can roll their tongue while 60.68% cannot do so. Again, among Idu Mishmi, 18.18% of total population can roll their tongue whereas 81.82% cannot do so.
2. It is seen that among all the three Mishmi populations there is no significant difference, in respect of tongue-rolling, among the three generations. It is also seen that there is no significant difference between any two generations in respect of this trait.
3. It is seen that there is significant difference, in respect of tongue-rolling, among the three Mishmi populations. When compared between the populations, there is significant difference between Digaru Mishmi and Idu Mishmi, and between Miju Mishmi and Idu Mishmi.

Tongue-folding :

1. It is found that among Digaru Mishmi, 18.01% of all individuals can fold their tongue, whereas 81.99% cannot do so. Among Miju Mishmi, 16.50% of all individuals can fold their tongue while 83.50% cannot do so. Again, among Idu Mishmi, 17.51% of total population can fold their tongue whereas 82.49% cannot do so.
2. It is seen that among the Digaru and Idu Mishmi, there is no significant difference, in respect of tongue-folding, among the three generations. However, significant difference in respect of this trait among the three generations is observed in the Miju

Mishmi. In respect of tongue-folding, no significant difference between any two generations was found in Digaru and Idu Mishmi. Only in Miju Mishmi, significant difference was observed between generation II and III in respect of this trait.

3. No significant difference, in respect of tongue-folding, among the three Mishmi populations was found. Again, when compared between the populations, there was no significant difference.

Relative length of first and second toe :

1. Among the Digaru Mishmi, the frequencies of I>II (T), II>I (F) and I=II (O) are 42.65%, 30.81% and 26.54% respectively; among the Miju Mishmi, they are 34.95%, 42.23% and 22.82% respectively; and among the Idu Mishmi, they are 48.48%, 27.27% and 24.24% respectively.
2. It is seen that there is no significant difference among the three generations in respect of this morphological trait in all the three Mishmi subgroups. However, significant difference between generation I and II in respect of this trait is seen the Digaru Mishmi but not in Miju and Idu Mishmi.
3. Significant difference is observed, in respect of this morphological trait, among the three Mishmi populations. Again, when compared between the populations, significant difference between Miju and Idu Mishmi was found.

Earlobe attachment :

1. It found that among the Digaru Mishmi, the frequency of free and attached earlobes are 55.92% and 44.08% respectively. Among the Miju Mishmi, they are 53.40% and 46.60% and among the Idu Mishmi, 62.63% and 37.37% respectively.

2. It is seen that among all the Mishmi populations there is no significant difference, in respect of earlobe attachment, among the three generations. It is also seen that there is no significant difference between any two generations in respect of this trait.

3. It is seen that there is no significant difference, in respect of earlobe attachment, among the three Mishmi populations. Again, when compared between the populations, it is seen that there is significant difference between Miju and Idu Mishmi.

In the present study, the Mishmis show some resemblance to each other than other populations compared. In respect of the genetic markers i.e. ABO and the Rh blood group and PTC taste sensitivity these three subgroups of Mishmi are by and large similar. But, the traits like anthropometry and dermatoglyphics show that they stand quite apart from each other. The reason can be when each of the subgroups of the Mishmi came to the present place, only a section of the population must have migrated which may not have represented the population. The same group survived through the time to form the present population. As the three Mishmi populations maintained isolation for several generations, in the process of time they must have a separate population culturally, as well as genetically.

In the present study, we have used a very limited numbers of markers through which we have tried to assess the genetic relationship of the Mishmis within themselves as well as with other neighbouring Mongoloid populations, particularly from Arunachal Pradesh and Assam. We have seen that with such limited traits it is extremely difficult to find out the exact phylogenetic relationship between and among populations, one need to have sufficient infrastructural facilities to collect data on various genetic markers. Unfortunately we do not have such facilities at present. When such facilities will be made available, we shall be in the better position to examine further this problem of phylogenetic relationship.

REFERENCES

Aggarwal, S. and M.P. Sachdeva. 2004. A study of taste sensitivity of phenylthiocarbamide (PTC) and colour blindness among the Rajputs of Kasauli, Himachal Pradesh. *Anthropologist.* 6(4): 289-290.

Ahmed Das, F. and H. Deori. 2001. Demographic profile of a Deori village of Lohit district, Arunachal Pradesh. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 29: 59-70.

Ahmed Das, F. and J. Konwar. 2002. A note on some demographic features of the Oraon of Tingkong tea estate of Tingkhong, Dibrugarh, Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 30: 113-128.

Ahmed Das, F. and J. R. Saikia. 1999. Some aspects of fertility of the Garo women of Pochimbosti Garo village in Sibasagar district, Assam. *J. Hum. Ecol.* 10(4): 273-277.

Ahmed Das, F. and R. Barua. 1999. A demographic study of the Manipuri Meiteis of Borkula Hanhchora village of Sibsagar District, Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 27: 83-92.

Barua, P.K. and D.D. Das. 2001. A note on finger ridge counts of the Tai Turungs: A Mongoloid population of Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 29:71-75.

Barua, S. 1982. Biodemographic factors associated with offspring mortality among the Hajongs of Meghalaya. *J. Indian Anthrop. Soc.* 17:143-146.

Barua, S. 1983. The Hajongs of Meghalaya: A Biodemographic study. *Hum. Sci.*, 32: 190-200.

Barua, S. 1985. Red-green colour blindness and earlobe attachment among the Hajongs of Meghalaya, (India). *Ind. J. Phys. Anthrop. & Hum. Genet.* 11: 151-154.

Baruah, T.K.M. 1960. *The Idu Mishmis.* Itanagar: Directorate of Research, Govt. of Arunachal Pradesh.

Basic Statistics of North Eastern Region. 1995. Shillong, North Eastern Council Secretariat.

Basu, A.1969. The Pahira: A population genetical study. *Amer. J. Phys. Anthrop.* 31:399-416.

Basu, A., P. Majumdar, A. Ghosh and S. Biswas. 1980. Human biological variations in Asia, with special reference to India. In: *Human Biological Diversity*, J. Hiernaun (Ed), pp. 197-269. Paris, New York, Barcelona and Milan: Meson.

Basu, R. N.1938. Blood groups among the Khasi. *Nature.* 142:797.

Bhasin, M.K. and S. Nag. 2002. A demographic profile of the people of Jammu and Kashmir. 2. Estimates, trends and differentials in fertility. *J. Hum. Ecol.* 13(1-2): 57-112.

Bhatia, H.M. 1977. *Procedures in blood banking and Immunohaematology.* Bombay: Blood Group Reference Centre.

Bhattacharjee, P.N. 1954. Blood groups investigations in the Abor Tribe. *Bull. Dept. Anthrop.* 1: 51-54.

Biswas, P.C. and D.K. Bhattacharjee. 1966. Growth trend in northern Indian population variation of four anthropometric traits from birth to maturity. In: *Human Adaptability to Environments and Physical Fitness*, M.S. Malhotra (Ed), pp. 270-280. Madras: Defence Institute of Physiology and Allied Disciplines, Govt. of India.

Bonne, B. 1963. The Samaritans: A demographic study. *Hum. Biol.* 35: 61-89.

Borthakur, P., S. Sengupta and A.K. Ghosh. 1997a. A genetic study on the Dalu of Meghalaya. *J. Hum. Ecol.* 8(6): 477-479.

Borthakur, P., S. Sengupta and A.K. Ghosh. 1997b. A note on some morpho-genetic variables among the Dalu of Meghalaya. *J. Hum. Ecol.* 8(6): 481-483.

Buzarbarua, P.M. and S.H.M. Rizvi. 1996. The Garias of Assam: A biodemographic study. In: *Peoples of North East India*, S. Sengupta (Ed), pp. 62-72. New Delhi: Gyan Publishing House.

Cavalli-Sforza, L.L., M. Kimura and I. Barrai. 1966. The probability of consanguineous Marriages. *Genetics.* 54:37-60.

Chakravartti, M.R. and D.P. Mukherjee. 1961. Dematoglyphic study of tribes and castes of the State of Assam. *Sc. Cult.* 27: 584-585.

Chakravarty, S.K.1976a. Selection potential among the Bengali Muslim of Cachar. Proc. 3rd Annual Conf. Indian Anthrop. Soc. Santiniketan. *J. Indian Anthrop. Soc.* 11: 177.

Chakravarty, S.K.1976b. ABO blood groups distribution among the Mikir of Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 5: 14-18.

Chakravarty, S.K. and S.H. Ahmad. 1989. Body dimensions, fertility and selection in a section of Gallong with endemic hypothyroidism and congenital defects of the central nervous system. In: *Genetical Demography of Indian Population*, pp. 1-5, Calcutta: Anthropological Survey of India.

Choudhury, B. and P.B. Das. 1974. Frequency of colour blindness in some populations of Arunachal Pradesh. *J. Gauhati Univ.* 25: 23-25.

Chouwdhury, J.N. 1987. *Arunachal Pradesh: From Frontier Tracts to Union Territory.* New Delhi: CosmoPublication.

Chouwdhury, J.N. 1996. *Arunachal Panorama.* Itanagar: Directorate of Research, Govt. of Arunachal Pradesh.

Crawford, M.H.1973. The use of genetic markers of the blood in the study of evolution of population. In: *Methods and Theories of Anthropological Genetics*, M.H. Crawford and P.L. Workman (Eds), pp. 19-38. Albuquerque: University of New Maxico Press.

Crow, J.F. 1958. Some possibilities for measuring selection intensities in man. *Hum. Biol.* 30:1-13.

Cummins, H. and C. Midlo. 1961. *Finger prints, Palms and Soles: An Introduction to Dermatoglyphics.* New York: Dover Publication Inc.

Danker-Hopfe, H., B.M. Das, H. Walter, P.B. Das and R. Das. 1988. Anthropological studies in Assam, India. 6. Differentiation process among Assamese populations. *Anthrop. Anz.* 46: 159-184.

Das, B.M. 1958. Blood Group of the Rabha. *Man in India.* 38:213-215.

Das, B.M. 1959. Finger prints of the Hajongs. *Man in India.* 39:20-27.

Das, B.M.1960a. *Ethnic Affinities of the Rabha.* Gauhati: Department of Publication, Gauhati University.

Das, B.M. 1960b. Somatic variations among the Hills and Plains Garo of Assam. *Man in India.* 40:128-148.

Das, B.M. 1966. On the palm prints of the Hajongs. *Man in India.* 46: 248-255.

Das, B.M. 1967a. Etude des characters anthropometrique des khasi de L'Assam, Inde. *L'Anthropologie.* 71:97-134.

Das, B.M. 1967b. A note on variation of earlobe attachment. *Acta. Gent. Stat. Med.* 17:154-157.

Das, B.M. 1968a. ABO blood groups in the tribal populations of North East India with special reference to the Khasi. *Anthropologist*, Special volume: 85-92.

Das, B.M. 1968b. A comparative study of the relative length of human first and second toes. *Man in India.* 48:258-268.

Das, B.M. 1971. Taste sensitivity to phenylthiourea among the Khasi of North East India. *Proc. Int. Sym. Hum. Gent. Andhra University*: 195-203.

Das, B.M. 1972. Variations in the Khasi populations in respect of finger patterns. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 1: 17-21.

Das, B.M. 1978. *Variation in Physical Characteristics in the Khasi Population of North East India.* Guwahati: Dutta Barua and Co.

Das, B.M. 1981. *Microevolution.* Ranchi, Anthropology series 4. New Delhi: Concept Publishing Company.

Das, B.M. 1987. *The peoples of Assam.* Delhi: Gyan Publishing House.

Das, B.M., B. Choudhury and D.K. Duarah. 1976. A study on hand clasping, arm folding and tongue rolling among the Nocte, Wancho and Tangsa of Tirap, Arunachal Pradesh. *Bull. Deptt. Anthrop. Gauhati Univ.* 4: 70-74.

Das, B.M. and A.C. Bhagabati. 1962. Investigation on the finger prints of the Khamyang. *J. Gauhati Univ.* 13:75-78.

Das, B.M. and P. Uzir. 1959. Relative length of the first and second toes of the Rabha foot. *J. Gauhati Univ.* 10: 153.

Das, B.M. and P. Uzir. 1961. A study of Khasi foot. *Man in India.* 41: 16-24.

Das, B.M. and P.B. Das. 1982. Child mortality among rural Assamese. *Bull. Anthropological Survey of India.* 31:14-29.

Das, B.M., P.B. Das and R. Das. 1980a. *The Lalungs: Their Physical Features and Biosocial Profile (Mimeographed).* Guwahati: Anthropology Department, Gauhati University.

Das, B.M., P.B. Das and R. Das. 1980b. *A Comparative study of physical anthropology of five mongoloid populations of Assam. (Mimeographed).* Guwahati: Anthropology Department, Gauhati University.

Das, B.M., P.B. Das, R. Das, H. Walter and H. Danker-Hopfe. 1985a. Anthropological studies in Assam, India. 1. Observations on five Mongoloid populations. *Anthrop. Anz.* 43:193-204.

Das, B.M., P.B. Das, R. Das, H. Walter and H. Danker-Hopfe. 1985b. Anthropological studies in Assam, India 2. Observations on Muslims. *Anthrop. Anz.* 43: 299-310.

Das, B.M. and R. Das. 1965. Finger pattern of the Kalita. *Man in India.* 45(3):247-250.

Das, B.M. and R. Das. 1981. Intra and intertribal variation in palmar flexion creases: A population study. *Ind. J. Phys. Anthrop. Hum. Genet.* 7: 173-178.

Das, B.M. and R. Deka. 1992-1993. *Physical Anthropology Practical.* Allahabad: Kitab Mahal.

Das, B.M., R. Deka and R. Das. 1980. ABO blood groups and Rh factor in six populations of Assam. *Bull. Anth. Surv.* 29:1-3.

Das, N.K. and A.K. Ghosh. 1988. Two Muslim sects of 24 Parganas, West Bengal – a study in selection intensity. *Hum. Sci.* 37: 237-242.

Das, P.B. and B. Choudhury. 1975. Hand Clasping, arm folding, earlobe attachment and colour blindness of the Gallong of Arunachal Pradesh. *Bull. Deptt. Anthrop. Gauhati Univ.* 4: 65-70.

Das, P.B. and S.K. Baruah. 1974. A study of some genetic traits among the Khasi of Meghalaya. *Bull. Dept. Anth. Gauhati Univ.* 3: 22-26.

Das, S.K., P.P. Majumdar and A. Basu. 1982. Demography and demographical genetics of two isolated mountain villages of Northern Sikkim, Eastern Himalaya. *J. Indian Anthrop. Soc.* 17:155-162.

Das, S.R., D.P. Mukherjee and P.N. Bhattacharjee. 1963. PTC taste threshold distribution in the Bodo, the Gadaba, the Bareng Paroja of Koraput district in Orissa. *Acta Genet. et. Stat. Med.* 13:369-377.

Datta, J.M. 1972. Demographic notes on Harappan skeleton. In: *Human Skeletal Remains from Harappa*, P. Gupta, P.C. Dutta and A. Basu (Eds). Calcutta: Anthropological Survey of India.

Data Choudhury, S.S. 1995. Mishmi: Idu. In: *People of India: Arunachal Pradesh*, Vol. XIV, K.S. Singh (Ed), pp. 256-260. Calcutta: Anthropological Survey of India.

Deb, A.1979. *Comparison between the hills and plains Mikirs of Assam in respect of certain anthropometric traits and their ethnic position.* Dibrugarh University: Unpublished Ph.D. Thesis, Assam.

Deka, A.1989. Reproductive performance and selection among the Jaintias of village Sa-Phai. In: *Genetical Demography of Indian Population*, K.S. Singh (Ed), pp. 6-11. Calcutta: Anthropological Survey of India.

Deka, R.1980. Section potential among the Sonowal Kachari of Upper Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 9: 136-140.

Deka, R. and A. Bora. 1973. An investigation on the finger prints of the Mikirs. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 2: 55-60.

Dkhar, D.S. 2007. *Digital and palmar dermatoglyphic study among the Khynriam-Khasi males of Mawlynrei village, East Khasi Hills district, Meghalaya.* North Eastern Hill University, Shillong: Unpublished M.Sc. dissertation.

Dobzhansky, T. 1951. *Genetics and the Origin of species.* New York: Columbia University Press.

Douglas, D. 1985. Demographic structure and opportunity for selection of Halfmoon township, Pennsylvania: 1850-1900. *Hum. Biol.* 57: 335-352.

Duarah, D.K. 1990. *The Monpas of Arunachal Pradesh.* Itanagar: Directorate of Research, Arunachal Pradesh.

Dutta Das, D. 2000. Palmar dermatoglyphics of the Nishis of Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 28: 82-87.

Eaton, J.W. and A.J. Mayer. 1953. The social biology of very high fertility among the Hutterites: The demography of a unique population. *Hum. Biol.* 25: 206-264.

Fix, A.G. and L.E. Lie-Injo. 1975. Genetic microdifferentiation in the Semai Senoi of Malaysia. *Am. J. Phys. Anthrop.* 43: 47-55.

Friedl, J. and W.S. Ellis. 1974. Inbreeding, isonomy and isolation in a Swiss community. *Hum. Biol.* 46: 699-721.

Gangadhar, M.R. and K. Rajasekhara Reddy. 2001. ABO and Rh (D) blood groups among the Adikarnatakas of Karnataka. *J. Hum. Ecol.* 12 (4): 327-328.

Gangadhar, M. R. and O. Ronibala Devi. 2006. ABO and Rh (D) blood groups among the Kaniyas of Karnataka. *Anthropologist.* 8(2): 145-146.

Gates, P.R. 1956. *Human Genetics*, I. The Macmillan Company.

Ghosh, A.K. 1969a. *An Ethno-Biological Study of the Kota of the Nilgiri Hills.* Calcutta University: Unpublished Ph.D. Thesis.

Ghosh, A.K. 1969b. ABO blood group frequencies of India, Pakistan and the adjoining areas as a whole. *Man In India.* 49: 372-377.

Ghosh, A.K. 1970. Selection intensity in the Kota of Nilgiri hills, Madras. *Soc. Biol.* 17: 224-225.

Ghosh, A.K. 1976. The Kota of Nilgiri Hills: A demographic study. *J. Biosoc. Sci.* 8: 17-26.

Ghosh, A.K., D.K. Limbu and R. Sarkar. 1996. A morpho-genetical study on the Mizo. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 24: 48-62

Ghosh, A.K., R.L. Kirk, S.R. Joshi and H.M. Bhatia. 1977. A population genetic study of the Kota in the Nilgiri Hills, South India. *Hum. Hered.* 27: 225-241.

Glass, B. 1956. On the evidence of random genetic drift in human populations. *Am. J. Phys. Anthrop.* 14: 541-555.

Goswami, M.C. and P.B. Das. 1990. *The People of Arunachal Pradesh: A Physical Survey.* Itanagar: Directorate of Research, Govt. Arunachal Pradesh.

Grewal, D.S. 1997. *Tribes of Arunachal Pradesh: Identity, Culture and language.* New Delhi: South Asia Publication.

Guha, B.S. 1935. The racial affinities of the people of India. *Census of India.* Part III. Delhi.

Guha, B.S. and P.C. Basu. 1931. A report on human relics recovered by the Naga Hills (Burma) expedition for the abolition of human sacrifices during 1926-27. *Anthropological Bulletin*, N. 1. Zoological Survey of India.

Harris, H. and K. Kalmus. 1949. The measurement of taste sensitivity to PTC. *Ann. Eugen.* (Lond.) 15: 24-31.

Harrison, G.A. 1977. Introduction, structure and function in the biology of human population. In: *Population Structure and Human Variation*, G.A Harrison (Ed), pp. 1-9. Cambridge: Cambridge University Press.

Harrison, G.A. and A. J. Boyce. 1972. Introduction: The framework of population studies. In: *The Structure of Human Populations*, G.A. Harrison and A.J. Boyce (Eds). Oxford: Clarendon Press.

Heurotte, J.G. 1966. A biological study of Indian populations at different levels of economic growth. In: *Human Adaptability to Environments and Physical Fitness,* M.S. Malhotra (Ed), pp. 395-406. Madras: Defence Institute of Physiology and Allied Disciplines, Govt. of India.

Husain, Z. 1995. Mishmi: Miju. In: *People of India: Arunachal Pradesh*, Vol. XIV, K.S. Singh (Ed), pp. 261-265. Calcutta: Anthropological Survey of India.

Hutton, J.H. 1921. *The Angami Nagas*. London.

Imtisenla. 2007. *A genetical-demographic study among the Khasis of Mawlynrei village of East Khasi Hills district, Meghalaya.* North Eastern Hill university, Shillong: Unpublished M.Sc. dissertation.

Ishihara, S. 1959. *The Series of Plates Designed as a Test for Colour Blindness*. Tokyo, Japan: Kannehara Shuppan Co. Ltd.

Ishihara, S. 1962. *Tests for Colour Blindness*. Tokyo, Japan: Kannehara Shuppan Co. Ltd.

Jai Prabhakar, S.C., M.R. Gangadhar and K. Rajasekhara Reddy. 2005. ABO and Rh (D) blood groups among the Vishwakarmas of Mysore District, Karnataka. *Anthropologist.* 7(1): 71-72.

Jalal Ahmed, T., S. Sengupta and A.K.Ghosh. 1997. A genetic study on the Lyngam of Meghalaya. *J. Hum. Ecol.* 8(6): 473-475.

Jaswal, I.J.S. 1978. Anomalous colour vision among the three tribes of Arunachal Pradesh, India. *Anthropologist*. 22:53-59.

Jaswal, S., I.J.S. Jaswal, S. Sengupta. 1986. Dermatoglyphics of the Apatani of Arunachal Pradesh. *Anthropologie* 24: 29-35.

Johnston, F.F. and K.M. Kensinger. 1971. Fertility and mortality differentials and their implications for micro-evolutionary change among the Cashinahua. *Hum. Biol.* 43: 356-364.

Kar, R.K. 1975. The Rh blood group among the Adi of Pasighat, Arunachal Pradesh. *Eastern Anthropologists,* 28(2): 165-168.

Kar, R.K. and J.L. Sharma. 1982-1983. A study of fertility among the Wancho: A Tribe in Arunachal Pradesh. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 11-12:67-80.

Karve, I. and K.C. Malhotra. 1968. A biological comparison of eight endogamous groups of the same rank. *Curr. Anthrop.* 9: 109-124.

Karve, I. and V.M. Dandekar. 1951. Anthropometric measurements of Maharastra. *Deccan Coll. Mon.* Ser. No.8: 1-134.

Keith, A. 1950. *A New Theory of Human Evolution.* Watts, London.

Khongsdier, R. 1990. The Pnar of Sutnga and Moopala villages: A study in selection intensity. *J. Indian Anthrop. Soc.* 25:182-184.

Khongsdier, R. 1992. Some demographic traits among the Pnar of Sutnga and Moopala in Jaintia Hills District of Meghalaya. *Man In India.* 72: 491-495.

Khongsdier, R.1993. Fertility differentials among the War Khasi of Meghalaya. *J. Anthropological Survey of India.* 42: 199-206.

Khongsdier, R. 1995. Prenatal and postnatal mortality in the War Khasi of Meghlaya. *J. Hum. Ecol.* 6(3): 201-204.

Khongsdier, R and B. Murry. 1999. A genetical study among the Dibongiya Deuri of Lakhimpur district of Assam. *J. Hum. Ecol.* 10(4): 293-295.

Kirk, R.L. 1973. Serum protein and enzyme groups in physical anthropology with special reference to Indian populations. In: *Physical Anthropology and its Extending Horizons*, A. Basu, A.K. Ghosh, S.K. Biswas and R. Ghosh (Eds), pp. 189-209. Calcutta: Orient Longman.

Kirk, R.L. 1978. Population genetics at the crossroads: A challenge for Indian science. *Medical Genetics in India.* Vol. 2. I.C. Verma (Ed), pp. 223-229. Pondicherry: Auroma Publications.

Kuchemann, C.F., A.J. Boyce and G.A. Harrison. 1967. A demographic and genetic study of a group of Oxfordshire villages. *Hum. Biol.* 39: 251-276.

Kumar, N.1945. Blood group and secretor frequency among the Gallong. *Bull. Deptt. Anthrop. Govt. of India.* 3:55-64.

Kumar, S., K. Tamura, I.B. Jakobsen, and M. Nei. 2001. MEGA 2: Molecular Evolutionary Genetics Analysis software, bioinformatics. *Bioinformatics*. 17:1244-1245.

Kuotsu, K. 2003. *Adult anthropometry of the Khasis of Mawkasiang-Mawdiangdiang-Umroh village, Meghalaya.* North Eastern Hill University, Shillong: Unpublished M.Sc. dissertation.

Laskar, G.W. 1952. Mixture and genetic drift in ongoing human population. *American Anthropologists.* 54 (New series): 433-436.

Laughlin, W.S. 1960. Aspects of current physical anthropology. *South West J. Anthrop.* 16: 75-92.

Lawler, S.D. and L.J. Lawler. 1951. *Human Blood Groups and Inheritance.* London: William Heinemann Ltd.

Limbu, D.K. 1996. The Semsa: A Population Genetical Study. Nort-Eastern Hill University, Shillong: Unpublished Ph. D thesis.

Livingstone, F.B. and J.N. Spuhler. 1965. Cultural determinants of natural selection. *Inter. Soc. Sci. J.* 17: 118-120.

Macfarlane E.W.E and S.S. Sarkar. 1941. Blood groups of India. *Amer. J. Phys. Anthrop.* 28:39-49.

Mahalnobis, P.C., D.N. Majumdar and C.R. Rao. 1949. Anthropometric survey of the United Provinces, 1941:A statistical study. *Sankhya*, 9: 89-324.

Majumdar, D.N. and C.R. Rao. 1960. *Race Elements in Bengal: A Quantitative Study.* Calcutta: Asia Publishing House.

Malhotra, K.C. 1978. Founder effect, genetic drift, and natural selection among four nomadic Mendelian isolates. In: *Evolutionary models and Studies in Human Diversity*, R.J. Meier et al., (Eds), pp. 315-323. Paris: Mouton Publishers.

Markendy, A.S. 2000. *A study on Anthropometric characters and nutritional status among the Khynriam (Meghalaya).* North Eastern Hill University, Shillong: Unpublished M.Sc. dissertation.

Marbaniang, L.J. 2007. *A genetic study among the Khasi-Khynriam of Mawlynrei village, East Khasi Hills district, Meghalaya.* North Eastern Hill University, Shillong: Unpublished M.Sc. dissertation.

Martin, R. 1928. *Lehrbuch der Anthropologie. Volumes* I, II and III. Verlag Von Gustav Fischer, Jena (cited by T. Sen, 1994).

Mayr, E. 1963. *Animal species and Evolution.* Cambridge: The Belknup Press of Harvard University Press.

Miki, T., T. Tanaka and T. Furuhata. 1960. On the distribution of ABO blood groups and the taste ability for PTC of the Lepchas and the Khasis. *Proc. Japan Acad.* 36: 78-80.

Mills, J.P. 1952. The Mishmis. *J. Royal Anthrop. Institute.* Vol.82.

Minami, K. 1952. The digital formula in Japanese featus. II – Study on the relative lengths between the first and second toes. *Folia. Ant. Jap.* 24: 295.

Mitra, P.N. 1936. Blood groups of the Angami Naga and Lushai tribes. *Ind. J. Med. Res.* 23: 685-686.

Mohr, J. 1951. Taste sensitivity to Phenylthiourea in Denmark. *Ann. Eugen.* 16; 282-286.

Mourant, A.E. 1954. *The Distribution of Human Blood Groups.* Oxford: Blackwell Scientific Publication.

Mukherjee, D.P. 1963. Variation in defective colour vision among some tribes of Assam. *Bull. Anth. Surv. India.* 12:39-42.

Murry, B., M.P. Sachdeva and A.K. Kalla. 2003. PTC taste sensitivity and colour blindness among the Lotha Naga of Nagaland. *Anthropologist.* 5(1): 65-66.

Nchang, H. 2006. *A genetic study among the Garo population of Rangsakona Village of Ri-Bhoi district, Meghalaya.* North Eastern Hill University, Shillong: Unpublished M.Sc. dissertation.

Nath, A.C. and B. Devi Das. 1995. A note on ear lobe attachment among the Kaibartas of Assam, India. *J. Hum. Ecol.* 6(3): 219-220.

Nei, M.1973. Analysis of gene diversity in subdivided populations. *Proc. Nat. Acad. Sci.* 70:3321-3323.

Nei, M.1987. *Molecular Evolutionary Genetics.* New York: Columbia University Press.

Nei, M., F. Tajima, and Y. Tateno. 1983. Accuracy of estimated phylogenetic trees from molecular data. *J. Mol. Evol.* 19:153-170.

Ota, T.1993. *DISPAN: Genetic distance and phylogenetic analysis.* Pennsylvania: Institute of Molecular Evolutionary Genetics, Pennsylvania State University, University Park.

Pandey, B.N., S.K. Mishra, S. Yadav and P. Dash Sharma. 2000. Foetal wastage and infant mortality in four endogamous population of Purnia District (Bihar). *J. Hum. Ecol.* 11(6): 477-481.

Paul Majumder, G. 2001. Some aspects of fertility of the Mahatos of Midnapore, West Bengal. *J. Hum. Ecol.* 12(5): 379-382.

Phookan, M. N. 1969. Anthropometric characters of the Dimasa Kachari of Assam. *J. Assam Sci. Soc.* 12:30-35.

Phookan , M .N . 1975. Biological distance among some sub-divisions of the Kachari of Assam in respect of ABO blood groups and their position among other tribes of North Eastern Indian. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 4:28-34.

Phookan, M.N. and N.A. Begum. 1976. A comparative study in respect of some genetic traits of two populations of Udaipur, Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 5: 57-61.

Phukan Gogoi, A and S. Sengupta. 1995. Finger prints of the Boro Kacharis of Assam. *J. Hum. Ecol.* 6(4): 297-298.

Phukan Gogoi, A and S. Sengupta. 1999. Blood groups among the Munda and Oraon tea garden labourers of Assam, India. *J. Hum. Ecol.* 10(4): 301-302.

Pickford, R.W. 1963. Natural selection and Colour blindness. *Eugen. Review.* 55:97-101.

Post, R.H. 1962a. Population differences in red and green colour vision deficiency: A review and a query on 'Selection Relaxation'. *Eugen. Quart.* 9:131-146.

Post, R.H. 1962b. Population differences in vision acuity: A review with speculative notes on selection relaxation. *Eugen. Quart.* 10:110-118.

Rao, V.L.N., B. Dharma Rao, Ch. Seshagiri Rao, K. Bharathi and B.R. Busi. 2006. Selection intensity among the Khonds of Andhra Pradesh. *Anthropologist.* 8(2): 143-144.

Reddy, P.Y.B. and A. Papa Rao. 1995. Distribution 0f the ABO and Rh (D) blood groups among the Sugalis- A tribal population of Andhra Pradesh. *J. Hum. Ecol.* 6(3): 217-218.

Relethford, J.H. 1986. Density dependent migration and human population structure in historical Massachusetts. *Amer. J. Phys. Anthrop.* 69:377-388.

Risley, H. 1915. *The People of India.* Calcutta.

Rizvi, S.H.M. 1974. *Unpublished report submitted to Anthropological Survey of India.* Shillong: North-Eastern Regional Station.

Roberts, D.F. 1956. A demographic study of Dinka village. *Hum. Biol.* 28:323-349.

Roberts, D.F. and J.C. Bear. 1980. Measures of genetic change in an evolving population. *Hum. Biol.* 52: 773-786.

Robert Varte, L., and R. Th. Varte. 2006. Natural selection intensity among the Hmar of Mizoram, India. *Anthropologist.* 8(3): 213-214.

Salzano, F.M. 1961. Studies on the Caingong Indians II. Morphological characters. *Z. Morph. Anthrop.* 51:356-371.

Salzano, F.M. 1964. Blood groups from Santa Catarina, Brazil. *Am. J. Phys. Anthrop.* 22:91-106.

Salzano, F.M., J.V. Neel and D. Maybury-Lewis. 1967. Further studies on the Xavante Indians. I. Demographic data on two additional villages: Genetic structure of the Tribe. *Am. J. Hum. Genet.* 19: 463-489.

Salzano, F.M. and M.C. Jacques. 1979. Genetic demography of the central Pano and Kanamari Indians of Brazil. *Hum. Biol.* 51:551-564.

Sarkar, N.C., A.C. Saikia and P.T. Viswanathan.1995. Distribution of ABO blood groups in Changlang, Arunachal Pradesh, India. *J. Hum. Ecol.* 6(4): 283-285.

Sarkar, S.S. 1935-1936. The racial affinities of the inhabitants of the Rajmahal Hills. *Trans. Bose Res. Inst.* 11:123.

Sengupta, S. and G. Gogoi. 2002. Dermatoglyphics of the Mishings of Assam, India. *Bull. Deptt. Anthro. Dibrugarh Univ.* 30: 73-80.

Sengupta, S. and K. Chakravarty. 1995. Family type, fertility and mortality: A study among the Ahoms of Assam. *J. Hum. Ecol.* 6(3): 197-200.

Sengupta, S. and M. Kalita. 1996. Selection intensity among the Sonowals of Assam. In: *Peoples of North East India*, S. Sengupta (Ed), pp. 73-80. New Delhi: Gyan publishing House.

Sengupta, S. and M. Kalita. 2001. Some aspects of reproductive performance of the Sonowal Kachari of Assam. *Bull. Deptt. Anthro. Dibrugarh Univ.* 29:49-58.

Sengupta, S. and M.N. Dutta. 1980. ABO blood group in the Kaibarta, the Ahom and the Wancho of North East India. *Acta Anthropogenetica.* 4:245-246.

Sengupta, S. and Purnungla. 2005. Some aspects of reproductive performance of the Ao Naga of Nagaland. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 33: 69-76.

Segupta, S. and R.K. Dutta. 2000. Factors influencing fertility: A case study among the Mishing of Assam. *Bull. Deptt. Anthrop. Dibrugarh Univ.* 28: 21-30.

Singh, I.P. and M.K. Bhasin. 2004. *A Manual of Biological Anthropology.* Delhi: Kamala-Raj Enterprises.

Singh, K.S. 1982. Incidence of colour blindness among the Tangkhul Naga of Manipur. *J. Indian Anthrop. Soc.* 17: 79-81.

Singh, K.S., V. Bhalla and V. Kaul. 1994. *The Biological Variation in Indian Populations.* Oxford University Press and Anthropological Survey of India.

Singh, L.R. 1986. *Physical variation between two sections of the Kabuis of Manipur and their ethnic position.* Gauhati University: Unpublished Ph.D. thesis.

Singh, P. and R. Purkait. 2006. A cephalometric study among sub caste groups Dangi and Ahirwar of Khurai block of Madhya Pradesh. *Anthroplogist.* 8(3): 215-217.

Singh, R.1975. Nutritional anthropometric measurements of male clerks in Madras. *Ann. Hum. Biol.* 2: 301-304.

Socio-economic Review of Lower Dibang Valley District. 2002. Roing: District Statistical Office, Lower Dibang Valley District.

Sutter, J. 1963. The relationship between Human Population Genetics and Demography. In: *Genetics of migrant and Isolate Populations*, E. Godschimdt (Ed). New York: Williams and Wilkins Co.

*Statistical Handbook of Lohit District.*1998. Tezu: Government of Arunachal Pradesh.

Steegman, A.T. 1975. Human adaptation to cold. In: *Physiological Anthropology*, A. Demon (Ed), pp. 130-166. London: Oxford University Press.

Takezaki, N. and M. Nei. 1996. Genetic distances and reconstruction of phylogenetic trees from microsatellite data. *Genetics.* 144: 389-399.

Tamura, K., J. Dudley, M. Nei, and S. Kumar. 2007. MEGA4: Molecular Evolutionary Genetics Analysis (MEGA) Software Version 4.0. *Mol. Biol. Evol.* 24(8): 1596-9.

Thurston, E. 1909. *Castes and Tribes of South India.* Madras: Government Press.

Varte, R.Th. 1998. Opportunity for natural selection: The Hmar of Manipur, India. *J. Hum. Ecol.* 9(5): 513-514.

Vasulu, T.S. 1987. Population structure among the yanadi. *Bull. Indian soc. Hum. Genet.* 12:14.

Veleti, K. 2001. Family Structure and its Effective Influence on Fertility. *J. Hum. Ecol.* 12(5): 387-390.

Vogel, F. and A.G. Motulsky. 1986. *Human Genetics: Problems and approaches*. Berlin: Springer-Verlag.

Volpe, E.P. 1985. *Understanding Evolution.* New Delhi: Universal Book Stall.

Waddell, L.A. 1901. The tribes of Brahmaputra Valley. *J. As. Soc. Bengal.* 3: 1-127.

Washburn, S.L. 1953. The strategy of physical anthropology. In: *Anthropology Today*, A.L. Kroeber (Ed). Chicago: University of Chicago Press.

Weiner, J.S. and J.A. Lourie. 1981. *Practical Human Biology.* London: Academic Press.

Williams, J.T. 1993. Origin and population structure of the Icelanders. *Hum. Biol.* 65:167-191.

World Health Organisation. 1964. *Research in population genetics of primitive groups.* WHO Tech. Rep. Ser. No. 279, Geneva: WHO.

World Health Organisation. 1968. *Research in human population genetics*. WHO Tech. Report Ser. No. 387, Geneva: WHO.

Wright, S. 1931. Evolution in Mendalian Population. *Genetics*. 16: 97-159.

Wright, S. 1938. Size of population and breeding structure in relation to evolution. *Science*. 87: 430-431.

Wright, S. 1940. Breeding structure of population in relation to speciation. *Am. Nat.* 74:232-248.

Wright, S. 1943. Isolation in distance. *Genetics*. 28:114-138.

APPENDIX

1. INTERVIEW SCHEDULE

For the Doctoral dissertation on
"Population Genetics of The Mishmis of Arunachal Pradesh"

Investigator_____
Department of Anthropology
NEHU, Shillong

I. Village_____ P/S_____ State_____
Altitude (in mts)_____

2. Demography

Sl. No.	Name	Caste/Tribe	Rel. to Head	Sex	Age	Marital status	Age at marri-age	Age at death	Education	Occupation	Place of occupa-tion	Place of birth	Salary/ Income

SCHEDULE 2 (DEMOGRAPHY-FERTILITY)

DATE_____

1.2. IDENTIFICATION AND GENERAL PARTICULARS

1. I D NO. 2. NAME 3. EDUCATION
4. DATE OF / AGE AT MARRIAGE 5. OCCUPATION

FERTILITY RECORD

1. Have you ever had any children? Yes/No (If No, skip to Q. 5).
2. If yes, how many of your children are now alive?
3. Have you ever had any other children who were born alive to you but are not living now? Yes/ No (If No, skip to Q.5.).
4. If Yes, how many?
5. Have you ever had any pregnancies that ended in a miscarriage or still birth? Yes/No.
6. If Yes, how many miscarriages? And how many still births?
7. Now let me be sure that I have everything right. In all have had children who are living _____ who have died _____ miscarriages _____ still births_____. Is that right? Yes/No (If Yes, skip to Q.9).
8. If No, specify.
9. Now, let me record all your pregnancies. Could you describe them in order of occurrence with a few other information?

PREGNANCY RECORD FORM											
Sl. No.	Name	Live Births			Deceased Children			Foetal Death			
		Sex	Age	Date of birth	Sex	Age	Date of birth	Age at death	Date of loss	MC	SB
1											
2											
3											
4											
5											
6											
7											
8											

(MC-Miscarriage, SB-Still birth)

10. Are you expecting a baby now? Yes/ No/ Don't know (If No/Don't know, skip to Q.12).
11. If Yes, in what month of pregnancy are you?
12. Do you think you can have more children? Yes/No/Don't know (If Yes/Don't know, coclude interview).
13. If No, why not?

SCHEDULE NO. 3

3. ANTHROPOMETRIC MEASUREMENTS													4. MORPHOLOGICAL CHARACTERS						
Sl. No.	A	B	C	D	E	F	G	H	I	J	K	L	M	A	B	C	D	E	F
																			R	L
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

INDEX

A. Height vertex
B. Sitting height
C. Chest girth
D. Head length
E. Head breadth
F. Bizygomatic breadth
G. Nasal height
H. Nasal breadth
I. Weight
J. Least frontal breadth
K. Head circumference
L. Bigonial breadth
M. Mid-arm-circumference

INDEX

A. Arm-folding
B. Hand-clasping
C. Tongue-rolling
D. Tongue-folding
E. Relative length of 1st and 2nd toe
F. Earlobe attachment

SCHEDULE NO. 4

Sl. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
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2																																						
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10																																						

SCHEDULE NO. 5

Sl. No.	6. SEROLOGY			7. PTC TASTE SENSITIVITY
	Blood + Anti-A	Blood + Anti-B	Blood + Anti-D	Threshold solution number
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

BIO-DATA

Name	:	Dolly Gogoi.
Date of birth	:	1st February, 1980.
Nationality	:	Indian.
Present address	:	Department of Anthropology.
Educational qualification	:	M. Sc. in Anthropology (Dibrugarh University).
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Area of research interest	:	Population genetics.
Title of Ph. D. thesis	:	Population genetics of the Mishmis of Arunachal Pradesh.

No. and date of registration for Ph. D: 802 of 18.05.2004.

Member of professional bodies: Life member of INCAA.

No & detail of workshop/seminar attended:

I. A National workshop on "Rainwater Harvesting, Flood Control and Integrated Water Management in North East India (October 16-17, 2008, organized by Department of Anthropology, NEHU and the Society for Indian Medical Anthropology, Mysore) was attended.

II. A workshop on "Research Methodology" (28th March, 2006 organized by ICSSR-NERC, Shillong and Department of Education, NEHU, Tura) was attended.