TRIBAL MALARIA AND ITS EFFECTS ON AIR FORCE STATION AMLA AND SURROUNDING AREAS : AN EPIDEMIOLOGICAL STUDY

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Abstract

An epidemiological study on the transmission of malaria was carried out in an Air Force (AF) station located in a densely forested, highly malarious tribal belt in Central India. Among the AF station population, Defence Service Corps (DSC) personnel, whose occupation involved night patrolling in densely forested locales on the perimeter of the AF station, with the tribal villages within flight range of the vector mosquitoes, were the group most affected in terms of both overall malaria incidence and high falciparum rates. Among the neighbouring villages, the tribal villages had significantly higher rates of malaria as compared to the non-tribal villages. Vector identification revealed the presence of malaria vectors *Anopheles culicifacies* and *A. fluviatilis*. Heavy breeding was noted in the surrounding villages, both in natural water channels and man made projects, such as installation of village hand pumps without proper drainage. A rising trend of malaria was obvious in these villages. Incidence among the service population could be controlled to some extent by specifically targeted measures inside the camp area. Strategy for controlling malaria in such endemic pockets has been discussed.

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KEY WORDS : Epidemiology; Falciparum; Malaria; Tribal.

Introduction

About 44 million population of tribal areas of Andhra Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Bihar, Rajasthan, Orissa and North Eastern States are contributing 50 percent of *Plasmodium falciparum* cases of the country [1]. Mobile tribal population engaged in forest related activities have been identified as high risk groups. The Air Force station in which the present study was carried out is located in a pocket surrounded by villages, most of them tribal, in a highly malarious tribal belt of Central India. No wonder it has the dubious distinction of recording the highest incidence of malaria when compared with other AF/military stations.

Improvement in local knowledge of malaria epidemiology (especially disease transmission), with refinement of surveillance mechanisms and proper use of collected data, could lead to the implementation of more selective malaria control measures [2].

With this in view, a detailed epidemiological study was made in the AF station to provide long and short term strategies to reduce the incidence of malaria among service personnel and families. The purpose was also to formulate a methodological model for similar application in other similar service situations.

Material and Methods

The AF station and the surrounding villages comprised the

study area. It is situated in a semi-hill, densely forested, highly malarious tribal area in Central India (Satpura Ranges) at an altitude of 2435 feet above sea level. The AF station comprised a population of 4300 including airmen/airmen families/DSC /defence civilians and their families. This population is surrounded on all sides by seven villages, four of them tribal and three non-tribal (tribal-population=2686, non tribal population=8147).

The methods employed were both inductive and deductive, field observations and record studies, observational and interventional, retrospective and prospective.

Field Observations

The area inside the camp and the neighbouring villages was extensively surveyed and the relevant ecological conditions that could affect malaria transmission were observed. Relevant social and occupational activities both of the AF population and the neighbouring villagers were noted. Mosquito breeding and potential mosquito breeding sites were identified. Vector studies were carried out by searching for anopheline larvae and adults. Identification of vectors was carried with aid of a standard text on medical entomology [3]. Metereological data was recorded from the station metereological section.

Record Studies

The quality of record keeping was first assessed. The population of the villages was confirmed from the Block authorities. The Annual Blood Examination Rate (ABER) of the civil villages was calculated (which was well above the 10% recommendation), before including the following parameters for study.

- (a) Annual Parasite Incidence (API)
- (b) Annual Falciparum Incidence (AFI)
- (c) Slide Positivity Rate (SPR)
- (d) Slide Falciparum Rate (SFR)

The above parameters were worked out category-wise both among AF station population (Airmen, DSC, families, Defence civilians) and neighbouring villages (tribal and non tribal). Data for three years (1997 to 1999) was recorded.

Intervention : After identifying the high risk population subgroup inside the AF station (DSC personnel), and exophilism of the vectors, intensive implementation of personal prophylaxis measures such as use of DMP/Odomos for night duty patrols, deltamethrin impregnated mosquito nets and specifically targeted health education of the high risk group was started from June 99 (at the onset of the malaria season). Similarly selective vector control strategy (on identification of *A fluviatilis*), such as clean weeding of water channels, introduction of larvivorous fish, besides routine vector control activities were instituted from June 1999 inside the AF campus. It would be pertinent to point out that earlier to this, antimalaria activities in the station were focused mainly on three rounds of residual spray and antilarval measures with hardly if any, emphasis on personal prophylactic measures for night duty patrols.

Results

Malaria vector breeding : The AF station and the surrounding villages were found to have thick vegetation, with watercourses running almost perennially through the AF station and neighbouring villages. There was very little organic pollution in these water channels. Most of these water streams had vegetation on their banks under shade of which anopheline breeding was noted at various sites. Some of the villages were tapping these water channels by installing pumps to divert water to the fields for irrigation purposes. There is thick forest cover. In the past three years there has been an increasing number of village hand pumps installed without provision for adequate drainage. Pooling of water was observed around these hand pumps with anopheline breeding in some. Rain water collected in hoof and cart marks in the 'Kutchha' paths used by the villagers. Anopheline larvae were recovered from these collections, which were later identified as *A culicifacies*

[4] on maturation. Adult anopheline vectors were seldom caught inspite of repeated search indoors. Very few samples of adults were therefore available for dissection. Few adults identified had features of *A fluviatilis* [5].

Activities of natives : Information gathered from direct observation of local tribals and from interviews of the natives revealed that majority of them were engaged in forest related activities such as collection of firewood, leaves for making "pattals" (used for serving food), animal grazing, etc (such activities were indulged in by even tribal women and children). Some tribal men folk were involved in nocturnal forest activities (not always legal, such as brewing of intoxicants, etc). The activities of non-tribal villagers were less adventurous and hardly involved visit to the forested areas. A large number of villagers (both tribal and non-tribal) also slept outdoors because of overcrowding.

Meteorological recordings : No extremes of temperature were noted from Jan to Dec. Summers and winters were mild. The maximum annual temperature was in the month of May touching 37.1°C and minimum in Dec was 6°C. Relative humidity varied between 55% to 72.5%. Annual rainfall was 1000 mm.

Annual Parasite Incidence (API) : Comparative rates per thousand are shown in Fig 1. It will be seen that in the year 1997 there was no significant difference between the incidence in civil and AF population (Chi sq = 0.86, P = 0.41). However, the incidence increased in 1998 among the AF population as compared to the villages and this difference was significant (Chi sq = 7.68, P = 0.005). With intervention in 1999, the rates fell down appreciably and significantly as compared to the civil villages (Chi sq = 37.06, P = <0.001). On the other hand the rates among the local villages showed a rising trend and were very high in 1999.

Slide Positivity Rates : As compared to civilian villages the SPR did not vary much among the AF population in the years 1997 and 1998 (Fig 2). However, it came down significantly in the year 1999.

Malaria rate in different categories in the AF Station (Fig 3) :

Fig. 1 : Rate per 1000 civil villages and AF station

Fig. 2 : SPR civil villages and AF station

Fig. 3 : Malaria rate per 1000 in different categories in AF station

shows that among the AF population it is the DSC personnel who had the highest rates of malaria in the station. The difference in all the three years between the DSC and other subgroups in the AF station was both appreciable and highly significant.

Malaria rate in tribal as compared to non tribal civil population : This is shown in Fig 4. As will be seen among the civil villagers the tribals had by far very high and statistically significant

rates compared to the non-tribals. Also the rates among the tribals is showing an ascending trend with very high API in 1999 (108.7 per thousand).

Slide positivity & Slide falciparum rates in tribal and non-tribal villages : SPR(%) in tribal and non tribal villages is shown in Fig 5. This also shows a rising trend in the civil villages with significantly higher rates in tribal villages compared to non-tribal

Fig. 4 : Rate of malaria per 1000 tribal and non tribal villages

Fig. 5 : SPR (%) in tribal and non tribal villages

villages. Similarly slide falciparum rates were higher in tribal villagers compared to non tribal villagers (Fig 6).

Falciparum rates DSC personnel and Airmen : The falciparum rates in DSC and Airmen have been compared in Fig 7. These were much higher and statistically significant in the DSC as compared to the airmen in all the three years. However, in 1999 the rates in DSC as well as in the airmen came down compared to

1998.

Rates per 1000 DSC personnel compared to the tribal population : As the DSC appeared to be the high risk group among the airmen and the tribal among the civil villagers, it was thought worthwhile to compare the rates among the DSC population and the tribal (Fig 8). Interestingly, the rate among the DSC personnel was significantly higher in 1997 and 1998 as compared to tribal.

Fig. 6 : Slide Falciparum rate tribal and non tribal villages

Fig. 7 : Falciparum rates DSC and Airmen

It came down appreciably (if not significantly) among the DSC as compared to the tribals in 1999.

Discussion

Metereological conditions of the station as noted, favour longevity of both the vectors identified as well as development of strains of *P vivax* and *P falciparum*

[4,5]. The identified vectors *A culicifacies* and *A fluviatilis* both appear to rest outdoors in the station, as attempts to collect adults indoors by knock down sprays were futile. While numerous observations all over India have confirmed indoor resting of *A. culicifacies*, some outdoor resting has also been observed.

Fig. 8 : Rate per 1000 DSC personnel compared to tribal villagers

Exclusive exophily of *A. culicifacies* has been noted in Dhadgaon area of West Khandesh district in Maharashtra, where it was found biting on forests workers engaged in charcoal manufacture [4]. Similarly, the other local vector, *A. fluviatilis*, has been noted to exhibit exophily. Sizeable proportion of adult population was found resting outdoors in the Satpura Ranges (where the station is located) [5]. In sylvan surroundings where the tribals visit and the DSC jawans carry out night patrols, the possible resting-places are numerous and far outnumber a few houses that occur in such localities. In spite of best efforts, adequate number of adults could not be caught for dissection purposes. Collection of adult mosquitoes in outdoor places is very difficult unless special techniques are used [5], which were lacking.

Exophily of the vectors is also collaborated by the different incidences of malaria in the subgroups both inside the camp area, as well as in the neighbouring villages, depending on their occupational/social activities, night patrolling in the case of the DSC and visits to the forests in case of the tribals. Both these subgroups had the highest incidence of both overall and falciparum malaria in particular.

In such settings, both occupational (for e.g. night operations of soldiers in forested malarious areas), as well as vectoral (exophily), personal prophylaxis measures take precedence over other malaria control methods. Targeted intervention among the DSC in the

AF station in the year 1999 brought down the incidence appreciably inspite of rising incidence in the neighbouring villages. In service settings, where involvement of soldiers in night operations is frequent, personal prophylaxis measures such as use of mosquito repellants should be emphasized. Trials on use of repellant impregnated uniforms should be carried out on a large scale including long term adverse effects if any.

Meteorological and topographical features of the place ensuring longevity of the vectors coupled with outdoor resting in dense forests preclude satisfactory vector control measures, particularly in the forested areas, which the tribals frequent. Consequent heavy transmission of falciparum malaria among the tribals perennially contributes to the local tribal developing some immunity, leading to a state of stable malaria in them [6]. This makes the nomadic service population who come in contact with such tribal areas within flight range of vector mosquitoes highly vulnerable because of their non-immune status. These can raise additional problems in that the very presence of such non-immunes may convert an endemic stable malaria into an epidemic unstable one. Control procedures in such situations must emphasize control of the vector at the outset, inside the service camps. We have at our disposal facilities and resources, which could support practical anopheline control not economically feasible in the adjoining civilian areas. We could even extend

these vector control measures to the civilian tribal villages including residual antiadult spray. This may not prevent the tribal contracting malaria in the forests but may prevent the second batch of anopheline mosquitoes getting infected from the tribal villages and affecting the inmates of the camp area which is within the flight range of these vector mosquitoes. Provision for extra insecticides can be considered in such stations.

A disturbing trend noted was the steady increase in malaria rates in the three years in the civil villages both tribal and non-tribal. This is likely due to the installation of village hand pumps in recent years without ensuring proper drainage - a case of man made malaria superimposed on tribal malaria. Efforts are on to tackle the rising trend in the civil areas with assistance of civilian health authorities and other sectors. Besides antilarval activities in these areas by our team, active and passive surveillance along with modified radical treatment with help of multipurpose workers of the Primary Health Centre has been going on for some time.

Malaria control can be compared to guerilla war-

fare. Any relaxation of control measures will lead to the activation of the guerillas. At least in this venture we can go across the "line of control" and extend our antimalarial activities beyond our camp limits to root out "cross border malarism". We have the expertise because historically malaria is a disease of military importance. It is no coincidence that the earliest pioneers in the field (Laveran, Ross) were military medical officers.

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