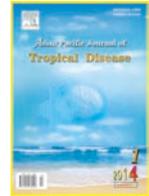




Contents lists available at ScienceDirect

## Asian Pacific Journal of Tropical Disease

journal homepage: www.elsevier.com/locate/apjtd



Document heading

doi: 10.1016/S2222-1808(14)60443-6

© 2014 by the Asian Pacific Journal of Tropical Disease. All rights reserved.

# An epidemiological study on clinical profile of malaria in Rampachodavaram and Maredumilli the tribal belt of east Godavari, Andhra Pradesh, India

P. Satyanarayana<sup>1\*</sup>, Farid Babu Meka<sup>2</sup>, Rekha Kumari Dulala<sup>2</sup>, Mrinmoy Ghosh<sup>3</sup>, K.R.S. Sambasiva Rao<sup>3</sup>

<sup>1</sup>Department of Physiology, Konaseema Institute of Medical Sciences, Amalapuram, East Godavari District, A.P., India

<sup>2</sup>Department of Biochemistry, Konaseema Institute of Medical Sciences, Amalapuram, East Godavari District, A.P., India

<sup>3</sup>Department of Biotechnology, Acharya Nagarjuna University, Nagarjunanagar-52251, Guntur, A.P., India

## PEER REVIEW

### Peer reviewer

Dr. K. Vani Madhavi. M.D., Professor & HOD, Communitymedicine (SPM) Department, KIMS Medical college, Amalapuram. EG.Dist, Andhra Pradesh, India

Tel: 9701594821

E-mail: vani\_madhavi04@yahoo.com

### Comments

This is a good study in which the authors observed the epidemiological features of malaria in the tribal belt where the problem is more prevalent. Being hilly area transportation facilities are less and sometimes in accessible because of the bad weather. The observations are useful for the policy makers for evaluating the programme.

Details on Page S224

## ABSTRACT

**Objective:** To observe the distribution of malaria infection in the tribal area of East Godavari District of Andhra Pradesh, India .

**Methods:** The data for the present study was collected from 6342 and 765 patients who were admitted at tribal hospital and hill forest camps respectively during the study period. The data was collected from the malaria suspected patients admitted in paediatric and adult critical care wards of a tertiary hospital and in interior hill and forest camps in and around the Rampachodavaram. The detailed medical case sheet proforma were prepared and data has been analyz. It was found that RDT's can be helpful to screen *Plasmodium falciparum* (*P. falciparum*) in endemic areas and remote tribal belt.

**Results:** A total number of 6342 and 765 patients were admitted at tribal hospital and hill forest camps respectively during the study period. Among 6342 of individuals tested, 4387 individuals were reported for malaria positive. Out of the 4387 slides examined, 59.0% were positive *P. falciparum* infection, 19.4% slides showed positive *Plasmodium vivax* infection and 21.5% had mixed infection. The total *P. falciparum* burden was estimated as 80.5%. In hill forest camps, out of 765 admitted patients, 650 patients who had clinical history showed suggestive of malaria were examined for malaria parasites.

**Conclusions:** The maximum numbers of malaria infection (4387) were reported from the tribal based hospital. Malaria is responsible for major health concern in this region, particularly in rainy season. *P. falciparum* was the major parasite type causing malaria, and most of the complications were due to *Plasmodium vivax*. Compared to rest of the hills and forest areas, where most of the tribal people reside has the heavy load of malaria mainly *P. falciparum*. One important finding from the present study was the sex-difference observed in the admission rate. The rate of malaria infection was significantly high for male (53.5%), followed by female (46.5%) and children (33%).

## KEYWORDS

Malaria, *Plasmodium falciparum*, *Plasmodium vivax*, RDT diagnosis

## 1. Introduction

Malaria is one of the foremost public health problems which impose great threat on humanity. About 36% of the world population is exposed to the risk of contracting

malaria. World Health Organization (WHO) revealed that 300 to 500 million malaria cases annually recorded in about 100 countries[1,2]. Out of which the vast majority of cases have been reported from the Africa (85.5%)[3], followed by the Southeast Asia (10%) and the Eastern Mediterranean Regions

\*Corresponding author: Dr. P. Satyanarayana, Professor and Head, Department of Physiology, KIMS & RF, Amalapuram, EG district, Andhra Pradesh, India.

Tel: 09985722250

E-mail: psn9983@gmail.com

Article history:

Received 10 Nov 2013

Received in revised form 16 Nov, 2nd revised form 22 Nov, 3rd revised form 28 Nov 2013

Accepted 27 Dec 2013

Available online 28 Jan 2014

(4%). Malaria causes one death at every 30 seconds. Annual 1.5 to 2 million mortalities has been attributed due to malaria[4].

Malaria is one of the common parasitic infections in India, causes insurmountable problems at many parts of country[5]. According to the National Vector Borne Disease Control Program survey, around 1.5 million cases of malaria are reported from India. Annually in India deaths caused by malaria were recorded 30014 to 48660 whereas 11% of all malaria related deaths has been reported in children at the age group below 5 years[6,7]. At present, except Himachal Pradesh, Jammu and Kashmir, the rest of Indian states are malaria prone. The states with high malaria prevalence rates include Jharkhand, Orissa, Chhattisgarh, Andhra Pradesh, Maharashtra, Gujarat, Madhya Pradesh, West Bengal and Karnataka, are the high-focus states[8,9].

Malaria has been posed a socio-economic impact at Andhra Pradesh, due to the high morbidity, mortality and the economic burden arising out of it (Muddaiah *et al.*, 2006)[1]. Incidence of malaria has been very high in Vishakhapatnam followed by Rampachodavaram at East Godavari district. The deaths due to malaria are mostly reported from Vishakhapatnam, East Godavari, Vizianagaram, Adilabad, Srikakulam, Krishna and Khammam districts[10].

Protozoal parasites of the genus *Plasmodium* is causing malaria. The female *Anopheline* mosquito plays a key role as a vector in the incidence of malaria. Out of 400 species of *Anopheles* mosquitoes, only 10 species are responsible for transmitting malaria[11]. Four species of the *Plasmodium* parasite such as *Plasmodium falciparum* (*P. falciparum*), *Plasmodium vivax* (*P. vivax*), *Plasmodium malariae*, and *Plasmodium ovale* cause malaria. Severe malaria has been associated with *P. falciparum* which causes the highest morbidity and mortality in India. According to NVBDC Programme, total of 1279381 million malaria cases reported in 2011 and 643496 million of them were caused by *P. falciparum*[10].

The proportion of *P. falciparum* and *P. vivax* varies in different parts of India. Treatment is based upon the primary species identified in an infection by standard microscopy diagnosis. Taking into the account of clinical data, it has been estimated that *P. falciparum* infections (65%) are mostly observed in forested areas inhabited by tribes in the states of Orissa, Jharkhand, Madhya Pradesh, Andhra Pradesh and Chhattisgarh, whereas, *P. vivax* is usually less deadly than *P. falciparum*, and said to be almost half reported cases of malaria in the country.

The present investigation is conducted to study the spectrum of clinical manifestations of severe malaria in male, female and population children at tribal hospital and hill

forest areas. In continuation, the work has been carried out to understand the relatedness of seasonal pattern of malaria infected. Moreover, the treatment outlines are conducted in all cases of malaria at the clinical geographical setting.

## 2. Materials and methods

### 2.1. Study area and data source

This prospective study was conducted during one year from January to December, 2012. Observing the incidence of malaria, Rampachodavaram, Maredumilli area situated at Andhra Pradesh, India was selected as study area for conducting the survey. The data was collected from the malaria suspected patients admitted in paediatric and adult critical care wards of a tertiary hospital and in interior hill and forest camps in and around the Rampachodavaram. The detailed medical case sheet proforma were prepared and data has been analyzed.

### 2.2. Diagnosis of malaria parasite

Peripheral blood was collected from the group of male, female and children patients examined for malaria parasite who had short duration (<3 d) of fever (temperature>38 °C) associated with any localized symptoms such as fever with sweating and shaking chill, fatigue, headache, vomiting, abdominal cramps, dry cough, muscle and joint pain. Annual parasitic incidence was calculated using standard formula.

In this study, diagnosis of malaria has been done on the basis of malaria parasite on blood slide examination of thick and thin smears, and/or malaria antigen positivity with RDTs and Widal test. Widal test is of little clinical relevance due to the number of cross reacting infections. The systematic outline of the diagnosis process has been illustrated in Figure 1.

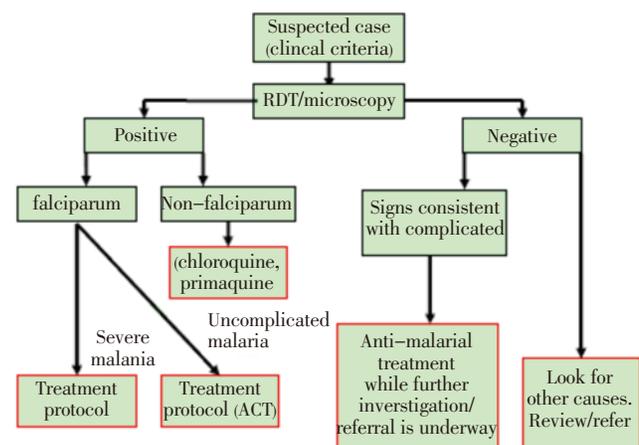


Figure 1. Systematic diagram of the clinical diagnosis analysis for malaria.

Both thick and thin blood films were prepared and stained by Ramnowski's method. The species and the stages in which the parasite were seen also noted. The slide falciparum rate and percentage of *P. falciparum* infection were calculated.

### 2.3. Treatment protocol for malaria infected individuals

Based on the clinical and laboratory parameters, male, female and children who has been categorized as severe malaria as per the guidelines of the WHO were included in the study<sup>[12]</sup>.

Patients with uncomplicated *P. falciparum* infected were treated with artemisinin combination therapy (ACT). Four different types of ACTs were reported such as, artemether plus lumefantrine, artesunate plus amodiaquine, artesunate plus mefloquine and artesunate plus sulfadoxine–pyrimethamine. WHO has now added a fifth ACT – dihydroartemisinin plus piperazine. ACTs for first–line treatment in infants and young children with attention to accurate dosing and ensuring the administered dose is retained. The choice of ACT in a country or region will be based on the level of resistance of the partner medicine in the combination. In case of uncomplicated *P. vivax* malaria infection, chloroquine combined with primaquine was used<sup>[13]</sup>. It was observed that at least a 14–day course of primaquine is required for the radical treatment of *P. vivax*. However ACT (exception AS+SP) has been adopted as the first–line treatment for *P. falciparum* malaria, is also be used for *P. vivax* malaria in combination with Primaquine for radical cure.

In the treatment of severe malaria for adult individuals, artesunate *i.v.* or *i.m.*: 2.4 mg/kg body weight was given at the intervals of 0 h, 12 h and 24 h followed by once a day after wards<sup>[14]</sup>. Lactating women should receive standard antimalarial treatment (including ACTs) except primaquine and tetra–cyclines. Children with complicated malaria were treated with artesunate *i.v.* or *i.m.*; quinine *i.v.* infusion or divided *i.m.* injection should be used.

In pregnancy the infected female was treated with quinine plus clindamycin to be given for 7 d. ACT is applied if quinine plus clindamycin treatment fails or uncertainty of compliance found within 7 d treatment<sup>[15]</sup>. At the second and third trimesters, the patient was treated with artesunate plus clindamycin or quinine plus clindamycin for a week.

## 3. Results

A total number of 6342 and 765 patients were admitted at tribal hospital and hill forest camps respectively during the study period. Among 6342 of individuals tested, 4387 individuals were reported for malaria positive. Out of the 4387 slides examined, 59.0% were positive *P. falciparum* infection, 19.4% slides showed positive *P. vivax* infection and 21.5% had mixed infection. The total *P. falciparum* burden was estimated as 80.5%.

In hill forest camps, out of 765 admitted patients, 650 patients who had clinical history suggestive of malaria were examined for malaria parasites. The parasitological parameters had showed that 60% of malaria occurred due to *P. falciparum* infection, and *P. vivax* was responsible for 15% infection whereas, mixed infection were found in 25% cases (Table 1). The highest malarial cases from tribal hospital and hill forest camps were reported in month of August (Table 2).

**Table 1**

Parasitological parameters of malaria in hospital and hill forest camps.

Types of infection	No. of cases reported in hospital	No. of cases reported in hill forest camps
<i>P. falciparum</i>	2591	390
<i>P. vivax</i>	855	98
<i>Plasmodium</i> mixed	941	162
Total	4387	650

**Table 2**

Seasonal pattern of total parasitological infection in one year enrolled at hospital and hill forest camps.

Month	TNF	TNM	<i>P. falciparum</i>	<i>P. vivax</i>	Mixed	PF %
January	146	144	65	27	52	81.0%
February	168	157	83	39	35	75.0%
March	182	174	93	38	43	78.0%
April	179	170	75	50	45	70.0%
May	411	303	142	89	72	70.0%
June	662	433	238	110	85	74.0%
July	704	607	322	114	171	81.0%
August	1074	846	557	155	134	81.0%
September	823	526	327	88	111	83.0%
October	910	479	303	76	100	84.1%
November	660	347	245	43	59	87.6%
December	423	201	141	26	34	87.0%
Total	6342	4387	2591	855	941	80.5%

TNF: Total number of fever cases enrolled; TNM: Total number of malaria positive cases; PF %: percentage of *P. falciparum* infection.

#### 4. Discussion

In the overall study, it was found that *P. falciparum* has been identified as the most common etiologic agent in both severe and non-severe malaria causing 80% of all malaria cases. Only 15% of malaria cases were caused by *P. vivax*, while 5 % cases due to dual infection by both species of parasites. Therefore *P. falciparum* infection was more likely to cause severe malaria than *P. vivax* or mixed infection. Contrary to the present study, the high percentage of *P. falciparum* infection has also been observed by Anand K. et al., in north India<sup>[16]</sup>. High number of *P. falciparum* infections may be due to their prolonged illness and severity of the disease who were admitted to the hospital and camps from the adjoining areas<sup>[17]</sup>.

The present study also focused on the gender wise distribution of malaria positive patients. The total slide positivity rate was significantly high in male (53.5%). Interestingly the infections in female were recodes as 46.5% and followed by children (33%). The primary counseling revealed that in most cases males were acquiring malaria due to more exposed<sup>[1]</sup>.

Malaria cases in India are reported throughout the year. During monsoon season (June to October) malaria cases were more reported as compared to winter season. During the rainy season more breeding grounds has been created. Almost every household are to be suffering from frequent bouts of malaria. The percentages of PF were found to be significantly higher at over the years. The study compares well with the study conducted by Talsania et al., 2010<sup>[2]</sup>.

Chloroquine is remaining the drug of choice for treatment of malaria infection in this region. However, the major threat today is the potential for resistance to arise in *P. falciparum* against artesunate or its partner drug<sup>[18]</sup>. For treatment, quinine or combination of sulfadoxine with pyrimethamine showed makeable result. However the doses were depending upon the clinical presentation of the patients. For *P. vivax* infection, chloroquine is highly susceptible to, and thus should always be the first line of treatment. Chloroquine combined with Primaquine has showed the fruitful effect on *P. vivax* infection. The pregnant women have been constituted an important risk group for malaria infection particularly in hyper and holoendemic situations<sup>[19]</sup>. In the time of pregnancy artesunate plus clindamycin or quinine plus clindamycin has been shown the positive effect.

In this study an attempt has been made to find out the spectrum of clinical and parasitological features in severe malaria in and around of Rampachodavaram, Maredumilli

area and to identify the factors which might be related with adverse outcome in malaria. When compared to rest of the hills and forest areas, where most of the tribal people reside has the heavy load of malaria mainly *P. falciparum* causing deaths and reemerging as threat to nation. It was found that RDT's can be helpful to screen *P. falciparum* in endemic areas and remote tribal belt. In compare with the earlier guideline, the present WHO guidelines in the management of malaria (artemesunine combination therapy) has been showed much effective on both parasite infections.

The awareness towards the malaria infection by effective campaigning program targeted against the spread of malaria, careful search for malarial parasites in the peripheral blood film in clinical setting and urgent supply of anti malarial vaccine should be undertaken. The antilarval, anti adult mosquito and personal protection must be improved and implemented effectively. Various government and non-government organizations are involved in awareness campaigning programs but still there is a need to strengthen the counseling and media campaigning in rural areas to enhance malaria prevention activity. Treatment protocol for malaria infected individuals showed that ACT has been showed much effective on both parasite infections. The multidisciplinary approaches that include clinical and field studies with laboratory, molecular, and genomic methods would be provide a powerful combination for malaria control and prevention in India.

#### Conflict of interest statement

We declare that we have no conflict of interest.

---

#### Comments

##### Background

Malaria continues to pose a major public health threat in India. High prevalence has been reported among ethnic and tribal groups living in remote forested and border areas as well as among mobile and migrant population. Transmission is seasonal with increased intensity related to rain. Limited health infrastructure and lack of drugs at village level are the factors responsible for high morbidity and mortality due to malaria.

##### Research frontiers

The present study was conducted in the tribal belt of East

Godavari district *i.e.* Rampachodavaram and Maredumilli area. The population of tribal areas of Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Gujarat, Maharashtra, Bihar, Jharkhand, Rajasthan, Orissa and North Eastern states are contributing about 50% of *P. falciparum* cases of the country.

#### Related reports

Muddaiah M. and Prakash PS (2006) have been reported A study of clinical profile of malaria in a tertiary referral centre in South Canara; Talsania NJ and Vani SN (2010): A study of malaria-related paediatric morbidity and mortality in Ahmedabad, Gujarat state, India.

#### Innovations & breakthroughs

*P. falciparum* was causing 80% of all malaria cases. Cases are more in the month of August, mixed infection were also there in the 25% of cases. Comparatively males are more affected. Almost every household are suffering from frequent attacks of malaria.

#### Applications

*P. falciparum* was more common which is dreadful with more complications. RDT immunological test found to be more useful in the community for early diagnosis in the resource poor setting.

#### Peer review

This is a good study in which the authors observed the epidemiological features of malaria in the tribal belt where the problem is more prevalent. Being hilly area transportation facilities are less and sometimes in accessible because of the bad weather. The observations are useful for the policy makers for evaluating the programme.

#### References

- [1] Muddaiah M, Prakash PS. A study of clinical profile of malaria in a tertiary referral centre in South Canara. *J Vector Borne Dis* 2006; **43**(1): 29–33.
- [2] Talsania NJ, Vani SN. A study of malaria-related paediatric morbidity and mortality in Ahmedabad, Gujarat state, India. *Natl J Community Med* 2010; **1**(2): 135–138.
- [3] Agnandji ST, Lell B, Soulanoudjingar SS, Fernandes JF, Abossolo BP, Conzelmann C, et al. First results of phase 3 trial of RTS,S/AS01 malaria vaccine in African children. *N Engl J Med* 2011; **365**(20): 1863–1875.
- [4] Murray CJ, Rosenfeld LC, Lim SS, Andrews KG, Foreman KJ, Haring D, et al. Global malaria mortality between 1980 and 2010: a systematic analysis. *Lancet* 2012; **379**(9814): 413–431.
- [5] Das NG, Baruah I, Kamal S, Sarkar PK, Das SC, Santhanam K. An epidemiological and entomological investigation on malaria outbreak at Tamalpur PHC, Assam. *Indian J Malariol* 1997; **34**: 164–170.
- [6] Kondrashin AV. Malaria in WHO Southeast Asia Region. *Indian J Malariol* 1992; **29**: 129–160.
- [7] Gupta BM, Bala A. A bibliometric analysis of malaria research in India during 1998–2009. *J Vector Borne Dis* 2010; **48**(3): 163–170.
- [8] Dutta P, Khan AM, Mahanta J. Problem of malaria in relation to socio-cultural diversity in some ethnic communities of Assam and Arunachal Pradesh. *J Parasitic Dis* 1999; **23**: 101–104.
- [9] Singh AL, Rahman A. Malaria and related environmental issues in India: a case study of Aligarh city. *GeoJournal* 2001; **89**: 89–99.
- [10] National Vector Borne Disease Control Programme (NVBDCP). Status of drug resistance in India. Delhi: National Vector Borne Disease Control Programme, Ministry of Health & Family Welfare; 2012. [Online] Available from: <http://www.nvbdc.gov.in/DRUG.html>. [Accessed on 1 March, 2012].
- [11] Park K. *Text book of preventive and social medicine*. 17th ed. Jabalpur: Banarasi Das Bhanot Publisher; 2002, p. 193.
- [12] World Health Organization. WHO Malaria Factsheet. Geneva: World Health Organization; 2012. [Online] Available from: <http://www.who.int/mediacentre/factsheets/fs094/en/index.html>. [Accessed on 1 March, 2012].
- [13] Rueangweerayut R, Phyo AP, Uthaisin C, Poravuth Y, Binh TQ, Tinto H, et al. Pyronaridine-artesunate versus mefloquine plus artesunate for malaria. *N Engl J Med* 2012; **366**: 1298–1309.
- [14] Phyo AP, Nkhoma S, Stepniewska K, Ashley EA, Nair S, McGready R, et al. Emergence of artemisinin-resistant malaria on the western border of Thailand: a longitudinal study. *Lancet* 2012; **379**: 1960–1966.
- [15] Leslie T, Mikhail A, Mayan I, Anwar M, Bakhtash S, Nader M, et al. Overdiagnosis and mistreatment of malaria among febrile patients at primary healthcare level in Afghanistan: observational study. *BMJ* 2012; **345**: e4389.
- [16] Anand K, Kant S, Kumar G. Clinical case definition of malaria at a secondary level hospital in northern India. *Southeast Asian J Trop Med Pub Health* 1999; **30**(2): 243–245.
- [17] Mishra G. Hospital based study of malaria in Ratnagiri district, Maharashtra. *J Vector Borne Disease* 2003; **40**: 109–111.
- [18] Das A, Anvikar AR, Cator LJ, Dhiman RC, Eapen A, Mishra N, et al. Malaria in India: The center for the study of complex malaria in India. *Acta Trop* 2012; **121**(3): 267–273.
- [19] Kochar DK, Thanvi I, Joshi A, Subhakaran S, Aseri B, Kumawat I. Falciparum malaria and pregnancy. *Indian J Malariol* 1998; **35**: 123–130.