Original Article

Measuring opportunity for natural selection: Adaptation among two linguistically cognate tribes inhabiting two eco-situations of North-East India

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BACKGROUND: Numerous literature on the migration of Mishings point out to the fact that the Mishing and the Minyong are two culturally and linguistically cognate tribes that co-existed in the same ecology in the hills of Arunachal Pradesh. The Mishing tribe after migration, now inhabits flood-prone areas of Brahmaputra valley of Assam.
AIM: The study aims to measure the adaptation process of these two cognate tribes inhabiting two different ecologies at present: Hills and plains by calculating the index of selection intensity by Crow's and Johnston and Kensinger's formulae.
MATERIALS AND METHODS: The reproductive histories of 77 Mishing mothers of completed fertility inhabiting a flood affected village of Assam and 74 Minyong mothers inhabiting a hilly village of Arunachal Pradesh are selected.
RESULTS AND DISCUSSION: The Minyongs show higher average fertility than the Mishings. The proportion of embryonic death is higher, and child death is lower among the Mishings (0.1661; 0.1623) than the Minyongs (0.1319; 0.2238). The index of selection due to mortality component is contributing more toward the total index of selection in both the tribes.
CONCLUSION: The contribution of mortality component is sizeable to the total selection like many other tribes of North-East India. Higher proportion of embryonic deaths among the Mishings infers that the causes are mostly biological whereas, the higher proportion of child deaths among the Minyongs infers that the causes are mostly socio-cultural.

Key words: Adaptation, cognate, minyongs, mishings, natural selection

Access this article online	
Quick Response Code:	Website: www.ijhg.com
	DOI: 10.4103/0971-6866.116113

Introduction

Man is the product of two interdependent courses of evolution – biological and cultural. This complex matrix of culture and gene has made human population survive since, its evolution and to evolve continuously to adapt to the changing environmental regime. Human adaptation is a very significant and extremely fascinating process because it is largely different from other related as well as non-related biological species. It is no doubt that largely, the emergence of culture in the course of human evolution has been determining biological evolution; however, it is a misconception that cultural progress has nullified biological evolution. Penrose[1] rightly states that although our species-*Homo sapiens* is freed from many habitational or spatial constraints; however, the species is not completely released from the evolutionary forces and factors, particularly the influences of natural selection. Ever since Charles Darwin published his remarkable work, The Origin of Species by Means of Natural Selection in 1859, even today natural selection is considered the most important mechanism to maintain and pattern the variety of organic life. The processes of adaptation and natural selection are two sides of the same coin because a population adapts to ecology due to its variation in the genotype (that is inherited) and modification in the culture (transmitted in a non-genetic way). Most of the empirical studies demonstrate that adaptation never occurs in abstract but only in relation to specific habitational pressures and challenges or selective pressures.[2] Natural selection operates mainly through two means, differential fertility, and differential

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mortality. Differential fertility refers to the differences in the contribution made to the next generation by individuals due to their inequalities in reproductive performance. Differential mortality operates on individuals prior to the reproductive age and represents that class of individuals who cannot contribute biologically to the next generations. With regard to selection, the most important variable to consider is Darwinian fitness or simply fitness, which is a measure of capacity to survive and to leave descendants or offspring. Capacity to survive is the phenomenon of adaptation at the biological level and cultural level in human groups. A class of individuals that can survive to the reproductive age contributes differentially to the next generations. However, it is probable that natural selection operating through differential mortality is less important among modern human populations where differential fertility appears to be the effective agent. Very significantly, this transition occurred due to improved quality of life and use of modern healthcare among the present populations. It is pertinent to note here that the contribution of mortality is sizeable as well as prominent to the total selection intensity among some less developed populations including in India.

Crow[3] devised an index of total selection intensity (I) to quantify the influence of natural selection inherent in an evolutionary process. The index assumes that the reproductive differentials are due to genotypic differences and more importantly, fitness is completely heritable. The index is divided into two components: I_m – due to mortality prior to the reproductive age and I_f – due to differences in reproductive performance among women who have reached reproductive age. As the reproductive outcome of a population is the result of the interaction of a variety of socio-cultural factors as well as genetic factors, therefore, the index sets an upper limit for the potential action of natural selection and is renamed as an opportunity for natural selection. Since this index covers mortality only at the postnatal age, Johnston and Kensinger[4] modified the formula by considering and adding the prenatal mortality component in the computation of the index of total selection intensity.

Crow's index of total selection intensity is as follows:

$$I = I_m + I_f/P_s;$$

$$I_m = P_d/P_s;$$

$$I_f = V_f/X^2;$$

where I is the index of total selection intensity, I_m the index of selection due to mortality, I_f the index of selection due to fertility, P_d the proportion of premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life), P_s the proportion of survivors up to the reproductive age and above ($1 - P_d$), V_f the variance in number of live-births due to fertility, and X is the mean number of live births per woman aged 45 years and above.

Johnston and Kensinger's index of total selection intensity is as follows:

$$I = I_{me} + I_{mc}/P_b + I_f/P_b \times P_s;$$

$$I_{me} = P_{ed}/P_b;$$

$$P_b = 1 - P_{ed};$$

$$I_{mc} = P_d/P_s;$$

$$P_s = 1 - P_d;$$

$$I_f = V/X^2;$$

where I is the index of total selection intensity, I_{me} the index of selection due to embryonic mortality, I_{mc} the index of selection due to child mortality, P_{ed} the probability to die before birth, P_b the probability to survive till birth, I_f the index of selection due to fertility, P_d the proportion of premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life), P_s the proportion of survivors up to the reproductive age and above ($1 - P_d$), V_f the variance in number of live-births due to fertility, and X is the mean number of live births per woman aged 45 years and above.

"P_d" and "P_s" are calculated based on pre-reproductive deaths in the modified formula of Johnston and Kensinger.

Prime Objective of the Study

The present study aims at understanding the process of adaptation of the Mishings of Assam and the Minyongs of Arunachal Pradesh by measuring the index of total selection intensity. The Mishings are the second most populated plains tribe of Assam who are socioculturally very close to the Adis of Arunachal Pradesh. Various accounts on Mishings refer to the fact that a portion of the Adi group inhabiting the lower Subansiri bank of Arunachal Pradesh had been displaced in time immemorial to the present Brahmaputra valley

of Assam (though the reasons of displacement may vary from author to author), and some scholars[5,6] have referred that this displaced group is the present Mishing community of Assam. The folk-tales and folk songs also reveal the fact that they were hill inhabitants of Arunachal Pradesh in the past. The folk-tales reveal their struggle while migrating to Assam through deep jungles of Arunachal Pradesh to the Brahmaputra valley of Assam. They show many similarities in the culture and ethno-linguistic arena with the Adi group, particularly the Padam and Minyong tribes. According to Taid,[7] Mishing is a Tibeto-Burman language/dialect spoken by Mishings of Assam and the Adis of Arunachal Pradesh. Its closest cognates are the vernaculars of the Adis in the Siang and Lohit districts of Arunachal Pradesh, particularly the speech forms of the Padam and Minyongs.[7] As per the census report of 1991,[8] the population of the Mishings in the state was 467,790, which constituted around 16.3% of its total tribal population of the state. According to 2001 census,[9] the population of Mishings is increased to 587,310, which is 17.8% of the total scheduled tribe population of the state. Thus, this decadal population growth clearly signifies that the Mishings are surviving and adapting properly after being migrated or displaced to the plains areas of Assam from the hilly areas of Arunachal Pradesh. It is pertinent to note here that the riverine areas that the Mishings inhabit are perennially flooded. Thus, their past ecological constraints were very different from the present ecological constraints. The culture of the Mishing tribe incorporates certain cultural elements of the Padam-Minyong culture, which offer them immense abilities to survive during the stressful duration of the perennial flood situations. Therefore, this study aims at measuring the intensity of natural selection in these two populations - The Mishings of Assam and the Minyongs of Arunachal Pradesh that are ecologically posited differently and one being the offshoot of the other.

A Brief Ethnographic Account of the Two Populations

The Mishings

The Mishings are erstwhile a hill tribe of Arunachal Pradesh[10,11] and has become second most populated scheduled tribe (plains) of Assam. Ethnically, they are Mongoloid and belong to the Indo-Tibetan linguistic group. Their ethno-linguistic affinity with the Adis is striking.[7,11] Traditionally, Mishings were hunting, fishing and gathering tribe, and as a plains tribe in Assam besides cultivation, they also resort to fishing; however, hunting is rare. They construct their houses in raised platforms about feet above the ground. A typical Mishing house is sometimes as much as 30/40 m in length and contains 30/40 persons living in a hall without compartments. The pigs and looms are kept under the platform of the house. The fireplace called *meram* is considered as an auspicious place. Rice beer or *apong* is regarded as a popular and prestigious drink in their socio-religious life. The *morung* or the bachelors' dormitory is an important institution. Every village has a kebang, which can aptly be compared with a village panchayat, which acts as the governing body. The Mishings originally believed in animism; however, the present religion is the synthesis of animism and Hinduism. In spite of diffusion, they worship the sun (*donyi*) and the moon (*polo*). They believe in different supernatural beings haunting the earth, usually unseen. The Mishings practice clan exogamy and tribal endogamy in matrimonial system.

The Minyongs

The Minyong forms a large group within the broader framework of the Adi tribe (Abor, exonym). They inhabit a large part of the Central and South-Eastern Siang district of Arunachal Pradesh. There are two broad theories of migration of the Minyong from the Indo-Tibetan borders or the Brahmaputra valley to their present habitat. Their oral narratives (*abang*) contain references to their southwardly migration and not from the Indo-Tibetan border.[12] In spite of the difficult terrain with rivers and hills, like the Mishings of Assam, they build permanent houses on wooden piles at a height of one to ten feet above the ground with split bamboo. The Minyongs mainly practice shifting cultivation known as *jhum* cultivation. However, at present they also do wet cultivation. Both men and women are involved. The main bulk of products are food crops mainly rice. The religious life of the Minyongs revolves around a multitude of spirits known as *uyu*, both malevolent and benevolent. The Supreme Being in the Minyong pantheon is the *donyi-polo* (sun-moon). Rice beer or *apong* is regarded

as a popular and prestigious drink in their socio-religious life. They practice clan exogamy and tribal endogamy in matrimonial system.

Materials and Methods

The demographic data on the reproductive histories of 77 ever-married Mishing women and 74 ever-married Minyong women of completed fertility are considered. The Mishings living in the village – Batuwamukh Miri Gaon of Dhemaji district of Assam (perennially flood-affected village) and the Minyong village – Mori, located in the West Siang district of Arunachal Pradesh is considered for the purpose. The demographic information pertaining to fertility and mortality are obtained mainly through interviewing these married women using a pre-tested structured schedule. The collected data include the fertility and mortality rates at both prenatal (miscarriage, abortions, and stillbirths) and postnatal stages. Due to relatively earlier menopausal age and early decline of fertility among the North-East Indian women, mothers of 45 years of age and above are considered to have completed their fertility.[13] In the present study, the indices of opportunity of the natural selection are calculated by applying both the original formula of Crow and modified formula of Johnston and Kensinger, which takes into account the embryonic deaths.

Results and Discussion

Table 1 depicts the parameters used in calculating the indices of opportunity for natural selection according to Crow's formula and Johnston and Kensinger's formula. The average number of live birth per mother among the Minyong population is found to be 6.58 ± 0.33, which is much higher than the Mishing mothers (6.00 ± 0.31) are. However, the proportion of embryonic deaths (miscarriage, abortion, and stillbirth) is comparatively higher (0.1661) among the Mishing mothers than the Minyong mothers (0.1319). Moreover, it is interesting that the proportion of premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life) is higher in case of the Minyongs (0.2238) though their proportion of embryonic deaths is lower than the Mishing women. The proportion of survivor up to 15 years of age and above seems slightly higher among the Mishing women (0.8377) than the Minyong women (0.7762).

Table 1: Parameters used in calculating the index of opportunity for natural selection

Parameters	Mishings	Minyongs
Total number of mothers with completed fertility (45 years and above)	77	74
Total number of conceptions	554	561
Total number of live births	462	487
Average number of live birth per woman	6.00±0.31	6.58±0.33
Number of embryonic deaths (miscarriage, abortion, still birth)	92	74
Proportion of embryonic deaths (miscarriage, abortion, still birth)	0.1661	0.1319
Number of death children up to 15 years of age	75	109
Proportion of premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life)	0.1623	0.2238
Number survivors up to 15 years of age and above	387	378
Proportion of survivors up to 15 years of age and above	0.8377	0.7762
Variance of mean live birth	3.03	4.67

Thus, from Table 1, it can be inferred that due to a higher proportion of embryonic deaths in case of the Mishing mothers, they have comparatively lower average number of live births per woman. However, it is pertinent to note here that though the Minyong women have slightly lower proportion of embryonic deaths but the higher proportion of premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life) and a lower proportion of survivor up to 15 years of age and above than the Mishing mothers. This clearly signifies that the prime causes of such deaths among the Minyongs are primarily exogenous or more importantly socio-cultural and ignorance towards health care facilities for child survival and rearing. Moreover, the study has revealed that the proportion of female survivor up to 15 years of age and above is comparatively lower than the male survivors in both the tribes; however, such a gap is more prominent among the Minyong tribe. This is because of age at marriage of the females in the Minyong population is found to begin from the age 14 years and the present study have revealed that about 12.27% of Minyong females have entered into marital unions at the tender age category of 14-17 years.

The indices of selection intensity by Crow's formula

and Johnston and Kensinger's formula of the two populations are shown in Table 2a and b. Table 2a depicts the indices of selection intensity among the Mishings. It is evident from the table that the Crow's index of selection due to mortality component is higher (0.1937) than the fertility component (0.0842). This is because of additive effects of the proportion of embryonic deaths and premature deaths up to pre-reproductive age (i.e., deaths before 15 years of life). However, the Johnston and Kensinger's formula clearly indicates that of the mortality component the index of selection due to embryonic mortality (0.1992) is contributing more towards the total index of selection intensity than the index of selection due to child mortality (0.1937).

A similar trend is also noticed in respect to the indices of selection intensity among the Minyong population. The index of selection due to mortality component (0.2883) is contributing more towards the total index of selection intensity than the index of selection due to fertility (0.1078). However, the Johnston and Kensinger's formula reveals an interesting fact that the index of selection due to the child mortality (0.2883) is much higher than index of selection due to embryonic mortality (0.1519). Thus, unlike the Mishing population, the index of selection due to the child mortality component (0.2883) is contributing more towards the total index of selection intensity than the index of selection due to embryonic mortality (0.1519).

Table 3 depicts the indices of Selection Intensity among some of the populations of Assam and Arunachal Pradesh, including the results of the present study. According to Reddy and Chopra,[14] the indices of selection intensity (*I*) among Indian populations range between 0.24 and 2.25; I_m between 0.01 and 0.81 and I_f between 0.17 and 0.83. The calculated data of the present populations indicate that the values of *I* among the Mishings as well as the Minyongs tend more toward the lower limit of the range. A similar trend is observed with I_m. However, it is significant to note that the index of selection due to fertility (I_f) is much lower than the lower limit of the range of Indian populations in both the populations. It is also pertinent to note here that the opportunity for selection (calculated using Crow's formula and Johnston and Kensinger's formula) in the present populations operates primarily through differential mortality rather than the differential fertility that is very often observed in many Indian populations. The values of "*I*" is the highest among the Singpho of Arunachal Pradesh (1.020);[15] among the North-East Indian populations so far studied. However, in Assam, the Sonowals have the highest value of "*I*," followed by the Mishings of Assam (present study) according to Crow's index. Nevertheless, if the value of "*I*" is considered according to Johnston and Kensinger's

Table 2a: Index of selection intensity: The Mishing

Crow's formula (1958)			Johnston and Kensinger's formula (1971)			
I_m	I_f	*I*	I_{me}	I_{mc}	I_f	*I*
0.1937	0.0842	0.2942	0.1992	0.1937	0.0842	0.5520

Table 2b: Index of selection intensity: The Minyong

Crow's formula (1958)			Johnston and Kensinger's formula (1971)			
I_m	I_f	*I*	I_{me}	I_{mc}	I_f	*I*
0.2883	0.1078	0.4272	0.1519	0.2883	0.1078	0.6439

Table 3: Indices of selection intensity: Some of the populations of Assam and Arunachal Pradesh

Population	Crow's formula (1958)			Johnston and Kensinger's formula (1971)				Source
	I_m	I_f	*I*	I_{me}	I_{mc}	I_f	*I*	
Assam								
Bengali Muslim of Cachar* (NA)	0.43	0.31	0.87					Chakravarty, 1976[16]
Bodo-Kachari (NA)	0.110	0.130	0.250					Guha and Mukherjee, 1990[17]
Sonowal (72)	0.1676	0.1638	0.3589	0.0535	0.1777	0.1638	0.4321	Sengupta and Kalita, 1996[18]
Khampti (29)	0.179	0.113	0.312	0.005	0.179	0.113	0.319	Sarkar *et al*., 1994[19]
Mishing (77)	0.1937	0.0842	0.2942	0.1992	0.1937	0.0842	0.5520	Present study
Arunachal Pradesh								
Minyong (74)	0.2883	0.1078	0.4272	0.1519	0.2883	0.1078	0.6439	Present study
Apatani (Guth) (120)	0.440	0.312	0.889					Padmanabham and Jaswal, 1982[15]
Apatani (Guchi) (64)	0.435	0.195	0.710					Padmanabham and Jaswal, 1982[15]
Galong (36)	0.750	0.180	1.070					Chakravarty and Ahmed, 1989[20]
Singpho (143)	0.437	0.406	1.020					Padmanabham and Jaswal, 1982[17]
Muklom (40)	0.107	0.188	0.315	0.021	0.107	0.188	0.342	Sarkar, 1997[21]

*Number in the bracket show the sample size taken for calculation by the authors, **NA: Not available

index, then the Mishings of the present study show the highest value. Except the Bodo-Kacharis of Assam, the index of selection due to mortality component is contributing more to the total index of selection intensity.

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Cite this article as: Sarma M. Measuring opportunity for natural selection: Adaptation among two linguistically cognate tribes inhabiting two eco-situations of North-East India. Indian J Hum Genet 2013;19:159-64.

Source of Support: Nil, **Conflict of Interest:** None declared.