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Mortality and Opportunity for Selection in Idu and Digaru Mishmis of Arunachal Pradesh

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KEY WORDS Mortality. Opportunity for Selection. Mishmis. Socio-environmental Factors. Tribe. Arunachal Pradesh.

ABSTRACT Demographic studies elucidating the impact of socio-ecological factors have not been conducted so far on the people of Arunachal Pradesh, specially the tribal groups. As a part of the ongoing research work in the area, the results of the investigation on the impact of socio-environmental factors on mortality have been reported in the present article. Data on 120 Idu Mishmi and 146 Digaru Mishmi households, representing two different endogamous groups, were collected. The Idu Mishmi experience relatively higher mortality than the Digaru Mishmi. The Idu mothers, aged 25 years and more, have higher mortality than the Digaru mothers. Index of selection potential is also higher in the Idu Mishmi than in the Digaru Mishmi indicating that selection is operating more on the former than on the latter. An alarmingly high infant mortality rate, specially in the Idu, can be attributed to the compound effect of higher fertility, lower level of education and income, poor health and sanitation facilities.

Mortality checks the unlimited growth of population and regulates the distribution of individuals in different age groups. Infant mortality rate, a major component of mortality, has long been regarded as a sensitive indicator of socio-economic differences at individual and population levels (Shin, 1975; Antonovsky and Bernstein, 1977; Reddy and Chopra, 1990 a). A decline in the infant mortality has brought the demographic transition in both the developing and developed regions. Mortality decline has been associated with the improvements in infant health and survival, decision about family size, and the adoption and spread of family planning methods (Taylor et al., 1976; Preston, 1978; Prakash and Malik, 1990). Better health and greater infant survival have been because of the improved nutrition, availability of pure drinking water, proper sewage disposal and better medical care (Davis, 1956; Stolnitz, 1965; Preston, 1978, 1980; Gortmaker, 1979; Kshatriya et al., 1997). Also educated parents, specially mothers, provide adequate care to their infants in terms of health and hygiene, thereby ensure lower infant mortality (Shah and Abbey, 1971; Caldwell, 1979; Bhasin and Kshatriya, 1990). The risk of infant mortality increases in the young and the old mothers due to premature and degenerated reproductive system respectively. Also, higher parity, that reduces the birth intervals, results in the retarded fetal growth and birth of babies with low body weight. These factors increase the death risk of the infants (Fedrick and Adelstein, 1973; Wolfers and Scrimshaw, 1975; Frisancho et al., 1976; Haas et al., 1987; Pandey, 1991; Zamudio et al., 1993). On the other hand, increased birth interval, due to prolonged lactational amenorrhea, decreases mortality (Jain et al., 1970; Buchanan, 1975; McNeilly, 1977; Van Ginneken, 1977; Unger et al., 1988; Pandey, 1991; Zamudio et al., 1993).

The present study aims at comparing the crude death rate, the infant mortality rate, the neo-natal mortality rate, the post-neonatal mortality rate, the estimates of mortality and opportunity for natural selection in Idu and Digaru Mishmis and to identify the factors responsible for causing these differences.

MATERIALS AND METHODS

Demographic data were collected from 120 Idu Mishmi of Dibang Valley and 146 Digaru Mishmi households of Lohit District. Topographical and climatic features of Dibang Valley and Lohit district of Arunachal Pradesh provide an opportunity to Demographers and Human Biologists to study the impact of various environmental constraints on population settlement and expansion. Dibang Valley is surrounded by China, Tibet, Assam, Lohit and Siang districts of Arunachal Pradesh. Dibang Valley district has limited cultivable land as the thick forests, steep hills, rivers and riverlets occupy major land mass of the area. As such

human population growth (population density 2 persons/km^2) and agriculture produce are low in this ecozone. High rainfall, damp climate and flood, are the major sources of epidemics that reduce the chances of survival. These factors also disturb the transport, material supply and communication system. Scarcity of resources and hardships in life have inculcated in them a feeling that more working hands, in terms of number of children, is one way to overcome the crisis. In this process uneducated, under nutritive population, living under subhygienic conditions having poor health condition, is being produced. With each passing year the condition is further deteriorated. Consequently, they have to spend all their energy to fulfill their primary needs, sometimes at the cost of education, hygiene and even health maintenance.

On the other hand, Lohit district, is surrounded by Dibang Valley and Tirap districts of Arunachal Pradesh, China, Burma and state of Assam. The Lohit district is separated from the Dibang Valley district by the Dibang river. Slightly higher population density (6 persons / km^2) indicates that conditions are relatively less harsh for living in this district. Tezu town of Lohit district, the place of data collection, has lower rainfall and humidity as compared to Dibang Valley. Also slightly better medical facilities, relatively faster supply and communication, education, socio-economic status, awareness towards modern technology make the area more conducive for survival.

Lohit district is mainly inhabited by the Digaru and the Mizu Mishmis, whereas Dibang Valley district is inhabited by the Idu Mishmi. The Idu and the Digaru Mishmis have perhaps been originated from the same parental stock and have diverged to this area several hundred years ago due to pressure of limited resources and poor technological level resulting into poor survival and low population density. A number of tribal migrations have taken place through the Lohit Valley in the past. Out of the various groups of Mishmi tribes in the district, the Idus (Chulikata) were the first to come. They were followed by the Digaru (Taraons) who might have entered the Lohit Valley about 500 year ago. The Mizu (Kamans) Mishmis were the last to come (Gazetteers of Lohit district, 1980).

The geographic barriers have a considerable effect in limiting social interactions and intergroup marriages in Mishmis. But these barriers have not been able to force a change in their socio-cultural life, specially in terms of food habits, education and addiction for alcohol, tobacco, and rice beer. Topographical differences and environmental constraints have been responsible for causing the divergence between the two groups. Specially unbearable climatic conditions and limited resources in Dibang Valley have caused high mortality and has restricted population growth.

Demographic information were collected from currently married mothers using the questionnaire prepared and pretested following the recommendation of International Biological Programme (Weiner and Lourie, 1969). Mortality measures, viz. crude death rate, infant mortality rate, neonatal mortality rate and post-neonatal mortality rate were taken following the recommendations of International Biological Programme (Weiner and Lourie, 1969). Apart from these measures, estimates of mortality were computed following the method given by Brass and his colleagues (Brass et al., 1968). Estimate of mortality translates the proportion surviving the proportion dead among the children everborn to women in different age groups into conventional measures of mortality. If fertility begins at an early age, then the children born to women in each group would be exposed to prolonged risk of mortality. Therefore, the proportion dead would tend to be higher for each age group of mothers than when fertility has a later onset. The index of early or late fertility is the ratio of the average number of children everborn in the first two age groups of women, and is denoted as P_1/P_2. In making adjustment for estimates derived from the proportion dead among the children everborn to the older women, the index of early or late fertility or the mean/median age of fertility could be used. In the present study the mean age (m) has been used for calculating the correction factor.

Brass and his colleagues proposed a set of multipliers, based on the ratio of dead to children everborn to women in the age intervals 15-19, 20-24, 25-29, and so on, for calculating estimates referring to the probability of dying before attaining a particular childhood age (Brass et al., 1968). The Brass's equation is as follows:

$q(x) = K(i) \times D(i)$

where, $q(x)$ is the probability of dying between birth and exact age x;

$K(i)$ is the multiplying factor for each group's (15-19, 20-24, ..., 40- 44) of women; and

$D(i)$ is the proportion dead among children everborn to each group's (15-19, 20-24, ..., 40-44) of women.

Brass and his colleagues suggested to derive $K(i)$ from the ratio of P_2/P_3 (Brass et al., 1968). This application in the Brass's method of estimation reduces the error due to misreporting of age, causing greater variability in parity, and small number of births in earlier age sets of mother (Brass, 1975).

The index of total selection was calculated following Crow's method (Crow, 1958). In this method, selective pressure is estimated based on the reproductive success of a population. Crow's method is based on the Fisher's theorem of natural selection (Fisher, 1930). It considers the proportion by which fitness would increase with specific birth and death rates if they were all selective and heritability of fitness was complete (Crow, 1972). In reality, the effect of genetic component in differential fertility and mortality is rather small and reproductive outcome of an individual or a population is a result of the interaction of a variety of socio-cultural factors (Crow, 1966; Cruz-Coke et al., 1966). Therefore, the index sets an upper limit for the potential action of Natural selection and is renamed as opportunity for Natural selection (Crow, 1966). Opportunity for Natural selection has two components - differential fertility and differential mortality (Crow, 1972). These two components determine the relative fitness of the population.

The index of selection potential (I_1) is as follow:

$$I_1 = I_m + P_s \times I_f$$

Where, I_m is index of mortality

I_f is index of fertility

P_s is the probability of surviving from birth to the reproductive ages.

The index of total selection was further separated into pre-natal and post-natal mortality components by Johnston and Kessinger (1971). The index of selection potential (I_2) thus becomes,

$$I_2 = I_{me} + 1/P_b \times I_{mc} + 1/P_b P_s \times I_f$$

Where, I_{me} is the index of embryonic mortality;

I_{mc} is index of childhood mortality; and

P_b is the proportion of survivors to birth

A further separation of survival, from birth to reproductive age, into different survival component give an index of selection potential (I_3) which is calculated as follow:

$$I_3 = I_{me} + 1/P_b \times I_c + 1/P_b P_q \times I_j + 1P_b P_q P_{s2} \times I_f$$

$I_{mc} = (1-P_b) / P_b$;

$I_c = (1-P_q) / P_q$;

$I_j = (1-P_{s2}) / P_{s2}$;

Where, P_b is the proportion of survivors to birth;

P_q is the proportion of survivors from birth to 5 years of age; and

P_{s2} is the proportion of survivors from 5 years to the reproductive age.

RESULTS AND DISCUSSION

The crude death rate is higher in the Idu Mishmi than in the Digaru Mishmi (Table 1). Crude death rate, the most widely used index of mortality, provides one of the basis for estimating population change and is often used in policy formulation and implementation. But it is not possible to understand from this index the microlevel demographic process in small scale, non-literate, isolated societies.

Infant mortality rate in the Idu Mishmi is higher than in the Digaru Mishmi (Table 1). The infant mortality rates are astonishingly higher in both the Mishmi groups as compared to the National figure (110 per 1000 live births as per 1981 SRS) but similar to many tribal groups in India (Das et al., 1982; Basu, 1986; Bhasin and Kshatriya, 1990; Reddy and Chopra, 1990b; Malhotra, 1994; Basu, 1996; Kshatriya et al., 1997). Randon inbreeding, due to small population size and indigenous nature of the Mishmis alongwith low nutritional intake, isolation, poor health facilities and prevalence of infectious diseases are some of the reasons for high infant mortality in both the Mishmi groups. As infant mortality depends to a great extent on the environmental conditions such as hygiene, nutrition, infectious, diseases, etc., the

Table 1 : Comparison of various Mortality measures in Idu and Digaru Mishmis

Mortality Measures (per 1000)	*Idu*	*Digaru*
Crude death rate	21.05	15.30
Infant mortality rate	323.53	222.22
Neonatal mortality rate	29.41	83.33
Post Neonantal mortality rate	294.12	138.89

risk of death is quite high in the earlier days.

Neonatal (birth to 28 days) death rate is lower in the Idu Mishmi than in the Digaru Mishmi (Table 1). Neonatal deaths are mainly due to several intrauterine environmental disturbances or genetical anamolies. The major cause of neonatal mortality is physiological impairment or organic weakness in the form of low birth weight or premature birth. High parity, low parity spacing, nutritional deprivation and addiction to alcohol in pregnant mothers are some of the salient causes of babies born premature with low body weight. These low weight babies scummble to death more often, if they are met with the adverse environmental conditions. Medical care has substantially reduced the post-natal (29 to 365 days) death rates, but its impact has been only marginal on the neonatal mortality rates. To the higher infant mortality rates, the neonatal mortality rates do not contribute much in case of the Idu Mishmi, but the post-natal mortality rates have substantial effect on increasing infant mortality rate. It has been suggested that infants are more vulnerable to infections and parasitic diseases such as influenza, pneumonia and bronchitis (UN, 1962). It has also been demonstrated that a health programme is successful, rather quickly and directly, if the proper care is given to the infants. Thus it seems that poor health and hygienic conditions are responsible for high post-natal mortality, specially in the Idus.

Child mortality is high in the first and second parity mothers in both the Mishmi groups. Mortality estimates for the Idu and the Digaru Mishmi show a similar trend as that of mortality rates except in the younger mothers below 24 years of age. The possibility of difference between mortality rates and mortality estimates exist because of the limited number of mothers in each group. Also, in the former, deaths in the last one year are counted, whereas in the later total number of deaths in their reproductive life are considered. The Idu Mishmi have higher proportion of deaths in children of all ages except the early ages (1 and 2 years) than the Digarus. It seems that in the Idus selection operates more strongly during prenatal stage thereby considerably reducing the pressure of selection during infancy. However in the Digarus selection pressure is stronger during infancy stage. Consequently, the average parity is lower in all the age groups of Idu mothers irrespective of their higher fertility rates.

The index of opportunity for selection is higher in the Idu Mishmi than in the Digaru Mishmi. It is evident that the selection intensities are associated with the mean live births and the mortality components. Higher

Table 2 : Mortality estimates for the Idu Mishmi

Age of mothers	*Pi*	*Si*	*1-Si/Pi*	*Age X*	*Multiplication factor*	*Proportion by age X*
15-19	0.40	0.40	0.000	1	0.941	0.0
20-24	1.93	1.64	0.150	2	0.990	0.148
25.29	3.00	2.20	0.266	3	0.982	0.261
30-34	4.58	2.82	0.384	5	0.991	0.381
35-39	6.65	3.65	0.451	10	0.999	0.451
40-44	7.70	3.94	0.488	15	0.975	0.476
45-49	6.18	3.23	0.477	20	0.973	0.464

Where, Pi = Average number of children everborn;
Si = Average number of children surviving;
m = 27.44;
P_1/P_2 = 0.207

Table 3: Mortality estimates for the Digaru Mishmi

Age of mothes	*Pi*	*Si*	*1-Si/Pi*	*Age X*	*Multiplication factor*	*Proportion dead by age X*
15-19	1.20	0.80	0.330	1	1.023	0.341
20-24	2.07	1.42	0.314	2	1.316	0.413
25-29	3.70	2.77	0.250	3	1.007	0.252
30-34	3.50	2.66	0.238	5	1.012	0.241
35-39	5.86	3.54	0.395	10	1.022	0.404
40-44	5.55	4.55	0.180	15	0.999	0.180
45-49	2.29	1.87	0.181	20	0.998	0.181

Where, Pi = Average number of children everborn;
Si = Average number of children surviving;
m = 27.97;
P_1/P_2 = 0.597

Table 4 : Comparison of index of opportunity for selection among Idu and Digaru Mishmis

	Idu	*Digaru*
Number of mothers	135	158
Total pregnancy reported	696	641
Total number of live birth	637	613
Average number of live birth	4.72	3.60
Variance of live birth	9.42	7.20
P_s	0.626	0.696
P_d	0.374	0.304
P_b	0.915	0.956
P_bP_s	0.573	0.665
I_t	1.271	1.227
I_m	0.597	0.437
I_f	0.423	0.550
I_f/P_s	0.676	0.790
% of fertility component	53.030	64.380
% of mortality component	46.970	35.620
I_2	1.483	0.869
I_{me}	0.093	0.046
I_{mc}	0.597	0.437
P_bP_s	0.573	0.665
I_{me}/P_b	0.652	0.457
I_3	1.461	1.331
P_{sq}	0.680	0.768
P_{s2}	0.921	0.906

Where,

I_1, I_2 and I_3	are the Selection Indices;
I_f	is the Fertility Index;
I_m	is the Mortality Index;
I_{me}	is the Embryonic Mortality Index;
I_{mc}	is the Childhood Mortality Index;
P_bP_s	is the Age Proportion o Survivors from the Early Embryo to Reproductive age;
P_s	is the Proportion of Survivors;
P_d	is the Proportion of dead;
P_b	is the Proportion of Survivors to Birth;
P_{s2}	is the Proportion of Survivors from 5 years of Age to Reproductive Age; and
P_{sq}	is the Proportion of Survivors from Birth to 5 years of age

mortality components, I_m (by Crow, 1958 method) and I_{me} and I_{mc} (Johnston and Kessinger, 1971 method) in the Idu Mishmi confirm that the relative contribution of mortality is more in the Idu Mishmi than in the Digaru Mishmi. Studies among the Indian tribal groups indicate that pre-reproductive mortality contributes heavily to the process of natural selection, whereas in the populations of industrially developed countries, pre-reproductive mortality is extremely low (Spuhler, 1962; Cavalli-Sforza and Bodmer, 1971).

CONCLUSION

The following conclusions can be derived from the present study. Firstly, both Idu and Digaru Mishmis have high mortality rates. Secondly, the Idu Mishmi have higher crude death rate than the Digaru Mishmi. Thirdly, infant mortality is higher in the Idus, more in the form of post-natal mortality than the neonatal mortality. Mortality estimate analysis suggests higher mortality in older Idu mothers (25 year and above) than the Digaru mothers. The trend is reversed in the younger mothers (below 25 years). Index of opportunity for natural selection reflects greater selection pressure on the Idu Mishmi than the Digaru Mishmi.

High mortality in the two Mishmi populations can be ascribed to a variety of reasons including lack of knowledge of the benefits of the family planning methods and the importance of small family size. Consideration of children as economical assets, feeling of replacement of the loss due to high infant and child mortality caused by the rigourous environment and the lack of medical facilities lead to the results contrary to their expectation. High fertility further lowers their socio-economic and health conditions and therefore, increases mortality. High fertility, lower level of education and income, poor medical facilities and lack of proper sanitation and drinking water are some of the reasons for such a high mortality rates in both the Mishmi groups specially the Idu Mishmi. The selection intensity indices confirm higher embryonic and childhood mortality, and lower survival ratio during childhood in the Idus than the Digarus. Thus the Idus face greater pressure of natural selection as compared to the Digarus.

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