*J Vect Borne Dis* 44, September 2007, pp. 205–212

# Sociocultural factors and malaria in the desert part of Rajasthan, India

S.P. Yadav, R.K. Kalundha & R.C. Sharma

*Desert Medicine Research Centre, New Pali Road, Jodhpur, India*

## Abstract

*Background & objectives:* Malaria is a new emerging problem of Indian Thar Desert. The study was attempted to find out some sociocultural factors associated with malaria transmission in this region and to supplement social solutions to ongoing malaria control efforts in the desert part of Rajasthan.

*Methods:* Interview technique was used for data collection on pre-tested schedules. In all 30 households (15 from low socioeconomic group and the same number of households from the high socioeconomic group) in a village were selected following systematic random sampling technique. A total of 450 respondents were selected randomly in 15 villages of Jaisalmer district, Rajasthan.

*Results:* One-third of the respondents had neither taken treatment for malaria nor took part in the vector control operations because they did not consider mosquito bites to be harmful and took malaria as a mild disease. Outdoor sleeping habits, sharing bed with children, uneasy and suffocation feeling in using mosquito bednets or any other protective device also contributed to the spread of malaria in the study villages.

*Interpretation & conclusion:* Community should be educated as a whole particularly the low socio-economic group of people to bring changes in their beliefs, sociocultural and health practices to protect themselves from mosquito bites by using bednets, repellents and other devices, such as wire mesh screening of house doors and windows.

**Key words** Desert – malaria – Rajasthan – sociocultural factors – transmission

## Introduction

Malaria is essentially a disease of poor countries and included under 'Tropical Diseases' by WHO, Geneva. The disease is prevalent in humid tropics affecting mainly Africa, Asia and South America. At present about 100 countries in the world are considered malarious, almost half of which are in Africa, south of Sahara. More than 2400 million of the world's population is still at risk. The incidence of malaria worldwide is estimated to be 300–500 million clinical cases each year, with about 90% of these cases occurring in Africa, south of Sahara—mostly caused by *Plasmodium falciparum*[1].

Malaria is still the most important cause of morbidity and mortality in India with approximately 2 to 3 million new cases arising every year[2]. Malaria alone kills nearly three million people annually, including one child in every 30 sec[3]. Malaria is prevalent in all parts of India except in some mountainous areas situated 5000 ft above the sea level and coastal areas of Western and Eastern Ghats. The prevalence of malaria is through out the tropical region of the globe irrespective to the arid conditions of the deserts, humid conditions of the rain forests, coastal regions, cold conditions of the mountains and river plains. India is gifted with diverse climatic conditions which vary from one region to another; thus leading to the

region specific efforts to control the menace of this disease. The cultural and behavioural diversity of Indian population makes it even more complex and difficult to implement the disease control programmes. The people living in different ecological conditions have different life style and face different situations and hardships thus making the implementation of any disease control programme even more difficult.

In spite of arid conditions prevailing in the desert part of Rajasthan and temperature reaching up to 50°C, focal outbreaks of malaria are frequent and the morbidity and mortality associated with the disease is alarming in this region. The ongoing control programmes being coordinated by National Vector Borne Disease Control Programme (NVBDCP) are trying hard for the containment of disease through chemotherapy and interruption of transmission through vector control by indoor residual spray of insecticides. However, the ongoing efforts of the programme will yield more results, if health seeking behaviour of desert population is also studied. Present study is an attempt to know the sociocultural factors associated with malaria transmission and to supplement social solutions to the ongoing malaria control efforts in the desert part of Rajasthan.

## Material & Methods

The study was carried out in malaria endemic Ramgarh Primary Health Centre (PHC) of Jaisalmer district. The PHC area forms the part of northwestern border of India. Ramgarh PHC includes 60 villages, out of which, 15 villages were selected randomly for the present study.

A total of 450 households were selected in 15 villages namely—Sanu, Seuwa, Tejpala, Bada, Naga, Sadhana, Raimala, Sultana, Mokal, Lanela, Kakab, Siyambar, Joga, Tibansar and Markh ka gaon. A mass fever survey was undertaken among selected households. In each village 15 members belonging to low socioeconomic group (LSEG) and the same number belonging to high socioeconomic group (HSEG) were interviewed. Thus data were collected from 450 respondents from all the 15 villages selected. In addition, data pertaining to malaria cases during five years (1999–2003) were collected with respect to each house from the records of the PHC. Information such as number of fever cases, collection of blood slides, examination of blood slides and status of slides collected from fever cases in the selected households was obtained from health records of the PHC. Pre-tested schedules were used for the data collection on sociodemographic, socioeconomic, sociocultural and health practices, migration and treatment seeking behaviour by door-to-door survey. Schedules were prepared in English and communicated in Hindi or in local dialect—*Marwari* to avoid communication gap. Head of the household or one member >18 yr of age who was present at the time of survey was interrogated.

## Results

Majority (75.6%) of the respondents were in 20 to 49 yr age group. About 88% were Hindus and among them 25.7% were scheduled castes/scheduled tribes (SC/ST) followed by 34.4% other backward castes (OBC) and 39.9% general castes (GS) (Table 1). The incidence in malaria was more common among the LSEG during five consecutive years from 1999–2003 in all the study villages (Table 2). This is an indication of the importance of sociocultural factors in contributing malaria transmission. Distribution pattern of malaria cases among different age groups of inhabitants of two different sociocultural groups of study population is shown in Table 3. Data indicate clearly that among infants (< 1 yr) malaria was absent in both the groups. In the 1–5 yr age group, 30.1% of total cases were present among LSEG, while only 5.4% of cases were observed in HSEG. In the 5–15 yr age group, 43.5% of cases were reported among LSEG, while only 8.6% of cases were present among HSEG. In the age group of >15 yr least difference of

**Table 1. Number of respondents and other sociodemographic profile**

| Characteristics | LSEG | HSEG | Total |
|---|---|---|---|
| *Age (yr)* | | | |
| < 20 | 19 | 15 | 34 |
| 20–29 | 35 | 17 | 52 |
| 30–39 | 51 | 62 | 113 |
| 40–49 | 89 | 86 | 175 |
| >50 | 31 | 45 | 76 |
| *Sex* | | | |
| Male | 163 | 144 | 307 |
| Female | 62 | 81 | 143 |
| *Religion* | | | |
| Hindu | 197 | 191 | 398 |
| Other than Hindu | 28 | 34 | 62 |
| *Caste* | | | |
| General caste | 93 | 66 | 159 |
| OBC | 58 | 79 | 137 |
| SC & ST | 56 | 46 | 102 |
| *Education* | | | |
| Illiterate | 172 | 88 | 260 |
| Literate | 31 | 61 | 92 |
| Primary | 10 | 46 | 56 |
| Middle | 8 | 23 | 31 |
| High School and above | 4 | 7 | 11 |
| *Occupation* | | | |
| Agriculture | 96 | 112 | 208 |
| Animal keeping | 55 | 51 | 106 |
| Service | 5 | 32 | 37 |
| Labours | 62 | 8 | 70 |
| Others | 7 | 22 | 29 |

LSEG—Low socioeconomic group; HSEG— High socioeconomic group.

malaria cases between LSEG (9.7%) and HSEG (2.7%) was observed in pre-school and school going age children. The pre-school and school going children were found to be more vulnerable to malaria.

Table 4 depicts status of knowledge between the two socioeconomic groups. The knowledge about malaria parasite was 9.8% in LSEG as against 63.1% in HSEG. However, other parameters of knowledge about disease causation were not as much different as about the parasite between the two groups. The important signs and symptoms of malaria such as high fever, chills vomiting, etc, were substantially less known to LSEG as compared to HSEG (Table 4). Table 5 enumerates details of different preventive measures being adopted by the two different groups. An interesting observation was that adoption of modern preventive measures such as use of mosquito nets, good night vapourisers, odomos cream, etc was more common among HSEG, while use of traditional or ad-hoc preventive measures such as use of oils, smoke of cow-dung, etc was more common among LSEG. Table 6 describes the level of knowledge, attitude about malaria vectors and personal prophylaxis among study subjects. Data resolved across different parameters under "knowledge about malaria vectors" show substantial difference in knowledge about vector mosquitoes within the two groups. The attitude regarding expectation of respondents from system (questions such as "Is Health Department not taking good care of malaria patients in your village?") was more pronounced among the LSEG (73.3%) as compared to the HSEG (54.2%). Table 7 depicts the refusal status of the study subjects.

## Discussion

The study indicates that sociocultural factors are responsible for giving the environment for transmission of malaria by their living style, social behaviours, beliefs and practices, social customs, level of education, type of occupation and economic status. These factors were influencing the degree of transmission of malaria in both the groups. Surroundings of living area, practices of water storage in the containers, covering practices of water containers through lids, frequency of changing potable water in the containers, use of proper lid on water storage tanks locally referred as *tanka* (cement tank used for water storage), and proper sanitation, were significantly different in the study population

**Table 2. Incidence of malaria in two different socioeconomic groups from 1999–2003**

| Study parameters | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | LSEG | HSEG | LSEG | HSEG | LSEG | HSEG | LSEG | HSEG | LSEG | HSEG |
| Population | 1396 | 1215 | 1440 | 1234 | 1483 | 1257 | 1529 | 1276 | 1571 | 1298 |
| Family size | 6.2 | 5.4 | 6.4 | 5.5 | 6.6 | 5.6 | 6.8 | 5.7 | 7.0 | 5.8 |
| ABER | 4.3 | 3.5 | 5.0 | 4.4 | 5.3 | 4.7 | 5.0 | 3.8 | 4.0 | 3.5 |
| (+)ve cases | 25 | 4 | 31 | 6 | 46 | 9 | 27 | 7 | 26 | 5 |
| *Pf* cases | 13 | 1 | 19 | 2 | 28 | 4 | 17 | 3 | 12 | 1 |
| API | 1.8 | 0.3 | 2.2 | 0.5 | 3.1 | 0.7 | 1.8 | 0.5 | 1.7 | 0.4 |
| Death | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 3. Number of malaria cases reported in different age groups**

| Age group (yr) | LSEG | | HSEG | | Total |
|---|---|---|---|---|---|
| | Male | Female | Male | Female | |
| 0–1 | 0 | 0 | 0 | 0 | 0 |
| 1–5 | 36 | 20 | 7 | 3 | 66 |
| 5–15 | 50 | 31 | 11 | 5 | 97 |
| >15 | 11 | 7 | 3 | 2 | 23 |
| Total | 97 | 58 | 21 | 10 | 186 |

**Table 4. Number of respondents having knowledge about causation; signs and symptoms of malaria**

| Causation | LSEG | HSEG | $\chi^2$ (p-value) |
|---|---|---|---|
| Malaria parasite | 22 | 142 | p<0.0001 |
| Personal hygiene | 24 | 9 | p <0.01 |
| Impure water and edible items | 60 | 24 | p <0.001 |
| Changing environment | 71 | 30 | p <0.0001 |
| Multiple causes | 28 | 13 | p <0.01 |
| Don't know | 20 | 7 | p <0.01 |
| Total | 225 | 225 | |
| Signs and symptoms | | | |
| High fever with chills or sweating on alternate day | 75 | 120 | p <0.001 |
| Fever with giddiness, vomiting and reddish on the faces | 37 | 65 | p <0.01 |
| Multiple signs and symptoms | 64 | 31 | p <0.001 |
| Others | 49 | 9 | p <0.0001 |
| Total | 225 | 225 | |

groups. Misconceptions about malaria have been reported in research publications from all over the world. Links between malaria and supernatural forces are found almost similar. For example, in the Gambia and in Kenya, malaria, especially in children, is often perceived as the result of the child being possessed by an evil spirit or devil[4]. Few studies in the desert part of Rajasthan[5–8] also found healthy subjects considered changing environment (26.4%), impure water and eatable items (17.4%) as well as personal hygiene (4.9%) responsible for causing malaria. As a result low socioeconomic community was taking double time to avail health facility between the occurrence of the malaria and diagnosis and treatment as compared to high socioeconomic community. Brown[9] suggested that malaria eradication programmes in Surdinia and Sri Lanka were based on a mental model of the vicious cycle which chara-cterises people who are sick because they are poor and they become poorer because they are sick'. Banguero[10] studied the association of socio-economic factors with malaria in Colombia in which 217 households (cases) were investigated by comparing a similar number of households as controls (in which no cases were reported in the same period). It was shown that the prevalence and incidence of malaria were associated with the low income of the family. Mata[11] pointed out that poor housing and deficient personal hygiene are due to poverty and low education level and also found that

**Table 5. Number of respondents using different preventive measures**

| Preventive measures | LSEG | HSEG | $\chi^2$ (p-value) |
|---|---|---|---|
| Mosquito net | 13 | 82 | p <0.0001 |
| Odomos cream | 5 | 36 | p <0.0001 |
| Oils | 60 | 21 | p <0.0001 |
| Tortoise coil | 6 | 25 | p <0.001 |
| Good night vapouriser | 2 | 14 | p <0.01 |
| Smoke of cow-dung | 39 | 18 | p <0.01 |
| Smoke of foliage | 37 | 15 | p <0.01 |
| Nothing | 63 | 14 | p <0.0001 |
| Total | 225 | 225 | |

poor housing and outdoor activities after dark are of great significance as sociocultural determinants of malaria transmission. In contrast, Banguero[10] found no relationship between the degree of completion of the house (roof, walls, windows and doors) and malaria incidence, nor did he find any association between the education level and the disease incidence.

The lower susceptibility in infants could be attributed to two reasons. Firstly, the social custom of keeping the infants well clothed and covered by sheet which did not allow the mosquitoes to bite. Secondly, infants born to immune mothers were at least partially protected by maternal antibodies and foetal haemoglobin during the first 3–5 months from the malarial parasite. Similarly, the population, over 15 yr of age exposed continuously to malaria will develop considerable degree of resistance and awareness about the disease and use preventive measures against mosquito bites, thereby decreasing the susceptibility in adults. Das *et al*[12], made almost similar observations in one study in rural western Uttar Pradesh. The human behaviour with regard to the etiology, treatment and prevention of malaria not only fosters the spread of the disease but also results in continuity of the disease within the community. People seek medical care depending upon the individual perceptions of illness. The concept of illness behaviour under which individual perceptions of ill health are analysed has been reviewed by many workers[13–21].

In Mechanic's[15] terms, illness behaviour is the way in which given symptoms may be differentially perceived, evaluated and acted (or not acted) upon by different kinds of persons[12-15]. It appears that although most of the studies about beliefs and values of the people and the continuance of malaria are not conceptually focused on the illness behaviour and malaria transmission, such studies seem to provide much wider perspectives which not only possess some practical significance but also some research interest. As regards the beliefs of the people in relation to the causation malaria, there are two typical examples, one from India[22] and another from Surinam[23]. The former study concerning tribal populations in 18 villages in Orissa state identified the perceptions about causation, prevention and treatment of malaria. In general, the tribes believed that diseases are caused primarily by the spirits of the dead, anger of the local deities and black magic. People in these villages could not distinguish malaria from other types of fever and regarded malaria as a mild and self-limiting disease. Malaria fever, they believed, is the result of climatic factors. Mosquito bites, were not viewed as harmful to health and treatment were not taken for malaria.

The refusal of household spraying in many parts of the world has been recorded either as due to ignorance of mosquito control or to rigid folk social beliefs that vary by degrees. Dhillon and Kar[22] identified some reasons for the refusal of household spraying in Orissa. One of the reasons is that spraying produces a bad smell in rooms in which they live. In addition, spraying causes inconvenience and waste of time in shifting household goods. Since the people are not aware of its benefits, spraying is considered useless in these villages. Barnes and Jenkins[23] investigated the reasons for refusal of household

**Table 6. Knowledge, attitude about biology of malaria vectors and preventive measures of malaria in two different socioeconomic groups**

| Study parameters | LSEG (n=225) | HSEG (n=225) | $\chi^2$ (p-value) |
|---|---|---|---|
| (A) *Knowledge about malaria vector* | | | |
| Does *Anopheles* mosquito carry malaria parasite? | 47 | 159 | p <0.0001 |
| Can you identify male/female mosquitoes? | 15 | 68 | p <0.0001 |
| Is the feeding time of malaria mosquitoes before dawn or after the dusk period? | 27 | 102 | p <0.0001 |
| Do you know if *Anopheles* mosquito rest in cool and dark place? | 18 | 87 | p <0.0001 |
| Do you know if *Anopheles* mosquitoes lay eggs in the water? | 31 | 136 | p <0.0001 |
| (B) *Personal prophylaxis* | | | |
| Do you know *Anopheles* takes 5–6 days to complete life-cycle? | 35 | 120 | p <0.0001 |
| Do you know mosquito-meshes on windows and doors can prevent the entry of mosquitoes in the house? | 51 | 144 | p <0.0001 |
| Do you know that the bednet can prevent the mosquito bites in the open field? | 63 | 161 | p <0.0001 |
| Do you know 'tanka', earthen pots, cess pits and stagnant water are the main sources of mosquitoes breeding? | 70 | 150 | p <0.0001 |
| Do you know by covering 'tanks' etc. and by proper drainage, the mosquito breeding can be prevented in the house? | 91 | 191 | p <0.0001 |
| (C) *Treatment and other aspects* | | | |
| Can malaria take human life? | 46 | 198 | p <0.0001 |
| Can present drug cure the patients? | 97 | 209 | p <0.0001 |
| Whether the malaria control programme will improve the disease condition? | 69 | 131 | p <0.0001 |
| Is Health Department not taking good care of malaria patients in your village? | 165 | 122 | p <0.0001 |
| Would you like to contribute in running Sub-centre, PHC, etc. in your village? | 40 | 72 | p <0.001 |
| Are present malaria control activities not of much help to malaria patient? | 154 | 187 | p <0.001 |
| Would you go and get chloroquine tablets from PHC/RH/Sub-centre, etc. if nobody came and delivered them regularly at your place? | 35 | 153 | p <0.0001 |
| Would you like to be treated discretely at the nearest PHC/RH/Sub-centre? | 123 | 162 | p <0.001 |
| Whether health workers are cordial in their dealing with malaria patients? | 109 | 137 | p <0.01 |

spraying as: (i) fear of the loss of domestic animals (cats, dogs and chickens); (ii) fear that the insecticides would cause personal harms to the householders and their families; (iii) fear that the insecticides would destroy or weaken the protective power of the Gods; (iv) jealousy between kinship groups for jobs with malaria eradication programme; (v) enviable position of the employees of the malaria eradication programme and promiscuous behaviour of the malaria eradication programme workmen with local women, leading to troubles in several households; (vi) use of unpleasant insecticides; (vii) dislike of modern medicines; and (viii) resistance to giving blood smears. In Oghalu's[24] study in Nigeria it was found that although more than half (55.9%) of the respondents used insecticides, the rest of the respondents did not use them because of the bad smell, lack of money to buy it and fear that it could poison their food and domestic animals. In *Terai* villages in Nepal, inhabitants mud-plaster their houses every day, or on any *Pooja* (worship) day in the family—a practice which is resorted to as soon as

**Table 7. Distribution of respondents according to reasons for refusal to indoor residual spraying of insecticides**

| Reasons for refusal to household spraying | LSEG | HSEG | $\chi^2$ (p-value) |
|---|---|---|---|
| Bad odour | 77 | 12 | p <0.0001 |
| Fear of water being poisoned | 66 | 10 | p <0.0001 |
| Fear of food being poisoned | 71 | 8 | p <0.0001 |
| Fear of stored eatable items being poisoned | 64 | 6 | p <0.0001 |
| Fear of killing domestic animals (goats, sheep, dogs, hens, etc.) | 59 | 3 | p <0.0001 |
| In convenience and wastage of time in shifting household goods | 48 | 2 | p <0.0001 |
| More than one or other reasons people were not convinced with the effectiveness of spray | 22 | 1 | p <0.001 |

the spray teams left the house. In some houses, the housewives rubbed-off the sprayed surface immediately after spray teams left the houses[25]. In the *Terai* villages, as seems to be the case in Orissa and Surinam, people fear that household spraying increases household rats, mice, and bedbugs and hence many houses remained unsprayed because of the refusal of the people. Also, a study carried out in Baygada and Teypore areas in Orissa in India during 1973–74 showed that 48 to 60% of sprayed houses had been mud-plastered within 2 to 6 days[26]. Bad odour, fear of water and food being poisoned in homes, fear of killing domestic animals like pets, discolouration of walls, inconvenience caused by removing furniture and other belongings, the dirtiness of the house after spraying and the perceived ineffectiveness of spraying are the reasons for refusal of household spraying in this area. Refusal to permit household spraying, for whatever cultural reasons, would inevitably increase the density of mosquitoes, which in turn would lead to increase in the frequency of mosquito bites, in the longevity of mosquitoes and in the spread of malaria disease.

There is a need for such studies to be undertaken by others for quantification and stratification of malaria throughout the country in different communities. The concept of preventive malaria control should percolate as a top down approach to *Panchayats* and communities should be the major players from the very beginning. Moreover, the strategies being followed presently for malaria control seem to be grossly inadequate and need a thorough revamp. Transmission control should rely on the bioenvironmental interventions for long-term gains in malaria control. Also, the few good epidemiological data that we have, and centres from where these emanate, must be put to the best use. IEC component must be established on local area need so that malaria control programme can benefit maximally.

## Acknowledgement

Authors are grateful to Sh. N.L. Kalra and the late Dr. M.A. Ansari, Members, Scientific Advisory Committee for imparting guidance and giving useful suggestions to the present study.

## References

1. *World Malaria Report*. Geneva: World Health Organization 2005. WHO/HTM/MAL/2005.1102.

2. Sharma VP. Current scenario of malaria in India. *Parassitologia* 1999; *41:* 349–53.

3. Malaria. Fact Sheet No. 94. Geneva: World Health Organization 1999. http/www.int/inf-fs/en/fact/094.html.

4. Mwenesi H, Harpham T, Snow RW. Child malaria treatment practices among mothers in Kenya. *Soc Sci Med* 1995; *40:* 1271–7.

5. Yadav SP, Tyagi BK, Ramnath T. Knowledge, attitude and practice towards malaria in rural communities of the epidemic-prone Thar Desert, Northwestern India. *J Com Dis* 1999; *31:* 127–36.

6 Tyagi BK, Yadav SP. Bionomics of malaria vectors in two physiographically different areas of the epidemic-prone Thar Desert, north-western Rajasthan (India). *J Arid Envir* 2001; *47:* 161–72.

7. Yadav SP, Sharma RC, Joshi V. Study of social determinants of malaria in desert part of Rajasthan, India. *J Vect Borne Dis* 2005; *42*(4): 141–6.

8. Yadav SP, Mathur ML. Knowledge and practices about malaria among the sandstone quarry workers in Jodhpur district, Rajasthan. *Ann Arid Zone* 2005; *44*(1): 65–70.

9. Brown JP. Socio-economic and demographic effects of malaria eradication: a comparison of Sri Lanka and Sardinia. *Soc Sci Med* 1986; *28:* 847–59.

10. Banguero H. Socio-economic factors associated with malaria in Colombia. *Soc Sci Med* 1984; *19*(10): 1099–104.

11. Mata L. Socio-cultural factors in the control and prevention of parasitic diseases. *Re Infect Dis* 1982; *4*(4): 871–9.

12. Das R, Khan Z, Amir A. Epidemiological assessment of the trend of malaria in rural western, U.P. *Ind J Com Med* 2004; *29:* 134–5.

13. Zborowski M. Cultural components in response to pain. *J Soc Issues* 1952; *8:* 16–30.

14. Apple D. How layman define illness. *J Hlth Soc Behaviour* 1960; *1:* 219–25.

15. Mechanic D. The concept of illness behaviour. *J Chronic Dis* 1961; *15:* 189–94.

16. Mechanic D, Volkart E. Stress, illness behaviour and the sick role. *Am Soc Rev* 1961; *26:* 51–8.

17. Baumann B. Diversities in conceptions of health and physical fitness. *J Human Behaviour* 1961; *33:* 44–53.

18. Mechanic D. The influence of mothers on their children's health attitudes and behaviour. *Pediatr* 1964; *33:* 444–53.

19. Suchman EA. Stages of illness and medical care. *J Hlth Human Behaviour* 1965; *8*(1): 114–28.

20. Segall A. The risk role concept: understanding illness behaviour. *J Hlth Human Behaviour* 1976; *1:* 162–8.

21. Notoatmodjo S. Illness behaviour study in Pasar Kemis-District West Java, Indonesia. *South East Asian J Trop Pub Hlth* 1983; *14:* 69–73.

22. Dhillon HS, Kar SB. Malaria eradication: an investigation of cultural patterns and beliefs among tribal populations in India. *J Hlth Education* 1965; *1:* 31–40.

23. Barnes ST, Jenkins CD. Changing personal and social behaviour experiences of health workers in a tribal society. *Soc Sci Med* 1972; *6:* 1–15.

24. Oghalu AI. The problem of non-participation of the local population in malaria control programme. *J Inst Hlth Education* 1980; *18*(1): 7–9.

25. Dixit KA. Problems of Nepal malaria eradication organization. *J Japan Med Assoc* 1966; *4:* 162–72.

26. Arora DD, Salu B. Extent and frequency of mud plastering in tribal units of Orissa state. *NMEP News* 1976; 16–26.

*Corresponding author:* Dr. S.P. Yadav, Desert Medicine Research Centre, New Pali Road, Jodhpur-342 005, India.
E-mail: spyadav_dmrc@yahoo.co.in

*Received:* 3 September 2006 *Accepted in revised form:* 9 April 2007