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Malaria prevalence and analysis of sociodemographic factors related to malaria in agency mandals, East Godavari, Andhra Pradesh, India

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ABSTRACT

The present communication deals with study of prevalence of malaria in five agency mandals of East Godavari district, Andhra Pradesh from January 2012 to February 2013. The study population belonged to men, women and children. A total of 750 blood samples were collected by door to door surveillance and by visiting local Primary Health Centres (PHCs). It has revealed that 63 subjects have suffered from malaria. So, the haematological and biochemical parameters were estimated to know the metabolic changes due to malaria infection. The high percent of malaria prevalence was observed in Devipatnam (25%) followed by Rampachodavaram (21%), Maredumilli (20%), Gangavaram (17%) and Y. Ramavaram (17%) mandals. Sociodemographic factors such as profession, protective measures, living standard, risk factors etc. were collected during the survey period. Poor sociodemographic profile of the study subjects is one of the main reasons for occurrence of malaria among population. Anemia and hypoglycemia were the common occurrences in malaria infected subjects.

Key words: Prevalence of malaria, sociodemographic characteristics, anemia, hypoglycemia

INTRODUCTION

Malaria is a big health problem and is endemic in an area where around two billion people live. *Plasmodium falciparum* causes approximately 600,000 deaths each year and the vast majority of the burden of malaria mortality is in sub-Saharan African countries (WHO, 2010). The presenting symptoms and mortality patterns of severe malaria vary widely according to the geographical setting and therefore transmission intensity. In areas with high stable transmission in sub-Saharan Africa, severe anemia in infants, which has as relatively good prognosis, is the main presentation and severe malaria does not occur in adults with acquired immunity (WHO/Communicable diseases cluster, 2000).

In areas with moderate transmission, cerebral malaria in young children is the most common presentation. In areas with low transmission, such as Southeast Asia, severe malaria occurs in

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all age groups including adults. Cerebral malaria, renal failure, severe jaundice, and pulmonary edema are the main manifestations in the young adult population (WHO/Communicable diseases cluster, 2000). Yet the determinants of severe malaria and its pathophysiology are not completely understood.

Therefore, epidemiological studies of severe malaria and its related deaths may provide additional understanding of its disease course, and eventually lead to improved case management.

Malaria not only poses a high risk to health, but the repeated clinical consequences of infection in endemic areas during early life and adulthood and outbreaks in epidemic prone areas place a burden on households, on the health services and ultimately on the economic growth of communities and the nation. Socioeconomic conditions of the community have direct bearing on the problem of malaria. Ignorance and impoverished conditions of people contribute in creating source and spread of malaria and hinder disease control strategy (Yadav et al., 1999; Collins et al., 1997).

Most of the malaria burden is borne by economically productive ages. The states inhabited by ethnic tribes are entrenched with stable malaria, particularly *P. falciparum* with growing drug resistance. Factors such as deteriorating health systems, growing drug and insecticide resistance, failure of water management but also socioeconomic, land-use factors, and climate are hypothesized to influence the emergence of malaria (World Bank Report, 2001).

Figure 1. Map of East Godavari district showing the mandals of Rampachodavaram, Maredumilli, Gangavaram, Devipatnam and Y. Ramavaram

The current study was conducted in agency mandals of East Godavari district to investigate the epidemiology of severe *P. falciparum* and *P. vivax* malaria among children adults. The sociodemographic characteristics were collected by using questionnaire based survey in different groups to understand whether sociodemographic or socioeconomic characteristics act as determinants for malaria risk. Occupation, worksites and to some extent socioeconomic factors are shown to be risk factors for malaria in several studies from Latin America (Fernandez & Sawyer, 1988; Castro & Makate, 1988) and Thailand (Funglandda et al., 1987).

MATERIALS AND METHODS

Study area

In the present study, five agency mandals of East Godavari district are selected because these villages are occupied by tribals and rural people and to create awareness of about some communicable diseases. In the present study Devipatnam, Rampachodavaram, Gangavaram, Y. Ramavaram and Maredumilli were selected (Figure 1).

East Godavari district is approximately populated with 51,51,549 people, out of which 13,73,210 were of urban and 36,80,517 were of rural. This district is occupied with 36% of forest range. The annual rainfall is 1,724 mm as per 2010 data.

Sample size and study population

Extensive survey was conducted in the above five mandals of East Godavari district from January 2012 to February 2013 to study the prevalence of malaria both *P. falciparum* and *P. vivax* in general population. The study people included were men, women and children of all age groups. A total of 750 blood samples were collected by door to door survey and by visiting local Primary Health Centres (PHCs). The blood smears were examined for malaria parasite. Out of 750 study subjects 63 subjects have suffered from malaria. So, the haematological and biochemical parameters of the subjects were estimated to know the metabolic changes due to malaria infection.

Sociodemographic data

Sociodemographic data was collected from these patients to know the status of the population. To collect the information of about the sociodemograpy, status of awareness and precautionary methods followed; the questionnaire method was followed. Thereby the collected data was analyzed.

Estimation of haematological and biochemical parameters

To estimate the haematological parameters like haemoglobin, total WBC count, differential leucocyte count and platelet count; whole blood sample preserved in K2 EDTA was collected. The method of Double Hydrodynamic Sequential System (DHSS) was followed and 'Horiba ABX Pentra 60 C+ (5 Part)' equipment was used to estimate the above haematological parameters. The biochemical parameters such as random blood sugar, total protein, albumin, globulin, A/G ratio, blood urea and serum creatinine were estimated by spectroscopic method using 'Roche Cobas c 111' instrument.

RESULTS

Table 1-5 show the month wise distribution of malaria positive cases (both *P.f* and *P.v*) in Rampachodavaram, Maredumilli, Gangavaram, Devipatnam and Y. Ramavaram respectively from January 2012 to February 2013. Maximum no. of cases filed were observed as 27 cases in the month of July in Rampachodavaram, 18 cases in the month of July in Maredumilli, 16 cases in the month of July in Gangavaram, 21 cases in the month of June in Devipatnam and 14 cases in both the months i.e., May and June in Y. Ramavaram mandal. Thus maximum number of cases was filed during the month of June and July in study areas, which is indicating that high malaria prevalence occurred during the beginning of monsoon.

During the study period, total malaria cases (including male, female and children) filed in different mandals were as follows: 154 cases in Rampachodavaram, 148 cases in Maredumilli, 131 cases in Gangavaram, 186 in Devipatnam and 131 cases in Y. Ramavaram. Among these

Table 1. Month wise distribution of malaria positive cases in Rampachodavaram mandal from January 2012 to February 2013

Month	Male	Female	Children	Total cases
January 2012	5	3	4	12
February 2012	2	2	2	6
March 2012	3	4	2	9
April 2012	4	3	2	9
May 2012	6	2	4	12
June 2012	5	4	7	16
July 2012	6	9	12	**27**
August 2012	2	4	0	6
September 2012	8	6	4	18
October 2012	0	4	2	6
November 2012	3	5	4	12
December 2012	0	1	1	2
January 2013	3	4	3	10
February 2013	3	4	2	9
Total	50	55	49	154

mandals, maximum number of cases was reported in Devipatnam mandal with 186 (Table 6). Further, the malaria prevalence in children is higher than those in adults in study area. Thus, high percent of malaria prevalence i.e., 25% was observed in Devipatnam mandal followed by 21% in Rampachodavaram, 20% in Maredumilli, 17% both in Gangavaram and Y. Ramavaram (Figure 2).

Table 7, shows socio-demographic data of the malaria patients residing in study area. A total of 750 subjects were analyzed for various characteristics. It is represented in Table 7 that 43% of the study patients were coolies, 73% of the subjects were uneducated, 69.8% of the subjects live in Kaccha type of house, 38% of subjects' surroundings are stagnated with water which is favorable for mosquito breeding, 36.5% of subjects' source of drinking water is from canal, 57.2% of the subjects doesn't take protected drinking water, 62% of the subjects have no toilet facility, 57% of the subjects have awareness about the communicable diseases, 52.2% of the subjects visit doctor during illness but 63.4% of the subjects visit medical volunteer during illness, 55.9% of the subjects use English medicines, 55.9% of the subjects know about the malaria symptoms, 58.8% of the subjects received treatment for malaria, 68% of the subjects do not use mosquito nets, 52.4% of the subjects use mosquito repellants, 57.1% of the subjects use larvicide and pesticide indoors, 52.4% of the subjects sleep outdoors, 50.7% of subjects use bed sheets during sleep at night, 55.5% of the subject were tested for blood smear at least one time and 44.4% of the subjects were effected with malaria according to the blood report. Thus, the poor living conditions, weak economic and social background, lack of awareness about communicable diseases resulted in prevalence of malaria in the above mandals which are chosen for the study.

From the above 750 subjects, a total of 63 subjects whom suffered with malaria were recruited to analyze the haematological and biochemical parameters. The haemoglobin content and WBC count was decreased, but neutrophil and lymphocyte counts increased during infection. Whereas the eosinophil, monocyte and platelet counts found to be in the normal range (Table 8). Thus anemia is the most dominant complication observed among the study patients. Regarding biochemical parameters, hypoglycemia is the common complication in all the subjects (Table 9).

Table 2. Month wise distribution of malaria positive cases in Maredumilli mandal from January 2012 to February 2013

Month	Male	Female	Children	Total cases
January 2012	4	3	2	9
February 2012	4	3	3	10
March 2012	2	3	3	8
April 2012	4	5	3	12
May 2012	3	6	3	12
June 2012	2	5	7	14
July 2012	4	8	6	18
August 2012	4	3	3	10
September 2012	3	3	3	9
October 2012	3	4	3	10
November 2012	2	4	2	8
December 2012	2	3	3	8
January 2013	3	3	4	10
February 2013	4	2	4	10
Total	44	55	49	148

Table 3. Month wise distribution of malaria positive cases in Gangavaram mandal from January 2012 to February 2013

Month	**Male**	**Female**	**Children**	**Total cases**
January 2012	3	3	3	9
February 2012	3	2	7	12
March 2012	3	3	2	8
April 2012	2	3	2	7
May 2012	0	2	2	4
June 2012	2	4	2	8
July 2012	4	7	5	**16**
August 2012	1	2	2	5
September 2012	2	5	5	12
October 2012	4	5	2	11
November 2012	4	2	1	7
December 2012	3	4	3	10
January 2013	1	3	6	10
February 2013	2	3	7	12
Total	34	48	49	131

DISCUSSION

The present study revealed the prevalence of malaria among children, women and men in five mandals of East Godavari district from January 2012 to February 2013. It was observed that peak prevalence was observed in the month of June or July in all the mandals i.e., 21%. In areas with high level of malaria transmission, children less than five years and women are the most vulnerable population and the main target of prevention strategies and also prevalence varied according to the geographical locations of the study areas. Similar study was carried out in at four health care facilities in several areas of Gabon, estimated the evolution of *P. falciparum*

Table 4. Month wise distribution of malaria positive cases in Devipatnam mandal from January 2012 to February 2013

Month	Male	Female	Children	Total cases
January 2012	4	4	5	13
February 2012	5	1	4	10
March 2012	6	0	5	11
April 2012	3	5	6	14
May 2012	3	4	3	10
June 2012	6	8	7	21
July 2012	7	4	8	19
August 2012	3	6	7	16
September 2012	7	2	5	14
October 2012	5	4	3	12
November 2012	3	7	4	14
December 2012	4	3	3	10
January 2013	1	6	3	10
February 2013	4	4	4	12
Total	61	58	67	186

Table 5. Month wise distribution of malaria positive cases in Y. Ramavaram Mandal from January 2012 to February 2013

Month	Male	Female	Children	Total cases
January 2012	3	2	4	9
February 2012	2	4	4	10
March 2012	3	5	4	12
April 2012	4	3	3	10
May 2012	3	4	7	14
June 2012	4	4	6	14
July 2012	4	3	5	12
August 2012	3	1	1	5
September 2012	2	2	2	6
October 2012	2	0	2	4
November 2012	3	4	3	10
December 2012	3	3	3	9
January 2013	2	3	2	7
February 2013	4	2	3	9
Total	42	40	49	131

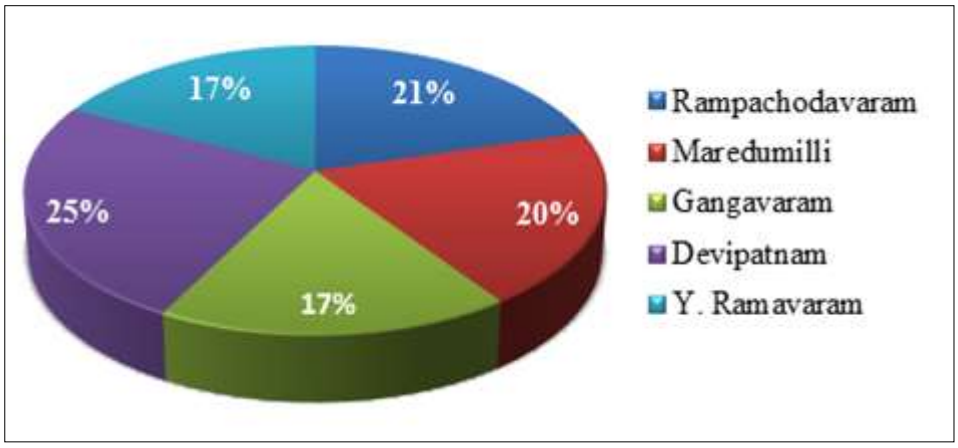
infection prevalence between 2005 and 2011. Large differences were observed between the sites, highlighting the heterogeneity of the epidemiological features of malaria in Gabon, even for sites that are geographically close together (Denise et al., 2013).

The malaria prevalence in children is higher than those in adults in study area. This is in agreement with the study of Denise et al. (2013) that in 2011, it was highest among children older than five years old at all sites compared to the previous years. But in the study area, the frequency of malaria infection is low because of medical care provided at Primary Health Centres

Table 6. Mandal wise distribution of malaria positive cases in East Godavari district from January 2012 to February 2013 according to different population

Name of the Mandal	No. of Subjects			
	Male	Female	Children	Total
Rampachodavaram	50	55	49	154
Maredumilli	44	55	49	148
Gangavaram	34	48	49	131
Devipatnam	61	58	**67**	**186**
Y. Ramavaram	42	40	49	131
Total	231	256	263	750

Figure 2. Percent distribution of malaria positive cases in five mandals of East Godavari district from January 2012 to February 2013



and presumptive treatment with ACT, the treatment prescribed (WHO, 2011). In Mlomp, Senegal, an area of moderate malaria transmission, the risk of malaria decreased by about 32 times between 1996 and 2010, including the control strategy implementation period (Brasseur et al., 2011). According to the study of Bouyou-Akotet et al., 2012; a reduction of malaria case frequency was observed among inpatients hospitalized in Libreville between 2002 and 2008, accompanied by a high frequency of viral and bacterial infections. The low rate of infection observed in five mandals of East Godavari district, is also confirmed in other study areas (Bouyou-Akotet, 2009).

The socioeconomic status is associated with malaria prevalence in the endemic areas. This is in agreement with previous reports on distinct socioeconomic risk factors for malaria (Somi et al., 2007; Kreuels et al., 2008; Baragatti et al., 2009). The possible explanation for the association of socioeconomic and sociodemographic status with malaria are (i) differing access to health facilities (ii) various environmental and housing conditions in the vicinity of households (iii) habitats and breeding sites for vectors (Edillo et al., 2002; Shililu et al., 2003). Apart from the socioeconomic status, sociodemographic factors were associated with malaria. According to the study of Anne et al. (2010) , the malaria risk was highest in the age group of children between 1 and 5 years, compared to children below the age of 1 year (Snow et al., 2005) and lower in children from families, which reported the use of mosquito protection measures (Clark et al., 2008; Baragatti et al., 2009).

The present study reported anemia as the common complication followed by hypoglycemia in the study subjects, is in agreement with other reports from other parts of the world. It has been demonstrated that severe

Table 7. Sociodemographic data of the malaria infected study subjects residing in study area from January 2012 to February 2013

S. No.	Characteristic	No. of Subjects (n = 750)	%
1.	**Profession**		
	Coolie	322	**43.0**
	Cultivation	182	24.0
	Small scale Business	115	16.0
	Staying at home	131	17.0
2.	**Education**		
	Yes	202	27.0
	No	548	**73.0**
3.	**Type of House**		
	Kaccha	524	**69.8**
	Pacca	226	30.2
4.	**Surroundings**		
	Water stagnation	285	**38.0**
	Clean & Dry	251	33.5
	Bushy	214	28.5
5.	**Source of Drinking Water**		
	Canal Water	274	**36.5**
	Tap Water	215	28.6
	Ground Water	261	34.9
6.	**Protected Drinking Water**		
	Yes	321	42.8
	No	429	**57.2**
7.	**Toilet Facility**		
	Yes	285	38.0
	No	465	**62.0**
8.	**Awareness of Communicable Diseases**		
	Yes	428	**57.0**
	No	322	43.0
9.	**Visiting Doctor during illness**		
	Yes	359	47.8
	No	391	**52.2**
10.	**Visiting medical volunteer during illness**		
	Yes	476	**63.4**
	No	274	36.5
11.	**Use of medicines**		
	English medicine	419	**55.9**
	Home-made medicine		44.4
12.	**Awareness about malaria symptoms**		
	Yes	419	**55.9**
	No	331	44.1
13.	**Treatment for malaria**		
	Yes	441	**58.8**
	No	309	41.2
14.	**Use of mosquito nets**		
	Yes		42.8
	No		**68**
15.	**Use of mosquito repellants**		
	Yes	393	**52.4**
	No	357	47.6
16.	**Use of Larvicide and Pesticide indoors**		
	Yes	428	**57.1**
	No	322	42.9
17.	**Sleeping outdoors**		
	Yes	357	47.6
	No	393	**52.4**

…Table 7. Sociodemographic data of the malaria infected study subjects residing in study area from January 2012 to February 2013

S. No.	Characteristic	No. of Subjects (n = 750)	%
18.	**Use of bed sheets at night**		
	Yes	380	**50.7**
	No	370	49.3
19.	**Tested blood smear at least one time**		
	Yes	416	**55.5**
	No	334	44.5
20.	**Result of Blood Report**		
	Malaria	333	**44.4**
	Chicken Guinea	274	36.5
	Dengue	143	19

Table 8. Estimation of haematological parameters in study patients in five mandals of East Godavari district during the study period. The following each value is the average value of 63 study patients

S. No.	Parameter	Result	Normal Range
1.	Haemoglobin	10.5 gm%	12-18 gm% (M) & 11 – 16 gm% (F)
2.	Total WBC count	4200 cells/cumm	4000 – 11000 cells/cmm
3.	Neutrophils	66	50 – 70
4.	Lymphocytes	29	20 – 40
5.	Eosinophils	4	1 – 8
6.	Monocytes	3	2 – 10
7.	Platelet count	1.81	1.50 – 4.00

Table 9. Estimation of Biochemical parameters in study patients in five mandals of East Godavari district during the study period. (The following each value is the average value of 63 study patients)

S. No.	Parameter	Result	Normal Range
1.	Blood Sugar (R)	87 mg/dl	70 – 110 (F); 70-140 (R); 70 – 180 (PP)
2.	Total Protein	6.7 g/dl	6.4 – 8.7 g/dl
3.	Albumin	3.8 g/dl	3.4 – 5.0 g/dl
4.	Globulin	2.9 g/dl	2.8 – 3.7 g/dl
5.	Albumin/Globulin Ratio	1.3	1:1.5 – 1:2
6.	Blood Urea	18 mg/dl	10 – 40
7.	Serum Creatinine	0.9 mg/dl	0.8 – 1.5 mg/dl

complication (45.4%) of *P. falciparum* malarial infection among patients in a hospital (Gedarif) in eastern Sudan (Giha et al., 2005). Anemia was the most common manifestation (30%), followed by hypoglycemia, of severe malaria among pregnant women in the same study area in Sudan (Ali et al., 2011). Interistingly, it has been observed that 36.2% of adult patients in the same study area had anemia regardless of their age, sex, education level or infection with malaria (Abdallah et al., 2012). In Tanzania, the clinical manifestations of severe malaria in children younger than five years were cerebral malaria (47.3%) and severe anemia (14.6%) (Msangeni et al., 2011 and Jayadev et al., 2014). Severe anemia (8.57%) and circulatory collapse (11.90%) were the most common manifestations of severe malaria in neighboring Ethiopia (Tekeste et al., 2013). In India, acute renal failure and jaundice were more common in

adults whereas children frequently developed severe anemia, while cerebral malaria occurred equally in adults and children (Mohanty et al., 2003 and Iribhogbe et al, 2013). Hypoglycemia is one of the defining features of severe malaria according to WHO guidelines, and indicates a poor prognosis (WHO, 2000). Recent findings showed a significant difference between blood glucose levels between children who died and survivors (Wilcox et al., 2010). Furthermore, the low death rate of hyperglycemia in this study could explain the low mortality rate itself.

In conclusion, the herein presented results show that people from poorer households are of greater risk for malaria. It is under discussion how poverty influences the prevalence of malaria or malaria influence the occurrence of poverty. In either case, the fight against malaria has to be lead by the fight against poverty and improvement of living standard.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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