Biolife 2(2):452-462
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE ORIGINAL ARTICLE

INCIDENCE OF URBAN MALARIA IN VIJAYAWADA CITY OF KRISHNA DISTRICT, ANDHRA PRADESH, INDIA

Jayadev. D. J[1] and Viveka Vardhani. V[2*]

[1,2]Department Zoology & Aquaculture, Acharya Nagarjuna University, Nagarjunanagar-522 510

E-mail: vadlamudi_vv@yahoo.co.in

ABSTRACT

Malaria, a disease of antiquity, has proved to be a formidable deterrent to the cultural and socio-economic progress of man in the tropical, sub-tropical and monsoon prone zones of the world. A survey (from July 2008 to June 2009) was conducted on the incidence of urban malaria in Vijayawada city of Krishna District, Andhra Pradesh, India showed high incidence of malaria in slum locality. No incidence of *P. falciparam* malaria was found in the analysis of 433 blood smears in posh areas. No fever cases were found in the age group of 0-1. There was no statistical difference in the occurrence of malaria in between male and female of different age groups.

Key words : Incidence of urban malaria, Posh, Mixed, Slum, Hilly and Low lying areas, Vijayawada.

INTRODUCTION

Malaria is a major public health problem, affecting over 200 million people worldwide and endemic in more than 100 countries and less than 40 % of the world's population is at risk (World Malaria Report, 2008). Annually 100 million people are affected by malaria and about 1.5 to 2.7 million persons are found to be killed by the disease worldwide (WHO, 1993). The climatic conditions in India favour the transmission of malaria in remote and rural areas, urban areas, forests, and hills and 20 per cent of population is at high risk of malaria mainly in north-eastern states, Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, West Bengal and Karnataka. The risk factors leading to complete reconciliation of cause and effect relationships of malaria were identified in India by GIS based studies (Srivastava *et al*., 1999; 2003). A study on malaria in hospital patients (448 numbers) of Ratnagiri District (Maharashtra) during May 1999 to April 2000 showed clinical history of malaria. Out of the 448 slides examined 44 slides were positive for malaria parasites (26 *P. falciparum* and 18 *P. vivax*), the SPR and the SFR were 9.82 and 5.8% respectively. Two *Plasmodium vivax* patients and 21 *Plasmodium falciparum* patients had gametocytes in the peripheral blood (Gouravi Mishra, 2003).

Persistent malaria is the characteristic feature in most forest areas and both *P. vivax* and *P. falciparum* are prevalent in forest areas of Madhya Pradesh (Singh and Khare, 1999). Hema Joshi (2003) reported the existence of genetic diversity among the field isolates of *P. falciparum* and *P. vivax* in India. A hospital based study on assessment of knowledge about malaria among patients indicated that the knowledge about malaria is poor in persons living in urban localities reported with fever (Matta *et al*., 2004). Control of malaria is also possible by educating the community to take measures for the non-prevalence of disease (Sharma *et al*., 2000). On a global scale, malaria has been a major public health concern.

According to WHO, over 107 countries world-wide are endemic for malaria and is found to be the most common cause of serious morbidity and mortality in such countries (Barua Madhumita *et al*., 2009). Of the four species of *Plasmodium* that naturally infect humans, *P. falciparum* and *P. vivax* are the most common and responsible for more serious disease (Barua Madhumita *et al*., 2009). The occurrence of malaria is depended on the interaction of three factors namely the parasite, host and vector. The physical, socio-economical and cultural factors of a community played a major role in the prevalence of malaria as reported by Das *et al*., (2004). It is clear from the available data that the perennial transmission of malarial disease is going on in Vijayawada area. Hence, a new vista has been opened to study the incidence of Urban Malaria. The study area of the city is having completely urban atmosphere (Fig-1).

.

MATERIAL AND METHODS

The present survey was conducted at weekly intervals from July 2008 to June 2009. The study area is located in and around the hilly areas, and the riverine belt of river Krishna (surrounding Vijayawada in one side of entire city). Vijayawada is surrounded by hills and hillocks with temperature fluctuations in between 30º C to 38° C and sometimes 40° C in last week of May. Rainfall is moderate with relative humidity, 60-66%.

The study was conducted in 15 localities. Blood smears were collected from fever patients, Vector and Larval collection was made in posh area (3 localities), mixed area (3 localities), slum area (3 localities), low lying area (3 localities) and hilly area (3 localities) basing upon type of housing, general hygiene, sanitation and living standards of the residents; these wards were selected randomly (Table 1). Epidemiological study includes the fever screening and collection of blood samples from the patients under weekly surveillance as per the methods given by Shankar et al., (2004). The conventional finger prick blood smear is used for diagnosis of the disease.

RESULTS AND DISCUSSION

High malarial positive cases were recorded in people living in slum locality. The housing

Figure-1. Panoramic view of Vijayawada city

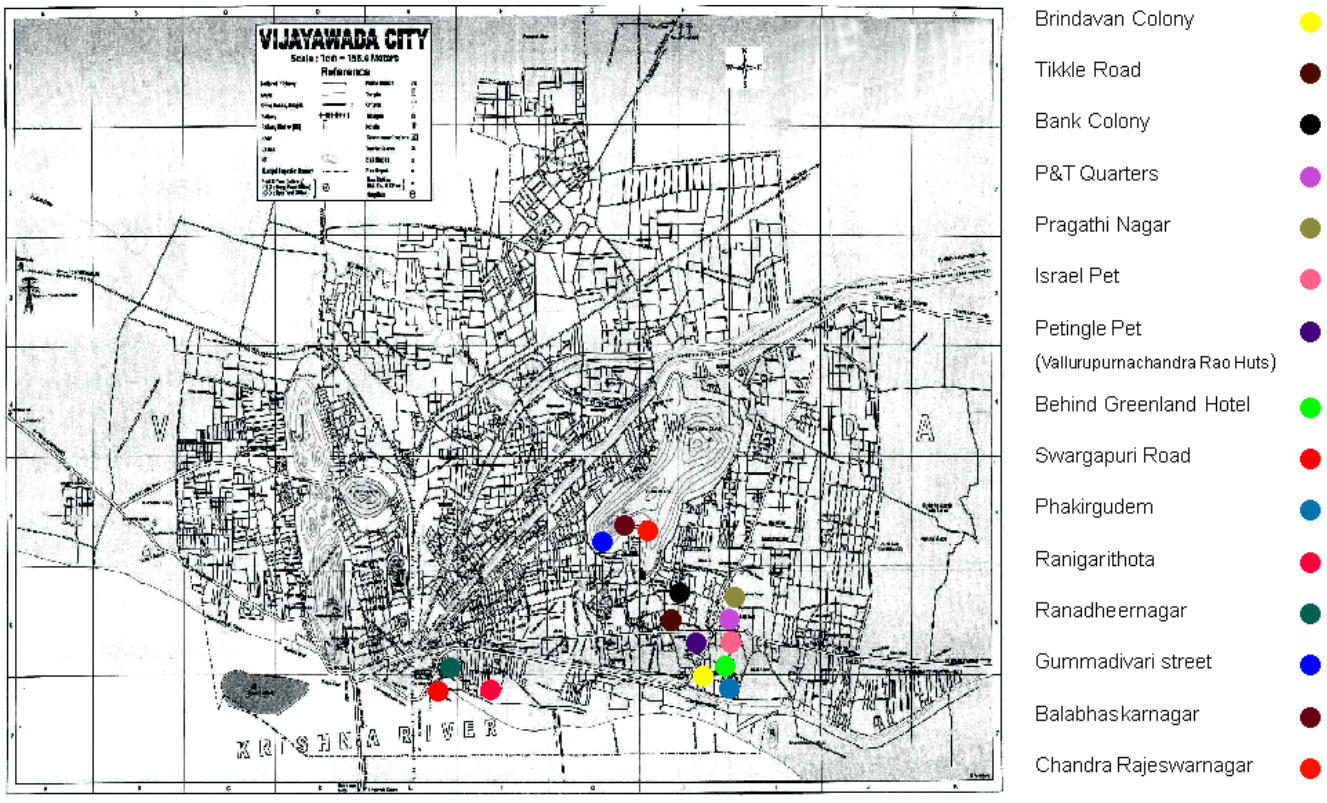

Table 1. Demographic details of the study area and income levels of the sampled inhabitants

Area	Locality	No. of Families	Total Population	Income Levels (Rs.)
Posh	Brindavan Colony	650	2120	2.5-3.0 Lakhs
	Tikkle Road	485	1675	
	Bank Colony	550	1774	
Mixed	P&T Quarters	550	1853	1.5-2.0 Lakhs
	Pragathi Nagar	340	1160	
	Israel Pet	373	1283	
Slum	Petingle Pet (Vallurupurnachandra Rao Huts)	531	1893	12,000-75,000
	Behind Greenland Hotel	427	1793	
	Swargapuri Road	553	1759	
Low lying	Phakirgudem	408	1753	1.0-1.25 Lakhs
	Ranigarithota	482	1784	
	Ranadheernagar	510	1879	
Hilly	Gummadivari street	311	1264	0.75-1.25 Lakhs
	Balabhaskarnagar	299	1175	
	Chandra Rajeswarnagar	286	1051	
	TOTAL	**6,755**	**24,216**	

Table 2. Details of the blood samples collected and positive malaria cases in study area

Locality	Blood Smears Examined	Positive Cases	*Plasmodium falciparum*	*Plasmodium vivax*
Brindavan Colony	168	3	0	3
Tikkle Road	122	5	1	4
Bank Colony	143	3	0	3
Sub-total	**433**	**11**	**1**	**10**
P&T Quarters	209	5	1	4
Pragathi Nagar	182	8	1	7
Israel Pet	248	6	0	6
Sub-total	**639**	**19**	**2**	**17**
Petingle Pet (Vallurupurnachandra Rao Huts)	300	23	2	21
Behind Greenland Hotel	248	19	1	18
Swargapuri Road	186	26	2	24
Sub-total	**734**	**68**	**5**	**63**
Phakirgudem	204	14	2	12
Ranigarithota	197	13	2	11
Ranadheernagar	216	17	1	16
Sub-total	**617**	**44**	**5**	**39**
Gummadivari street	148	16	2	14
Balabhaskarnagar	171	20	4	16
Chandra Rajeswarnagar	219	18	5	13
Sub-total	**538**	**54**	**11**	**43**
TOTAL	**2,961**	**196**	**24**	**172**

pattern, living standards, socio-economical problems, poor sanitation, and lack of proper health education may be playing a significant role for transmission of malaria in slum area. Man mosquito contact is favoured by housing pattern in this surveyed area.

Blood samples were collected under daily surveillance from the patients suffering from fever. The survey area covers 24,216 population. 2,961 blood smears were collected for knowing the incidence of malaria in the study period. 196 positive cases were declared and in these samples 24 cases of *P. falciparum* and 172 cases of *P. vivax* were observed (Table 2). In slum locality, in Swargapuri Road, 26 cases (2 *P. f.* & 24 *P. v.*), in Petingle pet, 23 cases (2 *P. f.* & 21 *P. v.*), and in the area behind Greenland Hotel, 19 cases (1 *P. f.* & 18 *P. v.*), were found. A total of 68 malarial positive cases were noted out of 734 blood samples. In 68 PC, *P. falciparum* were 5 and *P. vivax* were 63. In posh locality, the positive cases of malaria were found to be 11; 5 in Tikkle Road (1 *P. f.* & 4 *P. v.*), 3 in Brindavan Colony and 3 in Bank Colony (*P. v.).* There was no incidence of *P. falciparum* out of 433 blood smears.

Eleven month old male and female children were free from *P. falciparum* and *P. vivax.* 1- 4 age group females were also found free from *P. falciparum*. The age and sex wise incidence of *P. f.* and *P. v.* of the study area is shown in Table - 3. The prevalence of malaria was found to be negligible in Brindavan Colony (3 PC), Tikkel road (5 PC), Bank Colony (3 PC), P&T Quarters (5 PC), Pragathi Nagar (8 PC) and Israel Pet (6 PC). In the age group of 1- 4, it was found that 1 male was suffering from *P. falciparum* and 12 males and 9 females from *P. vivax*. In the age group of 5-8, 2 males and 2 females were suffering from *P. falciparum* and 14 males and 15 females from *P. vivax.* In the age group of 9-14, 5 males and 4 females were suffering from *P. falciparum*, 26 males and 20 females from *P. vivax*. In the age group of above 15, 6

Table 3. Statement showing the data of age-wise, month-wise and sex-wise blood smears collection

Locality/ Age group	0-1		1-4		5-8		9-14		15 - above		Total		Grand Total
	M	*F*	M	F	M	F	M	F	M	F	M	F	
Brindavan Colony	2	3	12	13	6	14	17	21	36	44	73	95	168
Tikkle Road	2	4	7	12	9	13	9	1	24	31	51	71	1322
Bank Colony	2	2	5	9	12	16	19	19	25	34	63	80	143
P&T Quarters	2	1	11	17	19	24	26	32	36	41	94	115	209
Pragathi nagar	1	1	14	14	18	21	21	27	34	31	88	94	182
Israel Pet	2	3	27	34	29	41	28	36	24	24	110	138	248
Petingal Pet	2	1	17	19	22	29	36	52	53	69	130	170	300
Behind Greenland Hotel	1	1	11	13	20	24	34	48	49	47	115	133	248
Swargapuri Road	4	9	10	13	19	22	29	37	20	23	82	104	186
Phakirgudem	3	2	9	11	13	16	21	24	50	55	96	108	204
Ranigari thota	2	2	8	7	16	19	22	26	43	52	91	106	197
Ranadheernagar	3	4	11	15	14	17	19	21	59	53	106	110	216
Gummadivari Street	0	1	6	9	8	11	14	21	34	44	62	86	148
Balabhaskarnagar	1	1	9	14	11	17	21	29	30	38	72	99	171
Chandra Rajeswaranagar	1	1	9	16	14	20	18	24	47	69	89	130	219
Total	**28**	**36**	**166**	**216**	**230**	**304**	**334**	**428**	**564**	**655**	**1322**	**1639**	**2961**

M = Male; F= Female

males and 4 females were suffering from *P. falciparum* and 43 males and 33 females from *P. vivax*. It is interesting to note that in this age group of above 15, the highest prevalence of *P. vivax* was found both in males (43 Nos.) and females (33 Nos.) and males were found to be more infected than females.

Observations on the incidence of malaria in different localities (July 2008 to June 2009) are shown in table - 4. The incidence of malaria was found to be maximum in Swargapuri Road (26 PC [Positive Case]), followed by Petengle Pet (23 PC), Bala Bhaskar Nagar (20 PC), Behind Greenland Hotel (19 PC), Chandra Rajeswara Nagar (18 PC), Ranadheer Nagar (17PC), Gummadivari Street (16 PC), Phakirgudem (14 PC), Ranigari Thota (13 PC), Pragathi Nagar (8 PC), Israel Pet (6 PC), P&T Quarters (5 PC), Bank Colony (3 PC) and Brindavan Colony (3 PC). The incidence of the disease was found to be maximum in males (26 PC), in September 2008 and in females (20 PC) in October 2008.

The number of blood smears examined, the total number of positive cases and the percentage of *P. falciparum* occurrence are shown in table - 5. Maximum number of positive cases (26) were found in a slum area (Swargapuri Road) and minimum number (3) were found in a Posh area (Brindavan Colony and Bank Colony). The locality wise blood smears collection, total number of positive cases, Annual Blood Examination Rate (ABER), Annual Parasites Incidence (API), Slide Positivity Rate (SPR), Slide *falciparum* Rate (S *f* R), *Plasmodium falciparum* Proportion (*P. f P*) and Annual *falciparum* Incidence (A *f* I) are shown in table 5. Blood smears (2,961) were examined for malarial parasite and found 196 positive cases. The survey conducted among the community population revealed the fever incidence in the community. The load of fever incidence is determined by using the formula given below:

Annual Blood Examination Rate (ABER): It is the proportion of blood slides examined for malaria in a human population in a year. ABER is calculated using the formula given below:

ABER = No. of blood slides examined in a year/ Total Population Surveyed x 100

2961/24216 x 100 = 12.2%

The load of fever incidence among 24,216 human populations was found to be 12.2%.

Detection of positive cases:

Out of the 2,961 blood samples collected and examined, the resulted positive cases found to be 196.

The annual parasites incidence among 1,000 population was calculated by using the formula given below:

Annual Parasites Incidence (API):

It is expressed as the number of malaria positive cases in a particular year for a particular place per thousand population.

API=Total no. of malaria positive cases in a year/ Population of the area x 1000

API = 196/24216 x 1000 = 8.0

The Annual Parasites Incidence among 24,216 human population was found to be 8.0, during the study period (June 2008 to July 2009).

Monthly Parasite Incidence (MPI):

It is expressed as the number of malaria positive cases in a particular month, for a particular place per thousand population.

MPI = No. of malaria positive cases in a month/ Total population of the area x 1000

MPI for July 2008 = 9/24216 x 1000 = 0.37

The parasite incidence for the month of July 2008 is 0.37.

MPI for August 2008 to June 2009 is 0.70, 1.61, 1.40, 1.15, 0.86, 0.74, 0.57, 0.37, 0.16, and 0.12 respectively.

There was no incidence of malaria positive cases in the month of May 2009, MPI for May 2009 is "0".

Table 4. Age-wise and sex-wise incidence *of Plasmodium falciparum* and *Plasmodium vivax* in different localities in the study area

Locality	Male (Age Groups)										Female (Age Groups)									
	0-1		1-4		5-8		9-14		15 above		0-1		1-4		5-8		9-14		15 above	
	Pf	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*	*Pf*	*Pv*
Brindavan Colony (3)	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Tikkle Road (5)	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	1	-	1	-	-
Bank Colony (3)	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1
P&T Quarters (5)	-	-	-	-	-	-	-	1	1	1	-	-	-	1	-	-	-	-	-	1
Pragathinagar (8)	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	1	2	-	1
Israel Pet (6)	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	1	-	1	-	1
Petingle Pet (23)	-	-	-	1	-	2	-	4	1	7	-	-	-	-	-	1	-	2	1	4
Behind Greenland Hotel (19)	-	-	-	1	1	1	-	2	-	5	-	-	-	1	-	1	-	3	-	4
Swargapuri Road (26)	-	-	-	2	-	2	-	3	1	9	-	-	-	2	-	2	-	1	1	3
Phakirgudem (14)	-	-	-	1	-	2	1	2	-	3	-	-	-	-	-	1	1	1	-	2
Ranigari thota (13)	-	-	-	1	-	1	1	3	-	2	-	-	-	-	-	-	-	2	1	2
Ranadheernagar (17)	-	-	-	2	-	1	-	2	1	4	-	-	-	-	-	2	-	2	-	3
Gummadivari Street (16)	-	-	-	1	-	-	1	2	-	2	-	-	-	2	-	2	1	2	-	3
Balabhaskarnagar (20)	-	-	1	1	-	1	-	2	1	3	-	-	-	2	1	1	-	2	1	4
Chandra Rajeswarnagar (18)	-	-	-	1	1	2	1	1	1	2	-	-	-	1	1	2	1	1	-	3
Total (196)	**0**	**0**	**1**	**12**	**2**	**14**	**5**	**26**	**6**	**43**	**0**	**0**	**0**	**9**	**2**	**15**	**4**	**20**	**4**	**33**

Pf = Plasmodium falciparum; Pv = Plasmodium vivax

Table 5. Incidence of malaria in different localities during July 2008 to June 2009

Locality	July, 08		Aug.,08		Sept., 08		Oct., 08		Nov., 08		Dec., 08		Jan., 09		Feb., 09		Mar., 09		Apr., 09		May, 09		June, 09	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Brindavan Colony (3)	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tikkle Road (5)	1	-	1	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Bank Colony (3)	-	-	-	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
P&T Quarters (5)	1	-	-	-	1	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Pragathinagar (8)	-	1	1	-	1	1	1	-	1	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Israel Pet (6)	-	-	-	-	2	-	1	-	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-
Petingle Pet (23)	1	1	2	1	3	2	3	1	2	1	-	-	1	1	1	-	1	1	-	-	-	-	1	-
Behind Greenland Hotel (19)	-	-	1	1	2	1	2	3	1	1	1	-	1	-	1	-	1	-	1	1	-	-	-	1
Swargapuri Road (26)	1	1	1	-	2	2	2	1	2	2	2	1	2	1	1	1	1	1	-	1	-	-	1	-
Phakirgudem (14)	-	-	-	1	2	1	1	1	1	2	2	1		1	1	-	-	-	-	-	-	-	-	-
Ranigari thota (13)	-	-	1	-	2	1	2	1	1	1	1	1	1	-	-	1	-	-	-	-	-	-	-	-
Ranadheer nagar (17)	-	-	-	1	2	1	2	1	2	1	2	1	2	1	1	-	-	-	-	-	-	-	-	-
Gummadivari Street (16)	-	-	1	-	2	1	1	2	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-
Bala bhaskarnagar (20)	1	-	2	1	3	1	1	1	2	1	1	1	1	-	1	-	2	1	-	-	-	-	-	-
Chandra Rajeswarnagar (18)	-	1	-	1	2	1	2	2	1	1	1	1	1	1	1	1	-	-	1	-	-	-	-	-
Total	**5**	**4**	**11**	**6**	**26**	**13**	**20**	**14**	**15**	**13**	**12**	**9**	**11**	**7**	**9**	**5**	**5**	**4**	**2**	**2**	**0**	**0**	**2**	**1**

M = Male; F = Female

Malarial disease load in the community:

The incidence of the urban malarial load in the community of study area was determined by the total positive cases detected from the fever cases screened during the study period.

The Slide Positive Rate was calculated using the formula given below:

Slide Positive Rate (SPR):

It is expressed as the proportion of positive slides out of those examined for malaria.

SPR = Total no. of positive cases detected/ Total no. of blood smears examined x 100

SPR = 196/2961 x 100 = 6.6%

The Slide Positivity Rate among 2,961 blood samples (196 positive cases) was found to be 6.6%.

Slide *vivax* Rate (S *v* R):

Table 6. Locality-wise blood smears collection, positives and parameters for the year of July 2008 to June 2009

Area	Locality	Population	Blood Smears Examined	*P.f*	*P. v*	Total Positive Cases	ABER %	API %	SPR %	S*f*R %	*P.f* %	A*f*I %
Posh	Brindavan Colony	2120	168	0	3	3	7.9	1.4	1.7	0	0	0
	Tikkle Road	1675	122	1	4	5	7.2	2.9	4.0	0.8	20	0.5
	Bank Colony	1774	143	0	3	3	8.0	1.6	2.0	0	0	0
Mixed	P&T Quarters	1853	209	1	4	5	11.2	2.6	2.3	0.4	20	0.5
	Pragathinagar	1160	182	1	7	8	15.6	6.8	4.3	0.5	12.5	0.8
	Israel Pet	1283	248	0	6	6	19.3	4.6	2.4	0	0	0
Slum	Petingal Pet	1893	300	2	21	23	15.8	12.1	7.6	0.6	8.6	1.0
	Behind Greenland Hotel	1793	248	1	18	19	13.8	10.5	7.6	0.4	5.2	0.5
	Swargapuri Road	1759	186	2	24	26	10.5	14.7	13.9	1.0	7.6	1.1
Low lying	Phakirgudem	1753	204	2	12	14	11.6	7.9	6.8	0.9	14.2	1.1
	Ranigari thota	1784	197	2	11	13	11.0	7.2	6.5	1.0	15.3	1.1
	Ranadheernagar	1879	216	1	16	17	11.4	9.0	7.8	0.4	5.8	0.5
Hilly	Gummadivari Street	1264	148	2	14	16	11.7	12.6	10.8	1.3	12.5	1.5
	Balabhaskarnagar	1175	171	4	16	20	14.5	17.0	11.6	2.3	20	3.4
	Chandra Rajeswaranagar	1051	219	5	13	18	20.8	17.1	8.2	2.2	27.7	4.7
		24216	**2961**	**24**	**172**	**196**						

P.f: *Plasmodium falciparum*; ***P.v***: *Plasmodium vivax*
ABER: Annual Blood Examination Rate; API: Annual Parasites Incidence; SPR: Slide Positivity Rate; S*f*R: Slide *falciparum* Rate
P.f%: *Plasmodium falciparum* Proportion: A*f*I: Annual *falciparum* Incidence.

It is the proportion of slides showing *P. vivax* infection out of the total slides examined for malaria.

$$S\,v\,R = \frac{172}{2961} \times 100 = 5.8\ \%$$

The slide Positivity Rate among 2,961 blood samples for 172, *P. vivax* cases was found to be 5.8%.

Slide *falciparum* Rate (S *f* R):
It is the proportion of slides showing *P. falciparum* infection out of the total slides examined for malaria.

$$S\,f\,R = \frac{24}{2961} \times 100 = 0.8\ \%$$

The slide positivity rate among 2961 blood samples for 24 P. *falciparum* cases was found to be 0.8 %.

***Plasmodium falciparum* Proportion (P. *f* P):** It is expressed as the proportion of slides showing *P. falciparum* infection out of the total positive slides with malaria infection.

P. f % = Total no. of *P. falciparum* cases/ Total no. of slides positive for malaria x 100

$$P.\,f\,\% = \frac{24}{196} \times 100 = 12.2\%$$

The *P. falciparum* proportion out of the total 196 positive cases was found to be 12.2%.

It is observed that fever incidences are alarming since August 2008 to January 2009 which is the season for malaria transmission. The age group susceptible suspected to the fever incidence was 15 and above, people belonging to this age group are mainly earning members of family irrespective of sex. The incidence of malaria was found to be almost equal in both males (49 cases) and females (37 cases) (Table -7). The model age (the age at which maximum fever incidence occurs) was found to be 15 years and above.

About 50% of the world population lives in endemic areas of malaria (WHO, 1994). The differences in the climate and ecology of the environment and the human activities are responsible for the prevalence of malaria. The tremendous ecological changes also led to drastic changes in vector densities as well as species distribution; some of the parasitic larvae shifted their habitat to water reservoirs. Exploitation of natural resources, unplanned urbanisation, deforestation, human activities etc.

altered the ecosystem and behaviour of vectors affecting malaria transmission. Increased population in urban area has major implication for malaria epidemiology both in terms of vector density and host – vector contact resulting in malaria transmission. The housing and clothing pattern of people living in urban area are conducive. Inadequate epidemiological surveillance and/or incomplete treatment are some of the major constraints for reducing and/or eliminating the disease.

In the present studies, the age group of 15 years and above was considered as high risk group. About 12.2% of population of study area (24,216 individuals) suffered with fever and 6.6% of the fever cases (2,961 samples) were declared as malaria positives. About 8.0% of people showed clinical signs of malaria; 0.9% suffered from *P. palciparum* malaria and 7.1% from *P. vivax* malaria. Malaria situation is getting worse in the surveyed area; comparatively, spread of *vivax* malaria is more than *falciparum* malaria. Our studies are similar to that of Manohar and Jha (1997) who also explained that about 1% of people living in different areas of the world die due to *falciparum* malaria. Vashisht *et al*., (2009) also reported the prevalence of 0.35%, 0.05%, 0.04% and 0.03% of *P. falciparum* during 2004 to 2007 in Rohtak District (Haryana State). It is also found that children (1-4 years) are also found to be high risk age group with malaria because they possess sub optimal immune response as suggested by Hyde and Patnode (1987) and Vivekavardhini (2013). In the present survey, the prevalence of *P. vivax* (21 cases) is more than *P. falciparum* (1 case) in children.

Malaria is widely prevalent in hilly and slum localities of surveyed area. In the present studies, a total of 196 positive cases of malaria were found in July 2008 to June 2009, this is almost equal to the number of malaria cases in comparison to previous year. A total of 1,748 cases were reported in the annual report of NVBDCP of Vijayawada in 2007. House to house survey (on the population of 24,216) in the most affected areas revealed 196 cases of malaria; no mortality was observed during the one year study. Malaria attack rate was 43.8% in 15 years and above age group and 56.2% among the other groups.

Out of 2,961 blood samples collected and examined for malaria, 8.0% were diagnosed as malaria positive cases. The source of infection was the vector host. The classification of age groups in disease survey and clinical observations in our study is in accordance with the findings of Yadav *et al.*, (2005). The high incidence of malarial cases was reported in August, September, October, November and December 2008 and in January 2009 during the survey period. Month-wise analysis of reported cases showed that the disease prevalence reached peak in September 2008 and started decreasing from September in males during the one year study. Vashisht *et al*., (2009) reported that the number of malaria positive cases started increasing from June and reached peak during September 2001-2006 study period in Rohtak District, Haryana. The high incidence of malaria coincides with the mosquitogenic period. Barua and Mahanta (1996) also suggested the peak coincidence of malaria with the mosquitogenic period and other mosquito borne diseases in Assam and Nagaland.

Table 7. Age and sex wise occurrence of malaria incidence from July 2008 to June 2009

Age Group (years)	No. of blood smears examined from fever cases			No. of positive cases		
	Male	Female	Total	Male	Female	Total
0-1	28	36	64	0	0	0
1-4	166	216	382	13	9	22
5-8	230	304	534	16	17	33
9-14	334	428	762	31	24	55
15-above	564	655	1219	49	37	86
Total	**1322**	**1639**	**2961**	**109**	**87**	**196**

Table 8. Representation of data in different age groups of males

Age Group	X_m	$X_i - \overline{X_m}$	$\left(X_i - \overline{X_m}\right)^2$
0 -1	0	21.8	475.24
1 – 4	13	8.8	77.44
5 – 8	16	5.8	33.64
9 – 14	31	9.2	84.64
15 above	49	27.2	739.84

$\sum \overline{X_m} = 109$

$\overline{X_m} = 109/5$

$= 21.8$

$\sum \left(X_i - \overline{X_m}\right)^2 = 1410.8$

$$S_{m^2} = \frac{1}{n-1}\sum \left(X_i - \overline{X}_m\right)^2$$

$$= \frac{1}{4}(1410.8) = 352.7$$

Table 9. Representation of data in different age groups of females

Age Group	X_f	$X_i - \overline{X}_f$	$\left(X_i - \overline{X}_f\right)^2$
0 -1	0	17.4	302.76
1 – 4	9	8.4	70.56
5 – 8	17	0.4	0.16
9 – 14	24	6.6	43.56
15 above	37	19.6	384.10

$\sum \overline{X}_f = 87$

$\overline{X_f} = 87/5$

$= 17.4$

$\sum \left(X_i - \overline{X_f}\right)^2 = 801.12$

$$S_{f^2} = \frac{1}{n-1}\sum \left(X_i - \overline{X_f}\right)^2$$

$$= \frac{1}{4}(801.12) = 200.2$$

The month-wise data on malaria incidence at 15 localities of Vijayawada urban area (Krishna District) between July 2008 to June 2009 showed that *P. vivax* and *P. falciparum* are the parasites (without mixed infection) prevailing in this area (during the study period). In the present study (Vijayawada urban area), the prevalence of *P. vivax* was 7.1% and *P. falciparum* 0.9%; it indicates a slight decrease in *P. falciparum* infection (July 2008 to June 2009). Mehrunnisa *et al*., (2002) also found higher transmission of *P. vivax* than *P. falciparum* in OPD (Out Patients Department) of Jawaharlal Medical College, Aligarh during 1998 & 1999. The report of Director of health (2010) (http://www.google.co.in/search/Health Medical & Family Welfare department/dhreport on malaria, rural, tribal and urban in A.P.) also stated that urban areas are generally seasonal and low-grade malaria transmission areas. The predominant *P. vivax* transmission is common in some urban areas with few pockets of *P. falciparum*. Park (2002) and Jayadev (2013) reported that in India, about 70% of the infections were due to *P. vivax* and 25-30% due to *P. falciparum*. Barua Madhumita *et al*., (2009) described *P. vivax* and *P. falciparum* as common species of *Plasmodium* causing a dreadful disease in humans.

REFERENCES

1. Barua Madhumita., Das Shukla and Kaur Iqbal Rajinder (2009). Optimal test and microscopy - a comparative evaluation for detection of malaria parasite. Journal of Communicable Diseases, 41(4): 285-288.
2. Barua, H. C. and Mahanta, J. (1996). Serological evidence of Den-2 activity in Assam and Nagaland. Journal of Communicable Diseases, 28: 56-58.
3. Das, N.G., Talukdar and Das, S.C. (2004).. Epidemiological and entomological aspects of malaria in forest-fringed villages of Sonitpur District, Assam. Journal of Vector Borne Diseases, 41: 5-9.
4. Gouravi Mishra. (2003). Hospital based study of malaria in Ratnagiri District, Maharashtra. Journal of Vector Borne Diseases, 40: 109-111.
5. Jayadev. D. J and Viveka Vardhani. V. 2013. An Entomological Study On Anopheles Stephensi, Culex Quinquefasciatus And Aedes Aegypti Fauna Potentiality In The Urban Area Of Autonagar, Vijayawada (Krishna District, Andhra Pradesh). Biolife, 1(4), 251-260.
6. Hema Joshi (2003). Markers for population genetic analysis of human *Plasmodia*species, *Plasmodium falciparum*and *Plasmodium vivax.* Journal of Vector Borne Diseases, 40: 78 - 83.
7. Hyde, R.M. and Patnode, R.A. (1987). John Wiley and Sons (SEA) Pvt. Ltd., Singapore. Immunology.
8. Manohar, R.K. and Jha, N. (1997). Role of chemoprophylaxis in prevention of malaria – A Review. Proceedings of the Second Symposium on Vector and Vector- Borne Diseases, 232-235.
9. Matta, S. Khokhar, A. and Sachdev, T.R. (2004). Assessment of knowledge about malaria among patients reported with fever: A Hospital-Based Study. Journal of Vector Borne Diseases, 41: 27-31.
10. Mehrunnisa, A., Wajihullah, Saifi, M. A. and Khan, H. M. (2002). Prevalence of malaria in Aligarh. Journal of Communicable Diseases, 34(1): 70-77.
11. Park, K. (2002). Textbook of Preventive & Social Medicine, XV Ed. Jabalpur: Banarsidas Bhanot, 192.
12. Shankar Matta, S. L., Kantharia and Desai, V.K. (2004). Malaria diagnosis in private laboratories of Surat city : a laboratory based study. Journal of Vector Borne Diseases, 41: 76-79.
13. Sharma, S.N., Saxena, N.B.L., Phukan, P.K., Anjan, J.K., Pandya, A.P. and Shiv Lal. (2000). Impact assessment of IEC campaign during anti-malaria month, June 1998 through KABP study. Journal of Communicable Diseases, 32: 49-53.
14. Singh, N. and Khare, K.K. (1999). Forest Malaria in Madhya Pradesh: Changing scenario of Diseases and its Vectors. Journal of Parasitic Diseases, 23: 105-112.
15. Srivastava, A., Nagapal, B.N., Saxena, R., Eapen, A., Ravindran, K.J., Subbarao, S.K., Rajamanikam, C., Palanisamy, M., Kalara,

N.L. and Appavoo, N.C. (2003). Geographical information system based malaria information system for urban malaria scheme in India. Computer Methods and Programmes in Biomedicine, 71: 63-75.
16. Srivastava, A., Nagpal, B.N., Saxena, R. and Sharma, V.P. (1999). Geographical Information System as a tool to study malaria receptivity in Nadiad Taluka, Kheda District, Gujarat, India. Southeast Asian Journal of Tropical Medicine and Public Health, 30: 4.
17. Vashisht, B.M., Kalhan Meenakshi, Seema and Jyothi, (2009). Situation Analysis of Malaria in District Rohtak, Haryana. Journal of communicable diseases, 41(2): 137-138.
18. Viveka Vardhani V and Adinarayana R. 2013. Incidence Of Filariasis In Endemic Areas By Means Of Field Survey To Detect The Mf Density, Mf Rate, Disease Rate And Endemicity In The Community. Biolife, 1(4), 159-164.
19. WHO Geneva (1993). A Global Strategy for Malaria Control, WHO, 30.
20. WHO, Geneva. (1994). World Health Organization, Weekly Epidemiological Records, 69: 309-16.
21. WHO. World Malaria Report Geneva. (2008). World Health Organisastion.
22. Yadav, S.P., Sharma, R.C. and Vinod Joshi (2005). Study of social determinants of malaria in desert part of Rajasthan, India. Journal of Vector Borne Diseases, 42: 141-146.

DOI:
https://dx.doi.org/10.5281/zenodo.7204520
Received: 3 April 2014;
Accepted; 20 May 2014;
Available online : 8 June 2014