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THE BAIGAS OF MADHYA PRADESH: A DEMOGRAPHIC STUDY

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Summary. This paper outlines the demographic characteristics of the Baiga tribe, one of the most primitive of the aboriginal tribal groups of Central India. The Baiga population has grown steadily since the first anthropological study of the tribe in the 1930s. Age at menarche, age at marriage, breast-feeding, and time interval between marriage and first conception are natural. There are more females than males. Sub-tribe endogamy is common; consanguineous marriage is favoured (34% of marriages are between first cousins) and marital distance is low (mean 7·1 km). Though the mean menarcheal age is high (15·2 years), mean age at first marriage is low (16·6 years), giving a long reproductive period.

Introduction

Tribal people of India are considered to be aboriginals, based on their anthropological characteristics. There are 427 tribal groups, constituting 8% of the population. In general, aboriginals are confined to marginal hilly and forest areas, probably because of pressures from local agriculturalists. They still maintain their unique identity, isolated from the mainstream, and modified to only a limited extent by the present civilisation. Madhya Pradesh is the largest tribal state, with 23% of the total tribal population in the country. Of 46 tribal groups in Madhya Pradesh (Dubey, 1981), six are considered to be primitive, based on neglect in the past, backwardness and low economic level.

The Baiga, one of these six primitive tribes, are now distributed mainly in five districts (Mandla, Shahdol, Bilaspur, Bhalaghat and Rajnandgaon). Russell & Hiralal (1916) described the Baiga as a primitive Dravidian tribe, but Elwin (1939) disagreed because of socio-cultural differences between Baigas and Gonds and classified the Baiga as a Kolarin tribe that migrated from Bengal and Bihar to Madhya Pradesh. However, Kulozik *et al.* (1986) and Labie *et al.* (1989) have studied haplotypes associated with the sickle cell gene in tribals from different parts of the country, and concluded that Indian tribals have uni-centric origin though they are now widely scattered and speak different dialects. Kaeda *et al.* (1995) observed a common glucose-6-phosphate dehydrogenase (G6PD) variant, G6PD Orissa (44 Ala-Gly), in tribals of different parts of the country and this finding further supports the above conclusion.

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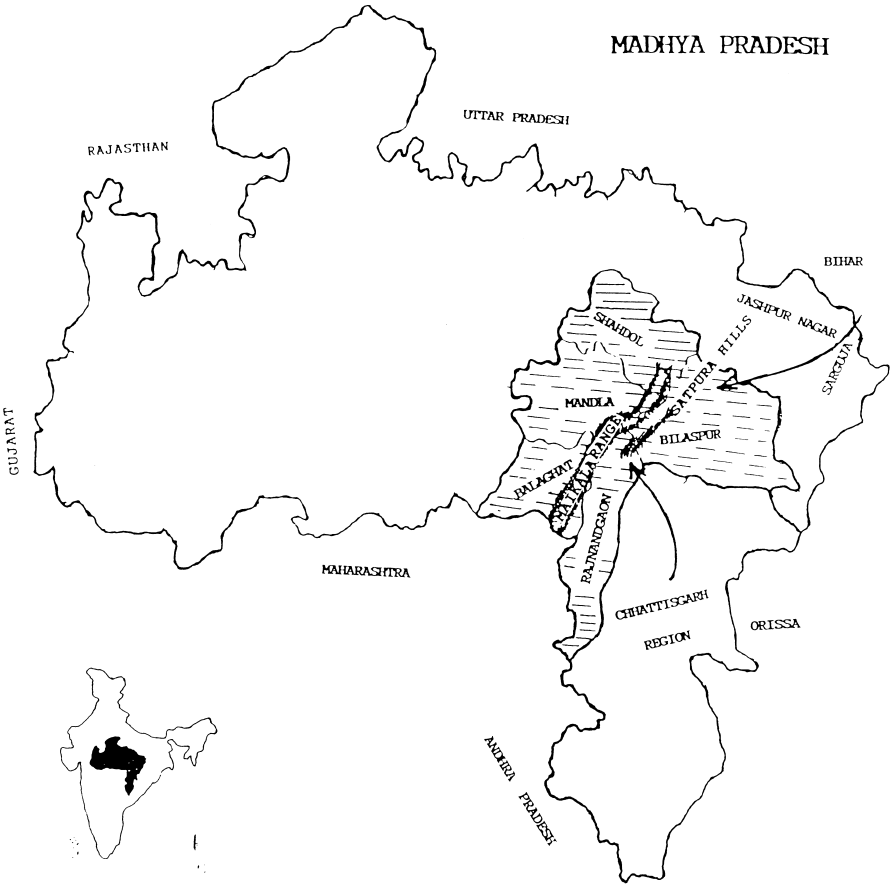


Fig. 1. Map showing present settlement of the Baiga tribe, and study area, Mandla district.

The Baiga tribals live in inaccessible thick forest and hilly areas. They were originally hunter–gatherers who later adopted shifting cultivation (slash and burn). In order to preserve the forest the British Indian administration restricted shifting cultivation from 1867 to 1869 (Elwin, 1939) and later outlawed it completely, allocating a piece of land to each tribal family for settled cultivation. Fortunately, Elwin studied the qualitative features of the Baiga and produced a detailed description of the tribe in the 1930s, when they were still hunter–gatherers with shifting cultivation.

The prevalence of hepatitis virus markers, genetic variation of serum proteins, the prevalence and the molecular nature of hereditary anaemias, consanguineous marriage and their relevance for natural selection in the Baiga are described elsewhere (Reddy & Tedder, 1995; Reddy & Mastana, 1995; Reddy *et al.*, 1995; Reddy & Modell, 1995, 1996). This paper describes the demographic characteristics of the population, the evidence for recent change, and possible genetic implications.

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Population and methods

The Baiga tribe is divided into sub-tribes or jats, each jat being confined to a particular area. The selected study area was Dindori tehsil, Mandla district, Madhya Pradesh, because it is believed that the Baigas of this region are the most ancient (Fig. 1) and the Baiga development authority considers they are backward relative to other areas. The area is very isolated, and includes no other tribe/caste, so there is minimum possibility of admixture. Malaria is highly endemic. The jat resident in the district are the Bhumia.

The district administration was approached for permission to enter the area, since there is a ban on visitors and foreign and outside researchers, but not on local researchers. Rapport was established with the inhabitants of the villages with the help of school teachers and forest workers. In 1991 and 1992 an in-depth study of population structure and health status was conducted in seventeen villages during the first half of the year (January–June). From July to November the area is inaccessible due to heavy rains and lack of proper roads. Information was collected from all families in each village, using a questionnaire structured for data entry on a computer. Baiga women were interviewed by female social workers, health workers and nurses who are well known in the area.

Information on number of family members, age and sex was collected for all households in the study area. Surnames of both husband and wife were recorded, since the tribe follow surname (garh) exogamy and sub-tribe (jat) endogamy. Ages were estimated carefully. The people were not able to give an exact date of birth, but all know their age relative to others, from childhood. Local events like harvesting crops and festivals, were used to cross-check the ages given. School records were used to check children's ages given by the parents. Age at menarche was recorded to assess the reproductive span and the impact of local conditions on pubertal development. Age at marriage was estimated carefully with the help of educated villagers. Marriage pattern was recorded by drawing a family pedigree for the present generation: information could not be collected further back than the second or third generation because of inability to remember. Marital distance was calculated based on birth places of husband and wife. Year of marriage was estimated from parents' present age and age at marriage, for all the families, and cross-checked using school records and local events; it was then related to age as estimated above. Information on time interval between marriage and first conception was collected, partly to check the present age of the wife.

The collected demographic data were edited, re-checked with the original questionnaires and entered in the Statistical Package for Social Sciences (SPSS). Frequency distributions were obtained for all variables and statistical tests of significance were applied. Data on population numbers were collected from available census records from 1901 to 1981. Data on incidence of malarial parasites in the study district were available for the past 12 years, 1981–92 (Table 1).

Results

The recorded population number has increased steadily since 1901. Though this may be partly due to increasing awareness of the Baiga, it probably mainly reflects

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Table 1. Prevalence of malarial parasites in peripheral blood in Baiga villages 1981–92

Year	Population	Examined	Positive cases				
			Plasmodium vivax	Plasmodium falciparum	Mixed	Total	% of population
1981	17,321	5410	208	220 (51·26)*	2	430	7·9
1982	18,180	6209	314	1116 (78·0)	1	1431	23·0
1983	18,753	3943	112	421 (78·7)	2	535	13·6
1984	18,964	5700	326	474 (58·9)	5	805	14·1
1985	20,176	5948	190	410 (68·0)	3	603	10·1
1986	20,551	3997	90	158 (62·9)	3	251	6·3
1987	21,021	6134	113	692 (86·0)	—	805	13·1
1988	21,273	4816	121	203 (62·5)	1	325	6·7
1989	21,880	5461	166	169 (50·4)	2	337	6·2
1990	22,887	8405	435	344 (44·0)	2	781	9·3
1991	23,524	12,379	783	759 (48·9)	11	1553	12·5
1992	22,395	8434	268	493 (64·6)	2	763	9·0
—	—	76,836	3126 (36·3%)	5459 (63·3)	34	8619	11·2

*% of total in parentheses.

population growth. At present, 42% of the population are under 14 years of age, 89% under 40 years and only 1·1% are 60 plus years (Table 2).

The sex ratio at birth in this study was 1819 females and 1825 males (females/males = 997) (Table 3). The living sex ratio was 1576 females to 1539 males (1024). The change in sex ratio with age (Table 3) suggests better female survival in childhood, and higher female mortality among adults (perhaps due to complications of pregnancy and delivery).

In the seventeen villages there were 617 families (3115 individuals). There were 77 garhs (surnames) observed in the male line with a wide range of frequency (1 to 60) (Table 4). Some garhs are repeated many times and observed in all villages. No couple was observed with the same garh for wife and husband and it seems the Baigas are very strict in garh exogamy. Women came into the study villages bringing 24 new garhs from outside the study area. Six women did not know their parental garh name.

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Table 2. Population structure (age/sex)

Age group (years)	Males	Females	Sex ratio female/male	Total	%
0–4	215	241	1·12	456	14·6
5–9	238	246	1·03	484	15·5
10–14	163	204	1·25	367	11·8
15–19	166	179	1·08	345	11·1
20–24	181	194	1·07	375	12·0
25–29	153	138	0·90	291	9·3
30–34	113	111	0·98	224	7·2
35–39	79	80	1·01	159	5·1
40–44	74	63	0·85	137	4·4
45–49	53	53	1·00	106	3·4
50–54	57	33	0·58	90	2·9
55–59	25	21	0·84	46	1·5
60–64	16	9	0·56	25	0·8
65–69	2	2		4	0·013
70–74	3	1		4	0·013
75–79	1	1		2	0·006
Total	1539	1576	1·02	3115	100

Table 3. Sex ratio at birth

Mortality	Males	Females	Ratio
Infant deaths (1–12 months)	127	97	97/127 = 0·76
Child deaths (1–12 years)	139	126	126/139 = 0·91
Pre-adult deaths (13–20 years)	4	6	6/4 = 1·5
Individuals dead	270	229	
Individuals surviving	1539	1576	
Total	1809	1805	
Sex ratio at birth	1000	997·8	

Mean marital distance was 7·1 km. Over 90% of marriages were contracted within 20 km distance. The radius of a village ranges from 1 to 4 km, so marriage within 4 km distance may be considered as village endogamy: 53·3% of marriages were contracted within 0–4 km distance (Table 5). Village endogamy was more common in villages with more surnames. Mean matrimonial distance calculated for each village ranged from 3·87 to 14·9 km with a high standard deviation of 5·2–12·8 km (Table 6).

Thirty-four percent of marriages were consanguineous. The minimum mean inbreeding coefficient is 0·0222, ranging from 0·00 to 0·06 in different villages (Reddy & Modell, 1995). Double marriages occurred in seventeen families (in eight the

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Table 4. Exogamic garh (surname) frequencies in Baiga males

Garh (surname)	Frequencies	Total males
27	1	27
11	2	22
3	3	9
7	4	28
4	5	20
3	6	18
1	7	7
3	8	24
2	9	18
1	12	12
1	13	13
1	14	14
1	16	16
1	17	17
1	20	20
2	21	42
1	23	23
1	27	27
1	28	28
1	31	31
1	41	41
1	44	44
1	57	57
1	60	60
Total 77		618

husband had two wives living; in nine families the husband re-married after the death of his first wife), and triple marriages in two families (in one family the husband married twice after the death of his first wife and in one family the wife re-married after the death of her first and second husbands).

The mean age at menarche in females was 15·2 years (Table 7). The mean age at first marriage was 18·5 years for males (range 10–29 years) and 16·6 for females (range 8–25 years). There was no significant difference between consanguineous and non-consanguineous groups, either for males or females. It seems that for women marriage occurs soon after menarche, giving a long reproductive period. There has been no significant change in age at marriage between 1960 and 1991 (Table 8).

The mean age difference between husband and wife (at first marriage) was 1·9 years, compared with 4·05 years for Madhya Pradesh overall (State Family Welfare Bureau, 1988–89).

Over 59% of women conceived within 24 months of marriage and 31·75% of women

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Table 5. Matrimonial distance

Distance (km)	No. of marriages	% of marriages
0–4	339	53·3
5–9	120	18·8
10–14	68	10·7
15–19	39	6·1
20–24	20	3·1
25–29	7	1·1
30–34	17	2·6
35–39	9	1·4
40–44	7	1·1
45–49	7	0·6
50–57	3	0·5
Total	636	100

Table 6. Matrimonial distance in different villages

Village	Mean distance (km)	SD	SE	Range (km)	Total no. of marriages
Azgarh	6·17	8·6	1·0	0–45	70
Chada	7·62	7·9	1·3	0–40	38
Dhurkuta	5·40	9·9	1·3	0–40	59
Khamera	5·9	8·9	1·5	0–45	35
Goura Kanhari	8·2	9·2	1·5	0–36	39
Tadpatra	8·4	1·2	0·2	0–30	28
Tantar	4·4	5·2	0·95	0–15	30
Silpidi	3·87	5·2	0·8	0–22	41
Seerajar	5·4	8·6	2·3	0–22	15
Kharidih	10·2	13·0	1·2	0–38	110
Bangla dadar	7·45	9·3	1·6	0–35	35
Kapoti	14·9	18·0	4·7	0–50	15
Bohera	4·6	6·8	1·4	0–20	25
Dhoimani	7·3	6·4	1·3	0–25	25
Kendra bohera	5·6	8·8	1·6	0–40	31
Ladra dadar	4·4	5·6	1·1	0–20	27
Beharpur	8·15	12·6	3·5	0–40	13
Total	7·1	9·8	0·4	0–50	636

conceived between 25 and 36 months of marriage; 3·7% of women had not conceived by 48 months (Table 9).

A study of the inheritance of the sickle cell gene in the Baiga families has shown

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Table 7. Age at menarche

Menarcheal age (years)	Women	%	Cumulative %
12	6	0·9	0·9
13	32	5·1	6·0
14	142	22·5	28·5
15	152	24·1	52·6
16	248	39·2	91·8
17	32	5·1	96·8
18	11	1·7	98·6
19	5	0·8	99·4
19+	4	0·6	100·0
Total	632	00·0	100·0

Table 8. Trends in age at first marriage

	Males		Females	
Decade	No.	Mean age±SD	No.	Mean age±SD
Up to 1960	95	18·5±1·8	95	16·5±1·8
1961–70	146	18·5±1·6	145	16·5±1·5
1971–80	157	18·5±2·0	157	16·5±1·7
1981–91 and later	219	18·4±2·0	219	16·6±1·8
Total	617	18·5±1·9	616	16·6±1·7

Table 9. Time interval between marriage and first conception

Duration (months)	Mothers	%	Cumulative %
Up to 24	363	59·4	59·4
25–36	194	31·8	92·0
37–48	31	5·1	96·3
49+	23	3·7	100·0
Total mothers	611	100·0	100·0

that about one-third of children living with a couple are not the offspring of both parents. This is called 'social parenting', since these children are not preferentially related to the father or the mother. Thus either a significant proportion of the children living with a couple are offspring of the parents' earlier relationships, or informal adoption is common (Reddy & Modell, 1995, 1996).

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Table 10. Trends in family planning

Decade of marriage	No. of women	Tubectomy		No. of men	Vasectomy	
		No.	%		No.	%
Up to 1960	95	14	14·7	95	3	3·2
1961–1970	147	41	27·9	146	10	6·8
1971–1980	164	67	40·9	156	1	0·6
1981–1990 and 1991	222	16	7·2	219	0	0
Total	628	138	22	616	14	2·28

Overall mean live births per couple were 4·4 and mean living children per couple were 3·6 (Reddy, 1993). Approximately 19% (114/606) of women breast-fed their babies for 12 months, 59% for up to 2 years and 21·2% for up to 3 years (Reddy & Modell (1995)). There has been an increasing demand for family planning (particularly tubectomy) among couples who married between 1960 and 1980 (Table 10).

Discussion

Studies of aboriginal populations cast light on the way of life of, and evolutionary pressures operating on man's early ancestors. Indian tribals are considered to represent the aboriginal population of India, and the Baiga are recognised as among the most primitive of these tribes.

The demographic picture of the Baiga today differs considerably from that described by Elwin in the 1930s (Elwin, 1939), and from the majority of Indian (caste) populations of today. Many changes have occurred in the past 50–60 years, possibly in connection with the enforced adoption of a more settled way of life following government legislation to protect the forest. The observed pre-reproductive mortality in this study (19%) is lower than that reported by Elwin (32%). The population has grown rapidly during this century and the population pyramid is typically broad-based. The adult sex ratio is now approximately balanced (Table 2). Elwin (1939) described a society still largely based on hunting–gathering and shifting cultivation, with a high pre-reproductive mortality (11–32%), and a markedly unbalanced adult sex ratio: there were 1355 tribal Baiga women to each 1000 men and polygamy was common. In the present study of 617 Bhumia (sub-tribe of Baiga) families, there was a slight excess of adult males, and polygamy is now uncommon. It seems that settled cultivation has reduced adult male deaths in the tribe.

A striking finding is the high frequency of social parenting. This was not reported by the families and was detected only because transmission of the sickle gene was studied within the Baiga families. A picture emerges of a population that leaves no adult without a partner, and no child without parents. These social factors must also be taken into account in genetic fitness calculations of recessive lethal or beneficial genes. Social parenting may also explain the relatively low reported rate of infertility in the tribe (Reddy & Modell, 1995, 1996).

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Inaccessibility of the area, poor roads and heavy rains mean that access to medical care is still very limited. The changes in mortality are therefore probably due to social factors such as settled agriculture and public health measures. For instance, a malaria control campaign has operated for the last few decades, though the rate of infection is still high. Eleven percent of the people attending local health centres have malarial parasites in their blood at any one time (Table 1), though of course they are selected for infection. Overall 63% of the malaria-infected population have plasmodium falciparum parasites in the blood. The high prevalence of sickle cell trait (16%) in the area may have a selective advantage against falciparum malaria (Reddy *et al.*, 1995). The prevalence of plasmodium vivax malaria suggests Duffy negative (Fy a- b-) blood groups may also be present. The individuals with red cells that are negative for Duffy blood group (Fy a- b-) are completely resistant to invasion by plasmodium vivax (Miller *et al.*, 1975, 1976). The fluctuation of malarial parasites (since 1981) may be due to changes in the climatic conditions and to the effectiveness of malaria control programmes in the area.

The Government of India (both state and central) is trying to protect tribals from exploitation (from local landlords, and from commercial pressures), and has a ban on external visitors. The Baiga Development Authority was established in the 1970s to provide education, transport, medical care (including family planning), and clean drinking water to the tribals.

The living sex ratio in the tribe (1024 females/1000 males) is high compared with figures for the state (941 females/1000 males) and the country overall (932 females/1000 males). The low status of women in caste populations and social factors such as the need for a dowry can lead to female infanticide or neglect. By contrast, the status of women is high among the tribals because women are a major asset in the family economy. Consequently in the present study population there are no distortions; the observed mortality in both males and females is natural.

No family violated the tribal rules for mate selection; all marriages were outside the garh (family surname), and within the jat (sub-tribe). In the Baiga tribe, after marriage women take their husband's surname (and leave the parental surname). Moreover, marriages are solemnised between the children of a brother and sister with different surnames. From the genetic point of view, there is little or no difference between exogamy and endogamy because tribal societies are basically endogamous. This is also true for most of the South Indian communities (Reddy, 1993).

Thus gene flow is generally within the sub-tribe. Physical environment plays a major role in mate choice. In general, inhabitants of inaccessible areas and socioeconomically backward communities tend to choose partners from nearby. For example, in the Danges population of Maharashtra 70% of marriages were contracted within 5 km (Majumdar & Malhotra, 1979) because the hilly and forested nature of the area restricts free movement. In the Gond population of Andhra Pradesh, Pingle & Haimendorf (1987) observed a low marital distance (5·39–11 miles) and village endogamy ranging from 16% to 45% of the population. Karve (1965) reported high village endogamy (40–50%) and a high inbreeding coefficient from Andhra Pradesh and Karnataka. The low mean marital distance of a scheduled caste population (Mala) from South India is considered to be a major factor in the high inbreding coefficient (Chengal Reddy, 1984). Both the low mean marital distance (7·1 km) and the

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convention of consanguineous marriage contribute to a high inbreeding coefficient ($F = 0{\cdot}0222$) in the Baigas.

The low matrimonial distance and high inbreeding coefficients in all these populations may accelerate natural selection through early exposure of lethal and beneficial recessive genes, and sub-populations may come to differ from each other after some generations, as illustrated by inter-tribal variation in the prevalence of sickle cell genes (Bhatia & Rao, 1987).

The observed mean age at menarche (15·2 years) is similar to that of European populations in the 1860s (Tanner, 1989) and is high compared to other rural and urban populations in India (Bhalla & Srivastava, 1974). In general, rural populations have a higher age at menarche than urban populations; it is even higher in the present study. Known reasons for late menarcheal age are low calorie diet, endemic malaria and a high altitude. As the study population live at over 3000 ft above sea level, all these factors may contribute.

Age at marriage is 16·6 years for females and 18·5 years for males. In general, pubertal age is 2 years earlier in girls than boys (Tanner, 1989); this corresponds well with the marriage age difference (1·9 years) in this natural population. Premarital sex is tolerated, but most Baigas marry as soon as they attain puberty because there are no social, economic or educational reasons for delay. Early age at marriage leads to a long reproductive period.

The (Madhya Pradesh) state figures for mean age at marriage are 20·61 years for males and 16·56 years for females (State Family Welfare Bureau, 1988–89). The Hindu marriage act (1955) forbade marriage for girls before 15 years of age; the limit was later raised to 18 years. South Indian caste populations have been slow to follow government legislation (Bittles, Devi & Rao, 1990), but female age at marriage is gradually rising in some South Indian populations (Caldwell, Reddy & Caldwell, 1983; Kulkarni, Savanur & Gokhle, 1986), shortening the reproductive span. There has been a dramatic increase in age at marriage in rural North India, from under 12 before 1930 to 19 in 1988, mainly as a result of socioeconomic development and advances in the education of women (Singh, 1992). The study population has not been influenced by government decisions, and retains a maximal reproductive span.

The mean number of live births per couple at the end of their reproductive span was 6·7. Birth spacing is directly related to a long duration of breast-feeding. The practice of birth control was new to the tribe during Elwin's time (1930s), but there is evidence of increased use of family planning methods in recent years (Table 9).

In conclusion, demographic features are still very natural in the Baiga tribe which provides a good example to understand the relationship between environmental and biological phenomena. There has been considerable change since the first anthropological study of the tribe in the 1930s but, overall, the Baiga tribe still maintains its unique identity, both socioculturally and biologically.

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References

Bhalla, M. & Srivastava, J. R. (1974) A perspective study of the age at menarche in Kanpur girls. *Ind. Pediat.* **11,** 487.

Bhatia, H. M. & Rao, V. R. (1987) *Genetic Atlas of Indian Tribes*. Institute of Immuno-haematology, Bombay.

Bittles, A. H., Devi, R. R. & Rao, A. (1990) Inter relationships between consanguinity, religion and fertility in Karnataka, South India. In: *Fertility and Resources*, pp. 62–75. Society for the Study of Human Biology Symposium 31. Edited by J. Landers & V. Reynolds. Cambridge University Press, Cambridge.

Caldwell, J. C., Reddy, P. H. & Caldwell, P. (1983) The causes of marriage change in South India. *Popul Stud.* **37,** 343.

Chengal Reddy, P. (1984) Distribution, endogamy and isolation of Malas of Chittoor district, Andhra Pradesh, India. *Social Biol.* **31,** 108.

Dubey, K. K. (1981) *Census of India 1981, Series 11—Madhya Pradesh Part IX—Special Tables for Scheduled Tribes*. Indian Administrative Service, Madhya Pradesh.

Elwin, V. (1939) *The Baiga*. Wyman, London.

Kaeda, J. S., Chhotray, G. P., Ranjit, M. R., Bautista, J. M., Reddy, P. H., Stevens, D., Naidu, J. M., Britt, R. P., Vulliamy, T. J., Luzzatto, L. & Mason, M. J. (1995) A new glucose-6-phosphate dehydrogenase (G6PD) variant, G6PD Orissa (44 Ala-Gly), is the major polymorphic variant in tribal populations in India. *Am. J. Hum. Genet.* **57,** 1335.

Karve, I. (1965) *Kinship Organization in India*, 2nd edn. Asia Publishing House, Bombay.

Kulkarni, P. M., Savanur, L. R. & Gokhle, C. V. (1986) Increase in age at marriage in rural Karnataka: evidence from a repeat survey. *Demography India*, **15,** 149.

Kulozik, A. E., Wainscoat, J. S., Serjeant, G. R., Al-Awamy, B., Essan, F., Falusi, Y., Hagan, S. K., Hilali, A. M., Kate, S., Ranasinghe, W. A. C. P. & Weatherall, D. J. (1986) Geographical survey of β^s globin gene haplotypes: evidence for an independent origin of the sickle cell mutation. *Am. J. hum. Genet.* **39,** 239.

Labie, D., Shrinivas, R., Dunda, O., Dode, C., Lapoumeroulie, C., Devi, V., Devi, S., Ramasami, K., Elicon, J., Ducrocq, R., Krishnamoorthy, R. & Nagel, R. L. (1989) Haplotype in tribal India bearing the sickle gene; evidence of uni-centric origin of ^{s} mutation and the uni-centric origin of tribal population of India. *Hum. Biol.* **61,** 479.

Majumdar, P. P. & Malhotra, K. C. (1979) Matrimonial distance, inbreeding coefficient and population size: Dhangar data. *Ann. hum. Biol.* **6,** 17.

Miller, L. H., Mason, S. J., Dorak, J. A., Maccinniss, M. H. & Rothman, I. K. (1975) Erythrocyte receptors for (plasmodium knowlesi) malaria. Duffy blood group determinants. *Science*, **189,** 561.

Miller, L. H., Mason, S. J., Clyde, D. F. & Maccinniss, A. B. (1976) The resistance factor plasmodium vivax in blacks: the Duffy blood group genotype, Fy a- b-. *New Eng. J. Med.* 295.

Pingle, U. & Haimendorf, F. (1987) *Gonds and Their Neighbours: A Study of Genetic Diversity*. Ethnographic and Folk Culture Society, Lucknow.

Reddy, P. H. (1993) *Haemoglobin Disorders Among the Tribal Population, the Baiga, of Madhya Pradesh, India*. PhD Thesis, University of London.

Reddy, P. H. & Mastana, S. S. (1995) Genetic variation of serum proteins (GC, TF and PI subtypes) in the Baigas of Madhya Pradesh. *Anthrop. Anz.* **53,** 53.

https://doi.org/10.1017/S0021932097000199 Published online by Cambridge University Press

REDDY, P. H. & MODELL, B. (1995) Consanguinity and reproductive behaviour in a tribal population 'the Baiga' in Madhya Pradesh, India. *Ann. hum. Biol.* **22,** 235.

REDDY, P. H. & MODELL, B. (1996) Reproductive behavior and natural selection for the sickle gene in the Baiga tribe of Central India: the role of social parenting. *Ann. hum. Genet*. **60,** 231.

REDDY, P. H., PETROU, M., REDDY, P. A., TIWARY, R. S. & MODELL, B. (1995) Hereditary anaemias and iron deficiency in a tribal population (the Baiga) of Central India. *Eur. J. Haematol.* **55,** 103.

REDDY, P. H. & TEDDER, R. S. (1995) Hepatitis virus markers in the Baiga tribal population of Madhya Pradesh, India. *Trans. Royal. Soc. trop. Med. Hyg.* **89,** 260.

RUSSELL, R. V. & HIRALAL, R. B. (1916) *Tribes and Castes of Central Provinces of India*. Cosmo, New Delhi.

SINGH, M. (1992) Changes in the age at marriage of women in rural North India. *J. biosoc. Sci.* **24,** 132.

STATE FAMILY WELFARE BUREAU (1988–89) *Basic Health and Family Welfare Statistics*. Madhya Pradesh, Bhopal.

TANNER, J. M. (1989) *Foetus into Man: Physical Growth from Conception to Maturity*, 2nd edn. Castlemead, Ware.

https://doi.org/10.1017/S0021932097000199 Published online by Cambridge University Press