

Demography and Demographical Genetics of Two Isolated Mountain Villages of Northern Sikkim, Eastern Himalaya

SAWPAK K. DAS¹, PARTHA P. MAJUMDER² AND AMITABHA BASU¹

¹*Anthropometry and Human Genetics Unit, Indian Statistical Institute, Calcutta*

²*Center for Demographic and Population Genetics, University of Texas Health Science Center, Houston, Texas*

Abstract: Demographic data on Lachung and Lachen, the two northernmost, permanently inhabited villages of Sikkim located at altitudes of approximately 2,300m and 2,600m, respectively, are presented. It has been shown that in general Lachen has lower fertility and higher mortality rates than Lachung. The possible genetic consequences of these demographic differences have been predicted.

Introduction

Sikkim is a tiny Himalayan ex-kingdom of 7,325 square kilometers of mainly mountainous and hilly tracts, which ceded to India in 1975. The total population of 210 000, as of Census 1971 (Census of India, 1981) comprises three major ethnic/linguistic groups: the Nepali (70 per cent), Lepcha (14 per cent) and Bhutia (16 per cent) (Chopra 1979). Of the three groups, the Nepalis inhabit the southern, Lepchas the central, and Bhutias the northern mountainous regions. The Bhutias of Sikkim seem to be a section of the larger Tibetan-speaking population of the Himalayan-subHimalayan region (e.g. Bhutia, Sherpa, Toto, Dukpa, Yolmo, etc.), the forefathers of whom had probably moved into this region from Tibet in the early 17th century (Chopra 1979). The Bhutias of Sikkim speak a Tibetan dialect, follow the Tibetan sect of Buddhism and traditionally have had extensive social and trade relations with Tibet until the border was sealed in the early 1950s.

A demographic survey was conducted in the two northernmost, permanently inhabited villages of Sikkim, i.e. Lachung and Lachen, at altitudes of approximately 2,300m and 2,600m, respectively. Both the villages are fairly isolated, with very limited transport and communication facilities having been established only recently. The primary occupation in both villages is agriculture, but in the case of Lachung the villagers move southwards to their fields at an altitude of about 1,200m, whereas in the case of Lachen they move further north to about 4,000m, during the agricultural season. In Lachung, some people have secondary occupations, e.g. work in timber trade and government-aided apple orchards, but Lachen generally lacks such activities and may therefore be economically relatively worse-off. Each of the two

villages is served by a poorly-stocked dispensary and an inadequately-staffed primary school.

The purpose of the present study is (a) to compare and contrast the demographic characteristics of fertility and mortality of the two abovementioned villages, and (b) to estimate the possible population genetical implications of the demographic differences, if any.

Materials and Methods

Lachung is a village of approximately 160 and Lachen of 110 households, of which demographic data were collected from 96 and 37 households, respectively, using household and fertility questionnaire/schedules. For the household schedule information were collected from household head on age, sex and marital status of all members, and for the fertility schedule from married females on their reproductive performance, i.e. live births, dead children, reproductive wastage, as well as polyandry. In the absence of any written records of births, ages were estimated by reference to important local events. All information were cross-checked from several sources. Reproductive wastages were probably considerably underreported, and therefore these data were not utilised.

Results and Discussion

Table 1 shows that about 35 per cent of the total population is in the age group 0-14, about 54 per cent in 15-49, and about 11 per cent in 50+ years, indicating a moderately growing population in both the villages, but the constriction at the base of the population pyramid in Lachung suggests a recent decline in fertility which may not have occurred in Lachen (Figure 1). The decline may be related to a considerably higher sex ratio (expressed in terms of per cent males) in the former, particularly in the reproductive age group of 15-49 years, and is further corroborated by the child : woman ratio which is rather low in both but slightly lower in Lachung (Table 1).

An important sociocultural characteristic of many Himalayan populations is fraternal polyandry (Goldstein 1978) which occurs in both these Himalayan villages, but in considerably higher frequency in Lachen (Table 2). Evidences are not clear but there is some indication that polyandry may reduce fertility (Goldstein 1976), and the higher incidence of never-pregnant women in Lachen (Table 3) thus is compatible with the higher frequency of polyandrous women in the same village (Table 2), although this observation in itself does not confirm any inverse relationship between polyandry and fertility. Our estimate of the frequency of polyandry is a minimal one, for we have excluded a woman's husband's brothers aged 15 years or below from this analysis (since husbandhood in those early ages is not biologically meaningful)

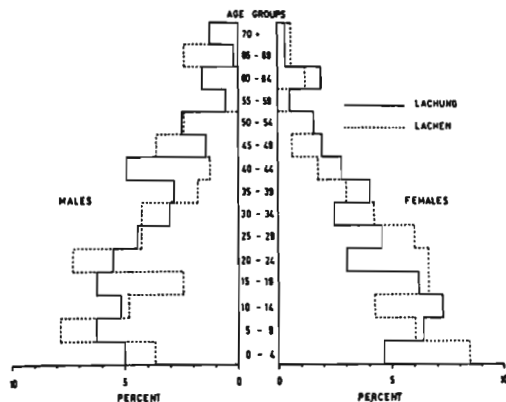


Fig. 1. Population Pyramid

Table 1. Age-sex structure

Age group	Lachung			Lachen		
	Male	Female	Total	Male	Female	Total
0-4	28	26	54	6	14	20
5-9	35	36	71	13	10	23
10-14	29	41	70	8	7	15
0-14	92	103	195	27	31	58
	Sex ratio	47.18	34.95%	Sex ratio	46.55	35.37%
15-19	35	35	70	4	11	15
20-24	31	17	48	12	11	23
25-29	25	26	51	7	10	17
30-34	17	14	31	7	7	14
35-39	16	23	39	3	5	8
40-44	28	16	44	2	3	5
45-49	8	11	19	6	1	7
15-49	160	142	302	41	48	89
	Sex ratio	52.98	54.12%	Sex ratio	46.07	54.27%
50-54	14	9	23	4	3	7
55-59	3	3	6	0	0	0
60-64	9	11	20	0	2	2
65-69	1	2	3	4	1	5
70+	7	2	9	2	1	3
50+	34	27	61	10	7	17
	Sex ratio	55.74	10.93%	Sex ratio	58.82	10.37%
Total	286	272	558	78	86	164
	Sex ratio	51.25	100.00%	Sex ratio	47.56	100.01%
	CW ratio	38.03		CW ratio	41.67	

Table 2. Multiple marriage¹

Village	No. of mar.										More-than-once-mar. % all mar.			
	Once		Twice		3 times		4 times		5 times		Total		M	F
	M	F	M	F	M	F	M	F	M	F	M	F		
Lachung	123	69	2	15	0	5	0	2	0	1	125	92	1.60	25.00
Lachen	50	22	1	14	0	2	0	0	0	0	51	38	1.96	42.11

¹Only such spouses who live together in the same household are considered in this analysis (i.e. those divorced, widowed, separated, etc. are not considered).

Note: Both Lachung and Lachen are polyandrous societies. All brothers of a woman's ceremonially married husband are automatically her husbands. However, in the above analysis we have considered only the brothers attaining the reproductive age (those older than 15 years), for below that age husbandhood is not biologically meaningful.

Table 3. Ever-pregnant and never-pregnant women

Age group	Lachung			Lachen		
	Ever-pregnant	Never-pregnant	Nev.-preg. % all	Ever-pregnant	Never-pregnant	Nev.-preg. % all
15-24	5	2		2	2	
25-34	18	3		12	1	
35-44	30	2		6	0	
45+	34	2		4	2	
Total	87	9	9.38	24	5	17.24

although by social norms they are also her husbands. All the other measures of fertility, i.e. number of surviving children per woman, completed family size and net reproductive index, and total fertility rate, also show lower values in Lachen than in Lachung (Tables 4, 5 and 6). Contrary to this, the child : woman ratio suggests a slightly higher fertility in Lachen (as has been mentioned above) but the limitations of this ratio as a measure of fertility is well known. Alternatively, the lower child : woman ratio in Lachung may be due to a recent fertility decline in the same village (as has also been suggested by the constriction at the base of its population pyramid)—a process which may not yet have started in the already low-fertility population of Lachen. That fertility may indeed have declined in Lachung compared to Lachen in recent years is also suggested by the age specific fertility rates for age periods below 19 and 20-24 years (Table 6). The possibility of a declining fertility can also be tested by comparing completed family size (which measures the total number of live births produced by elderly women, i.e. those aged 45+ years) and total fertility rate (which estimates the number of live births to be produced by a group of women, some of whom have not reached the age of 45 years, by the time they reach that age, i.e. includes the effects of fertility of younger women).

Table 4. *Number of married women by surviving sibship size*

Village	No. of surviving children										No. of Surv. ch. per woman		
	0	1	2	3	4	5	6	7	8	9		10	Total
Lachung	10	11	16	9	12	13	13	5	5	1	1	96	3.70
Lachen	8	6	11	1	2	2	2	3	2	0	0	37	2.65

Table 5. *Completed family size*

Village	No. of women*	No. of live births						Avg. no. per woman**	Net reproductive index
		Living		Dead		Total			
		M	F	M	F	M	F		
Lachung	22 [†]	59	67	13	13	72	80	6.91	3.64
Lachen	5 [‡]	6	5	4	4	10	9	3.80	1.80

*Aged 45+ years.

**Completed family size.

†Includes to women who had never been pregnant.

‡Includes two women who had never been pregnant.

Table 6. *Age-specific fertility rates*

Village	Age period							Total fertility rate
	20	20-24	25-29	30-34	35-39	40-44	45+	
Lachung								
No. of women	63	63	54	47	42	28	18	
No. of liv. bir.	16	53	53	51	28	14	6	
No. of live, bir. per woman	0.25	0.84	0.98	1.09	0.67	0.50	0.33	4.66
Lachen								
No. of women	20	19	15	9	7	4	3	
No. of liv. bir.	9	21	12	8	2	1	0	
No. of liv. bir. per woman	0.45	1.11	0.80	0.89	0.29	0.25	0	3.79

Note: For estimation of age-specific fertility rate each woman has been counted once for each 5-yearly reproductive age period she has passed (e.g. a woman aged 28 years, say, has been counted 3 times, once for each age period <20, 20-24 and 25-29 years), so that the sum of figures shown in row entitled "No. of women" would not tally with the actual number of women on which this analysis is based.

With unchanging fertility $cfs = tfr$, with declining fertility $cfs > tfr$ and with increasing fertility $cfs < tfr$, given the abovementioned definitions. The trend of a declining fertility in Lachung but not in Lachen as suggested above is further confirmed by the fact that while in Lachung $cfs > tfr$, in Lachen the two are virtually equal (Table 5 and 6).

Table 7 shows that both infant mortality and mortality before reproductive age are considerably higher in Lachen than in Lachung.

Table 7. *Infant mortality and mortality before reproductive age*

Village	Total no. of birth	Mortality			
		Before 1 year		Before 15 years	
		No.	%	No.	%
Lachung	354	27	7.63	52	14.69
Lachen	94	21	22.34	37	39.36

We are not in a position to identify the causes of the higher fertility and lower mortality in Lachung but the differential transhumance pattern, i.e. the people of Lachung going down to lower and those of Lachen to higher altitudes for agricultural work, and the consequent differential exposure to altitudinal stresses, may provide an explanation. It is also possible that the relatively lower frequency of polyandry has led to the higher fertility and the lower fertility to lower mortality in Lachung.

While the cause of the demographic differences between Lachung and Lachen cannot yet be identified, their genetic consequences can be predicted. It is well known that in such small population large fluctuations of gene frequencies due to random error of sampling may occur irrespective of the adaptive advantage/disadvantage of the gene concerned. The magnitude of such fluctuation was measured (following Lasker 1965) by variance of gene frequency q , i.e. $\sigma^2_{q_0}$, which is higher in Lachen (Table 7). In other words, a gene having an initial frequency of $q = 0.5$ may deviate by a quantity $\sigma_{q_0} = 0.0319$ in Lachen and $\sigma_{q_0} = 0.0258$ in Lachung per generation by chance alone. Admixture with neighbouring population may act to offset the effect of drift and genetic selection may, depending on the selective advantage or disadvantage of the gene concerned, offset or accentuate the effect of drift, but admixture rates are so low in both the villages (3 cases of outside-village marriage in Lachung and 1 case in Lachen) that they could be ignored. Crow's (1958) index of maximum opportunity for selection could not be computed because of the extremely small number of women aged 45+ years in our samples, particularly in Lachen (mean and variance of fertility of these women are necessary to compute this index).

The present study thus shows that the sociocultural factor of differential transhumance pattern, and the consequent differential exposure to the altitude-related physical environmental factors, may have made important effects on the demographic characteristics of fertility and mortality, and consequently on the demographical-genetical characteristic of genetic drift, in these isolated mountain villages of northern Sikkim. Further studies on the precise nature

Table 8. *Effective population size and variance due to drift*

Village	No. of households surveyed	Breeding size, N	Mean fertility, \bar{x}	Variance of fertility, σ_x^2	Effective population size, N_e	Total no. of households	Corrected N_e , N_{ew}	Variance due to drift σ_d^2	e_{4q}
Lachung	96	225	3.698	5.981	112.517	160	187.528	0.00067	0.0258
Lachen	37	85	2.648	6.177	41.335	110	122.888	0.00107	0.0319

Note: The estimate of N_e was corrected for total no. of households in the following manner:

No. of households surveyed (Lachung) = 96

N_e (Lachung) = 112.517

Total no. of households (Lachung) = 160

N_{ew} (Lachung) = 112.517 (160/96) = 187.528

The same procedure was followed in the case of Lachen.

of interaction of sociocultural and physical environmental factors, and the mechanisms of the effects of these interactions on demographic and other human biological traits, in these and other populations should yield interesting results.

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