Sickle cell anaemia carrier prevalence amongst different tribal and non-tribal population groups from Ballarpur, district Chandrapur, Central India

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Background

Initial studies in Western Maharashtra[1] various groups reported prevalence of sickle cell anemia (SCA) in different parts of the state[2]. Due to tribal status, prevalence studies were explored more in Gadchiroli district. However, neighboring Chandrapur district remained relatively unexplored due to lack of significant sample size, although prevalence in some specific tribal communities and scheduled caste population were reported (Table 1)[2]. Attempts were made to establish SCA prevalence within < 100 sq. km. single geographic region covering >10% of the total population from selected locations from Ballarpur tehsil to establish SCA prevalence at sub-district level in Central India.

Introduction

Malaria and sickle cell disease (SCD) are more common in tribal populations of India, with varying prevalence in different ethnic groups. SCD affects mostly the socioeconomically underprivileged communities, living in the three clusters of 10 neighboring states in India. Most of this endogamous population in India, including, scheduled caste (SC), scheduled tribe (ST), nomadic tribe (NT) and other communities (also known as OBC) are confined to locations, where SCD co-exists with endemic malaria. SCD in tribal population is well known in Central India. Since, these communities are highly endogamous, the study of the prevalence of SCD in all these population groups will be interesting to find out whether there is any trend (increase, decrease or constant) in carrier prevalence as compared to earlier reports from the same geographic region. Due to lack of new born screening facility with molecular testing in Ballarpur tehsil, district Chandrapur (Fig. 1), accurate rate of sickle cell carrier prevalence with its trend is incompletely understood.

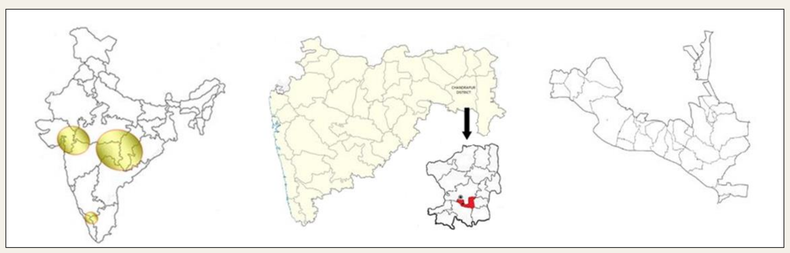

Fig 1: Sickle cell anaemia: Three clusters of 10 neighboring states (5-4-3 state model) in India (left); Chandrapur district in Maharashtra state (middle); Tehsil map of Ballarpur (right)

Table 1: Prevalence of SCA in the state of Maharashtra, one of the earlier reported studies (Kate and Lingojwar, 2002).

Communities	Location	Prevalence (%)
Scheduled Caste (SC)	Chandrapur	24
ST (All tribes with SCA in state)	Tribal regions in the state	0-35
Nomadic Tribe (NT)	Nanded/Yewatmal/Osmanabad	5
Other communities (OBCs)	Nagpur/Gadchiroli	4-12

Objective

1. To establish sickle cell anemia prevalence within 100 sq. km. region with 10% the total population screening in the single sub-district region in Central India.
2. To analyze prevalence pattern in tribal and non-tribal communities.

Methods

With the specific aim of analyzing sickle cell carrier prevalence in different communities, 17 geographic locations were selected from Ballarpur tehsil, Chandrapur district, Central India, an area known for endemic malaria and were confirmed diagnosed by combination of solubility test (Fig. 2) and cellulose acetate membrane electrophoresis (Fig. 3) at alkaline pH. Some of the known SCD patients, including two compound heterozygotes were also attended the screening program. Haemoglobin estimation was done by Drabkin's method[3]. All the samples were tested by combination of solubility test (which is very specific for HbS)[4,5] and Haemoglobin electrophoresis by cellulose acetate membrane electrophoresis at alkaline pH[6], which is considered not only the gold standard for resource poor setting in developing countries, where newborn screening is not existing but also one of the two best methods (HPLC and electrophoresis) for new diagnostic kits standardization[7]. Family studies by pedigree analysis from all available data (Fig. 4) were also carried out for final confirmation of homozygous sickle cell patients and heterozygous sickle cell carriers. (Location #17, includes 43% few cases and SCA families from nearby places not included in #1 to #16. Location #16 includes only one area of Ballarpur city i.e. Ravindra Nagar ward 16).*

In this random population study, total males were 1773, average age 14.42 years (1 to 90 years, except one SS patient) and total females were 1635, average age 15.23 years (1 to 80 years). From the confirmed analyzed data (N=3408, AA= 2829, AS= 526 and SCD=53), community-wise and village-wise prevalence was reported based on percent of sickle cell carriers in this region.

Results

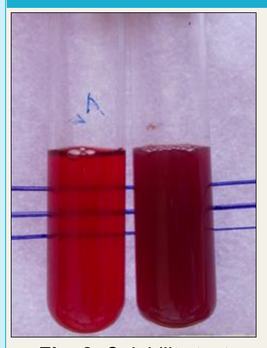

Fig. 2: Solubility test (Representative image)

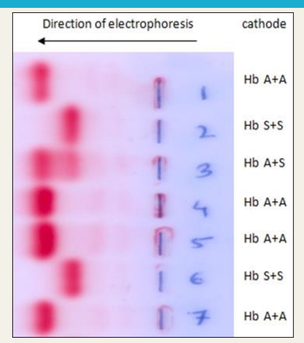

Fig. 3: Hb Electrophoresis (Representative image)

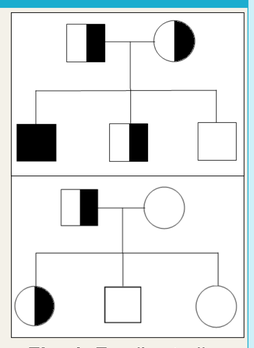

Fig. 4: Family studies (Representative images)

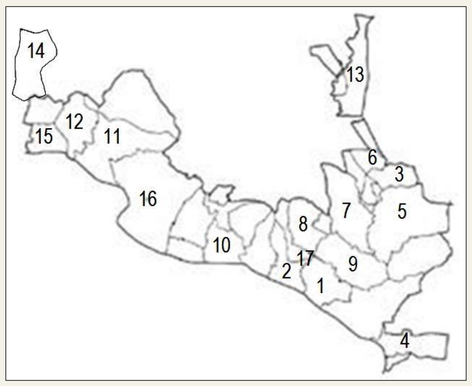

Fig 5: Map of Ballarpur tehsil: 3 urban (#11,12 and 16) and 14 rural locations

Table 2: Village-wise prevalence of SCD based on outcome of this study. Demography and population details were referred from available resources on census[8] (Study duration, July 2005 to December 2005).

Location No. (Village code no.)	Town ward / Village area (sq. km.)	Population density	Population studied (% of total population)	Village-wise Prevalence of SCD (%)
1	6.5	145	115 (12.29 %)	19.13
2	5.3	244	216 (16.67 %)	20.37
3	3.6	686	347 (14.09 %)	16.13
4	6.1	104	79 (12.44 %)	15.18
5	15.3	111	199 (11.74 %)	13.56
6	2.2	470	228 (22.05 %)	9.64
7	10.3	89	85 (9.27 %)	4.70
8	5.6	171	140 (14.5 %)	9.28
9	9.3	259	250 (10.4 %)	16.40
10	4.9	237	123 (10.51 %)	16.26
11	12.5	755	628 (6.68 %)	13.02
12	6.6	581	355 (9.25 %)	14.92
13	7.8	132	40 (3.8 %)	12.50
14	3.6	225	254 (31.71 %)	12.59
15	5.7	142	112 (13.86 %)	11.60
16*	3.0	195	130 (3.60 %)	28.46
17*	3.0	250	107 (14.26%)	35.51*
Total	98.8 sq. km.	297 (mean)	3408 (10.10%)	15.43%

Studied locations mentioned in the table 2 are indicated in the figure 5. Village-wise prevalence (Table 2) and community-wise prevalence (Table 3 and Fig. 6) suggested that, in the tribal population (N=985), sickle cell carrier prevalence is 9.95%. In ST, it is 12.60% and in NT, it is 2.66%. In SC community, (N=853), prevalence of sickle cell carrier is 27.43%. In OBC, (N=1512), sickle cell carrier prevalence is 12.23%. In the non-tribal open category (N=48), carrier prevalence is 8.33%. Overall carrier prevalence of Ballarpur region is 15.43% within less than 100 sq km area screened.

Table 3: Community-wise prevalence of SCA in Ballarpur, Chandrapur, Central India

Population type	Major communities	Total tested Male / Female (M/F)	Heterozygous carriers (M / F)	Homozygous SCD (M / F)	SCA carrier Prevalence (%)
Non Tribe	OBC	1512 (802M / 710F)	185 (92M / 93F)	15 (12M / 3F)	12.23
Non Tribe	SC	853 (415M/ 438F)	234 (110M /124F)	29 (16M / 13F)	27.43
Non Tribe	General	48 (25M / 23F)	4 (0M / 4F)	2 (1M / 1F)	8.33
Non Tribe	SBC	10 (5M / 5F)	5 (3M / 2F)	0 (0M / 0F)	Need more studies
Tribe	ST	722 (394M / 328F)	91 (39M / 52F)	6 (3M / 3F)	12.6
Tribe	NT	263 (132M /131F)	7 (5M / 2F)	1 (1M /0F)	2.66
Total Tribe and Non Tribe	OBC,SBC,SC, ST, NT, General	3408 (1773M / 1635F)	526 (249M / 277F)	53 (33M /20F)	2.66 to 27.43

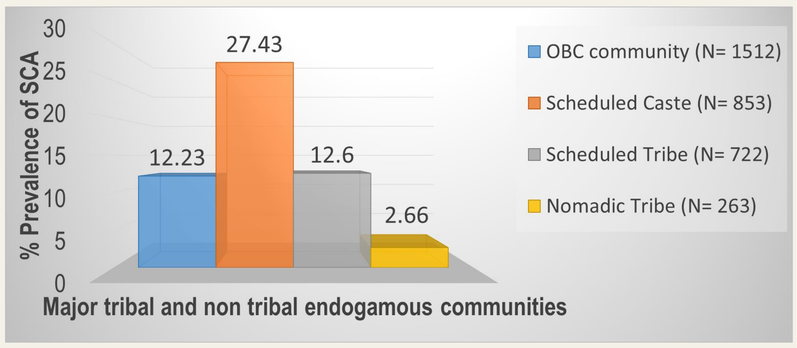

Fig 6: Sickle cell anemia prevalence (%) in various socioeconomic communities.

Conclusion

After comparing with earlier reports, in the state of Maharashtra, these results are found to be consistent for OBC and ST. In SC community, prevalence is increased by >3%. Not much information was available on NT community, as this is the much unexplored group due to their constant migration pattern. However, in our study (N=263), the observed prevalence is 2.66%. As most of the tribal as well as non-tribal population groups are endogamous, i.e. marriage within their community, carrier prevalence percent in this location need to explore with large scale studies based on specific community sampling along with new born screening at birth and compulsory school screening programs before they reach reproductive age for marriage counseling programs.

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