Factors associated with malaria in block Banar, district Jodhpur, Rajasthan, India, 2008

BY

P.K.Anand

MAE – FETP Scholar, 2007-2008

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF APPLIED EPIDEMIOLOGY (M.A.E.)

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CERTIFICATION

This is to certify that this dissertation entitled '**Factors associated with malaria in block Banar, district Jodhpur, Rajasthan, India, 2008**' submitted by **Dr. Parveen Kumar Anand** in partial fulfilment of the requirements for the degree of Master of Applied Epidemiology is the original work done by him and has not been submitted earlier in part or whole for any other Publication or degree.

Eplan

COURSE-IN-CHARGE

Date 31-1-07

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Date : 31 /12/2008 Dr. P.K.Anand

Place: Chennai

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SECTION -1

DISSERTATION

Abstract

Background & Objectives: India reported 1.47 million cases and 1173 deaths in the country in the year 2007. For the Rajasthan state figures were 55000 and 46 for the cases and deaths respectively in 2007. Malaria is known to be an exclusively local phenomenon. Its transmission determined by local malariogenic conditions. Study identified the different factors associated significantly with the malaria cases. **Methods:** It was Primary health centres based prospective case-control study. We recruited 42 cases of malaria along with 84 age and gender matched controls. Information on selected exposures collected on pretested questionnaire by trained field staff after getting informed and written consent of participant. Matched Odds ratio and multivariable analysis was performed in Epiinfo software to estimate the independent association of exposures with malaria without confounding effects of other variables. **Results:** In conditional logistic regression malaria was significantly associated with history of recent travel in last one month, presence of Prosopis juliflora plants near home and history of malaria in family member, with $p<0.05$. Odds of history of recent travel was 4.89 [95% confidence interval 1.33-17.93] and of presence of prosopis juliflora plants near home was 4.90 [95% confidence interval-1.0025-23.97]. Odds of history of malaria in family member was 11.76 [95% confidence interval -1.11-124.41]. **Conclusion:** History of malaria in any family member, recent travel and presence of juliflora plant near home are independently associated factors for malaria in this study area. Field experimentation is needed to validate these initial findings.

Keywords: Prosopis Juliflora, malaria, factors, travel, family malaria

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Introduction

World malaria report 2008 provides an estimated figure of 247 million cases of malaria and a million deaths due to it world over, in year 2006. This report indicates the endemicity of the disease in 109 countries of the world[1]. Estimated figures for cases and deaths due to malaria were 21 million and 35000 respectively for South East Asia region in year 2006[1].

National vector borne disease control programme of India reported 1.47 million cases and 1173 deaths in the country in the year 2007. For the Rajasthan state figures were 55000 and 46 for the cases and deaths respectively in 2007[2].

Batra CP et al reported the problem of malaria in district Jodhpur of Rajasthan in 1999. The slide positivity rate and slide falciparum rate were 67.54 % and 7.10 % respectively in his study[3]. Jodhpur represents a low risk area for malaria transmission. Monsoon period i.e. July to September is the main transmission in this area. Study on analysis of malaria surveillance data of period from January 2002 to March 2007 in Jodhpur revealed, malaria is persisting across the period. There were differences in mean monthly incidence rates in different block primary health centres. Block primary health centres Banar and Bap reported significantly higher mean monthly incidence rates in comparison to rate in Jodhpur district (Unpublished report)[4].

Malaria is known to be an exclusively local phenomenon. Its transmission, prevalence and distribution of parasite species are determined by local malariogenic conditions[5]. Transmission of malaria may differ even from village

to village[6]. Studies have found out the importation of cases from other areas[7], Travel history[8, 9,10,11], Poor knowledge[11], sleeping on floor[11], family malaria history[11], adults[12], males[12], children in forest fringe villages[12], distance from health facility[12], involved in forest activities[12,13], vegetation index[14], cases in last month[14], rainfall[14,15,16], agriculture land[6,17], proximity to river distributaries[17,18], live stock[19] , type of house[16,19,20], and Socioeconomic conditions[21] as the factors associated with malaria transmission.

Incidence of malaria with the prosopis juliflora plant thickets found as the most frequently mentioned problem, in a case study in Kenya[22].

Ruler of princely state of "Marwar", introduced Prosopis juliflora plant, an exotic species, in Jodhpur in 1913 to bloom the vegetation scarce area of state[23]. Rajasthan has witnessed manifold increase in growth of forest plantations, from 50,000 hectares in decade of 1961-70 to more than 450,000 hectares in 1991-2000. Monoculture of certain species, which includes prosopis juliflora, has dominated the plantation programme. Such monoculture expected to put ecological stress on scenario of desert[24]. Having considered the issues of environmental balance and biodiversity conservation, office of chief conservator of forest, Rajasthan, issued a circular in year 2006. This circular advocated for exemption from need of prior permission from department for transportation of timber of selected eight plant species. These eight plant species including prosopis juliflora are exempted from Rajasthan forest (products transportation) rule 1957 for transportation within state either by non-mechanized or mechanized vehicles[25].

Identification of the factors or characteristics associated with disease in local context is a demanding area of research. This information helps in targeting the available resources towards those who need these most.

Studies on the risks of malaria in terms of human host area are scarce in low risk area of desert. Detailed analytical epidemiological study to find out the association status of different personal, household and environment related factors including role of prosopis juliflora plant, are needed in Jodhpur. Result of the study will help the programme managers to focus the prevention and control strategy among groups deserving these more.

Objectives

- To describe the cases of malaria in respect to their time, place and person characteristics
- To identify the different factors associated significantly with the Malaria cases in block Banar

Methodology

Study site

District Jodhpur geographical area of 22850 sq. Kms. Its population is 28.81 lacs as per year 2001 census. It stretches between $26^0 0'$ and $27^0 37'$ at north Latitude and between $72^0\ 55'$ and $73^0\ 52'$ at East Longitude. It is situated at the height between 250-300 meters above sea level. District comes under arid zone of the state. Its ambient temperature varies from 49 degree centigrade in summer to 1

degree in winter. Average rainfall is 302 mm here. There is no perennial river in the district[26].

Health setup in district composed of 9 block primary health centres (BPHC)[26]. Banar BPHC reported relatively more malaria transmission in district. Mean monthly incidence rate of malaria in Banar BPHC was significantly higher than the rate of district at $p<0.05$ (P.K.Anand et al unpublished study). Banar BPHC delivers the health care services through its 6 primary health centres (PHCs). These are Banar, Bisalpur, Fidusar, Keru, Narwa and Salwa kala PHC. PHC Fidusar is situated near stone quarries area. Other PHCs are in agriculture area.

Study population

Population of the Banar BPHC is 2,00,000 in 2008 as per health department data. Population is engaged in agriculture, grazing livestocks, stone quarries, and handicraft industries of wood, metal and leather. Agriculture is dependent primarily on rainwater. Usually population migrates from one place to another in search of livelihoods.

Study design

Primary health centres (PHCs) based prospective matched case control study in collaboration with state department for health was chosen. Study period ranged from May to November 2008, transmission season in area. All 6 PHCs were selected. Cases and controls attending PHCs in block Banar for their illnesses, recruited prospectively. Three controls of same gender, OPD attended and within +/- 5 yrs. of age of the case, planned to match. Cases and controls were recruited within the same study period.

Operational definitions used

Cases-Any fever patient confirmed with presence of malaria parasite in blood smear on microscopic examination.

Controls- Any non-fever patient, coming at OPD for the treatment of their illness.

Media exposure- Any person who watches newspaper and/or television either at least 4 days in week at the minimum rate of 1 hour/day or less than 4 days in week classified as regularly and irregularly exposed respectively. Who had not watched either newspaper or TV even for once in last one month, noted as unexposed.

Malaria transmission- A person who knows that mosquitoes spread the malaria classified as aware about malaria transmission, otherwise unaware.

Malaria prevention- Any person knowing at least one preventive measure against mosquito bite (i.e. Impregnated mosquito bed net, ordinary bed net, mosquito repellent cream, mosquito repellent coil, mosquito repellent liquid) noted as aware. Who does not know even one of these were the termed as unaware regarding malaria prevention.

Personal protection measures- Any person using at least one protective measure against mosquito bite (Impregnated mosquito bed net, Ordinary bed net, mosquito repellent cream, mosquito repellent coil, mosquito repellent liquid) within last one month, daily in night, irregularly and not at all, classified as user, irregular user and non-user.

Recent travel- Any person who came back in his/her resident place within last one month period after having had stayed and slept their for at least one night, classified as traveled recently.

Stagnant water body/pond- any water body/pond within 1 km. from residence of volunteer, which had not been emptying for last one-month period, labeled as stagnant water body/pond.

Prosopis juliflora- presence of the plant within 1 km. from residence of volunteer, for one month labeled as exposed to it.

Sample size

Sample size was calculated in statcalc of Epi-info software considering following assumptions: -

1.Confidence coefficient= 95%

2.Statistical power=80%

3.Control: case ratio = 3:1

4.Expected exposure in controls= 50%

5. Odd's ratio = 3

6. Expected non responders =10%

Final sample size estimated as cases= 48 and controls= 145.

Sampling procedure

All the 6 PHCs of block Banar included in the study. The interviewing health worker enrolled malaria cases and controls coming for treatment at the OPDs in study. All malaria cases attending the OPDs were enrolled for study, till we got the required number of cases. Controls were selected based on their similarity to case in respect of gender, age and date of admission. In case of tie, preference was given to the control, which reported at OPD early.

Data collection procedure

FETP scholar tested the questionnaire in field to assess its feasibility. Questionnaire modified as per the requirements. Scholar trained the public health workers with respect to identification of case and control, obtaining consent of participant, interviewing the participants, and filling of questionnaire and data storage. Trained public health worker interviewed the cases and controls and collected the data. Cases were given treatment as per guidelines of national anti malaria programme. Controls were also treated for their illnesses. Ten minutes time were taken for data collection from either case or control. FETP scholar supervised the work of field worker through regular weekly visit.

Local calendar of events was used in ensuring the referent time of exposure. Local landmarks were used to ensure referent distance of exposure factors. FETP scholar collected duly filled questionnaires from PHCs and entered data on weekly basis, to minimize the error while entering the data in computer database.

Data collection

Information collected

Information on following variables was collected

1. Personal characteristics
    a. Name
    b. Age
    c. Gender
    d. Caste
    e. Religion

f. Patient status (Case or control)

2. Socioeconomic characteristics

    a. Residence

    b. Occupation

    c. Education

    d. Monthly income in Indian national rupees

3. Exposure to media

    a. Reading news paper

    b. View Tele vision

4. Awareness about Malaria

    a. Awareness about malaria transmission

    b. Awareness about malaria prevention measures

5. Personal protection measure

    a. Use of antimosquito measure

6. Recent travel

    a. History of recent travel within last one month

7. Malaria in family in last month

    a. History of malaria in any family member within last one month

8. Environment characteristics

    a. History of working in stone quarry

    b. Exposure to mud room at home

    c. Exposure to pet animals at home

    d. Exposure to stagnant water body/pond near home

    e. Exposure to prosopis juliflora near home

Data analysis

Cases of malaria described in respect to their time, place & person characteristics. Epicurve and shaded map used to describe the time and place characteristics, while person characteristics described as a table. Matched Odds Ratio (Mantel Haenszel) or Matched OR (MH) estimated with Epiinfo software version 3.3.2. Adjusted OR (MH) for age and gender with 95% confidence limits estimated in the programme. Command "Match" was used to estimate the adjusted OR (MH) of malaria among various exposure variables in Epiinfo. Factors with p <0.2 fitted in conditional logistic regression to remove the confounding effects of one variable on another. Multivariate analysis brought out with independent Odds of factor among cases.

Conditional Logistic regression modeling was done by step down technique and observing the probability value of likelihood ratio of model at less than 0.05[11]. Further removal of factors stopped if the probability value began to rise. "Match", "outcome" and "other variables" used in Logistic regression command of Epiinfo for this purpose.

Quality assurance

Study protocol peer reviewed before beginning of study. English questionnaire translated in to "Marwari" dialect written in Hindi by a person who understands both English and "Marwari" and then "Marwari" questionnaire written in Hindi back translated into English by other person to look for any discrepancy. Prepared questionnaire was tested by FETP scholar in field to assess its capability in picking the right information and then modified accordingly if required so. Trained field worker collected data on pretested questionnaire.

Protection of human subjects

Confidentiality

Personal information of volunteer noted on a personal identifier portion with individual codes. These codes wrote again on remaining questionnaire for identification of volunteer. Personal identifier portion separated out and kept in lock & key with scholar. Remaining questionnaire with out personal information utilized for analyzing data.

Informed consent

Written and informed consent was taken before recruitment from each participant. In case of minor and illiterate participant, health worker read the consent form in front of participant and then take the left thumb impression if the participant willing. In case of minor or illiterate volunteer, signature of guardian or witness were taken if found available.

Ethical committee clearance

Ethical clearance sought from institutional ethical committee of National Institute of Epidemiology, Chennai before beginning the data collection.

Results

There was 100% response rate from the volunteers at PHCs. We recruited 42 malaria cases and 84 controls during study period against expected 48 cases and 144 controls. Out of all of the 6 PHCs under study, only 3 PHCs Banar, Bisalpur and Fidusar recruited matched case and controls.

Distribution of malaria cases

Malaria cases occurred from the month of May till October. Out of these 6 months, 27 cases were recruited in the August and September months of rainy

season (Fig.1). Fidusar PHC recruited maximum number of sets i.e. 27, whereas these figures for Banar and Bisalpur PHCs were 5 and 10 sets respectively. Keru, Narwa and Salwakala PHCs did not recruit any matched set of case and controls (Fig.1).

Percentage of cases was 95.2% and 71.4% in those above 5 years of age and male gender respectively. In 15-44 years age group percentage of cases was 71.4%. 7.1 % cases occurred in persons of 45 years and above age group. 54.8% cases belong to the rural area for residence. Regarding occupation 50% of cases were manual labour by occupation. 31 % cases were of non-earning category in this study. 78.6% of malaria cases were either illiterate or up to primary education. 57.1 % of cases belonged to family with monthly income of Rs.1000 and more. 85.7 % cases were of Hindu religion. Combined percentage of scheduled castes and scheduled tribe was 47.6% (Table-1).

Matched analysis

Adjusted OR(MH) value for history of recent travel was 3.6 with 95% confidence limits of 1.17-11. The corrected chi-square's p value for this association was 0.04.History of malaria in any family member within last one month had adjusted OR(MH) of value 9. Though the probability of this association was 0.06. Persons with below median income have shown the OR(MH) and p value of 0.42 and 0.08 respectively. The values of OR(MH) were 1.84, 2.1 and 4.33 for factors, not read news paper, presence of pond near home and presence of prosopis juliflora plant near home respectively. Association of these factors was weak with $p<0.2$ in all three. OR(MH) for unaware about malaria transmission was 0.44 with $p = 0.19$ (Table-3).

Interaction

Values of crude OR was 1.55 for presence of juliflora alone near home. OR was 0 for the presence of pond alone near home. There was not even a single case with pond alone near home. Value was 2.87 if pond and juliflora both were available near home. In each of these case 95% confidence intervals did not exclude 1(Table-4).

Conditional logistic regression

OR of recent travel, presence of juliflora near home and history of malaria in family member were 4.89, 4.90 and 11.76 respectively, with $p<0.05$. The values of coefficients were 1.5872, 1.5897 and 2.4652 for recent travel, juliflora near home and malaria in family respectively. The probability value of likelihood ratio of this model was 0.0012 (Table-5).

Discussion

Malaria is not the disease of rainy season only in block Banar, Jodhpur. As it is evident from this study, malaria cases occurred in summer month i.e. May and also in rainy season i.e. in July – September. Though almost half cases recruited in rainy months. This finding is similar to the association of rain found in other studies[14,15,16]. Majority of cases in study recruited by only three PHCs. PHCs like Fidusar and Banar reported more cases. This may be because of their location near to urban Jodhpur area. PHCs at far like Keru, Narwa and Salwa kala did not recruit even single set of case controls. This difference may be because of health transition in periurban area or differences in Epidemiological factors[6]. Factors pertaining to malaria programme and surveillance system at the

PHCs level can also be the factors. Though these factors are not addressed in this study.

Malaria affects almost all age group of persons in this study area. Age range of cases was from 1 year to 65 years. This age distribution of malaria cases is consistent with the distribution in low risk area[11]. This might be because of the low herd immunity in the area. Malaria is the disease of productive age group in area. This is supported by the fact that the majority of cases belong to 15-44 years age group. Place distribution of cases is almost equal in urban and rural area. It is the poor socioeconomic group of people, which suffers it most. People either with less education or illiterate affected by disease primarily. This may be because of their poor socioeconomic status leading to poor immunity and poor housing[16,19,20]. Education works as the proxy indicator for socioeconomic status.

Odd's of occurrence of malaria was 4.89 times higher among those who had traveled recently comparison to those not traveled, in conditional logistic regression. This association was significant with $p < 0.05$. History of travel had been found to be associated with malaria in other studies also[8,9,10,11]. Study by Rogelio Danis-Lozano et al has proved this association in setting of low transmission, like Jodhpur[11]. This finding suggests that malaria infection might have occurred out of the resident villages. Information was not collected on places visited. Risk of infection for different places could not be identified. Significant association was found in between family history of malaria and malaria outcome is also in consistency with study by Rogelio Danis-Lozano et al done in residual transmission focus of Oaxaca, Mexico. He reported 6 times higher risk of infection in those households, which had malaria case in previous year. This mechanism may explain the maintenance of low transmission of

malaria in dry season in Jodhpur. This focalized transmission may act as source for spread of malaria in favorable conditions.

Though we do not find any significant interaction between pond and juliflora near home, behavior of crude OR for their interaction was interesting. Taking absence of both factors as reference, presence of juliflora alone and with pond had ORs of 1.55 and 2.87 respectively. There was an increasing trend. Esther Mwangi & Brent Swallow had shown a link between prosopis juliflora and malaria in their case study. Our study supports their finding and estimates the Odds of disease among exposed to it in analytical way. This association is particularly important for the desert environment, which is deficient in thick shrubs. We assume this plant along the water bodies or ponds may provide breeding places and resting environment for malaria vector, which is otherwise not available out of household in hot and dry desert condition. Even though, we found history of recent travel, family malaria and existence of juliflora near home as the significantly associated factors for malaria in block Banar in multivariate analysis.

We anticipated for selection bias at the planning stage of study. We used the IDSP definition for confirmed malaria case and operational definition for controls to minimize this bias.Since study intends to collect information on past exposure within last one month, so recall bias also anticipated. Cases may recall more than controls because of illness, so that controls also selected from OPDs, just to ensure similar severity weight of illness between cases and controls. Recruitment of cases and controls at OPDs and training of interviewer to collect retrospective information using local calendar of events, would have minimize this bias also.

Though the study tried for minimizing the recall and selection bias, this is not free from limitation. Since we did not measure the distance of exposures from residence, information bias cannot be rule out. Other limitations are, (1) study does not have expected power due to less availability of controls, (2) control's blood smear, was not examined for malaria parasite. Public health physician does not advise for malaria microscopy, if patient neither have fever nor its history in last 15 days. This practice is as per programme guideline. There is possibility for the parasite carrier to be recruited as control in study. Proportion of asymptomatic parasitemia might have affected minimal because of low transmission of malaria in Jodhpur. We would have accepted null hypotheses for few factors due to low power of study. Study may not have detected some risk factors because of large acceptance error. Even than factors came out as significant in logistic regression, provides insights about Epidemiology of malaria in this part of country.

Conclusion

Malaria occurs in dry and wet season in Jodhpur. Malaria burden differs in different PHCs. Malaria is a disease of poor socioeconomic status in area. It affects almost each age group and both gender. History of malaria in any family member, recent travel and presence of juliflora plant near home are independently associated factors for malaria in this study area.

Recommendation

Prospective cohort study in strictly defined settings for environmental factors is needed to validate the initial finding of this study. Environmental and entomological studies are also required to investigate the adaptability of malaria

vector with Juliflora plant in desert setting. Consistent efforts with quality control exercise by health department are required in area across all PHCs. Preventive & control efforts for malaria are required for all age groups and both genders. Extra vigil over households with frequent history of travel and malaria, residing near to prosopis juliflora plant will help in controlling further occurrence of malaria.

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Table- 1 General characteristics of malaria cases in block Banar of district Jodhpur, Rajasthan, India, 2008

Characteristics		Cases (n=42)	
		No.	%
Age	<5 years	2	4.8
	5-14 years	7	16.7
	15-44 years	30	71.4
	45 & more	3	7.1
Gender	Male	30	71.4
	Female	12	28.6
Residence	Urban	19	45.2
	Rural	23	54.8
Occupation	Non earning	13	31.0
	Manual labour	21	50.0
	Sedentary occupation	8	19.0
Education	Illiterate	15	35.7
	Primary	18	42.9
	Secondary & >	9	21.4

Table- 1 (continued) General characteristics of malaria cases in block Banar of district Jodhpur, Rajasthan, India, 2008

Characteristics		Cases (n=42)	
		No.	%
Income	Up to 1000 Indian national rupees	18	42.9
	>1000 Indian national rupees	24	57.1
Religion	Hindu	36	85.7
	Muslim	6	14.3
Caste	SC[1]	15	35.7
	ST[2]	5	11.9
	OBC[3]	19	45.2
	General	3	7.1

[1] Scheduled caste
[2] Scheduled Tribe
[3] Other Backward Caste

Table-2 Distribution of malaria case control pairs according to the exposure status of the cases and controls, Jodhpur, Rajasthan, India, 2008

Exposure factor	Number of case control pairs						
	Concordant for exposure status		Discordant for exposure status				
	Case exposed	Case unexposed	Case exposed	Case unexposed	Matched OR	95 % CI	P value[4]
Illiteracy	15	42	15	12	1.25	0.49-3.1	0.81
Rural residence	38	25	8	13	0.61	0.20-1.8	0.26
Income < Median (1000 INR)	30	34	6	14	0.42	0.13-1.3	0.08
SC/ST category	20	23	20	21	0.95	0.44-2.0	0.75
Labor occupation	28	27	14	15	0.93	0.38-2.2	0.70
Don't read News paper	32	15	24	13	1.84	0.80-4.2	0.19
Don't view tele vision	18	21	28	17	1.64	0.79-3.4	0.23
Malaria transmission not known	0	71	4	9	0.44	0.09-1.9	0.12
Malaria prevention not known	8	58	10	8	1.25	0.40-3.8	0.92

[4] MH Chi Square corrected p value

Table-2 continued

Exposure factor	Number of case control pairs Concordant for exposure status		Discordant for exposure status				
	Case exposed	Case unexposed	Case exposed	Case unexposed	Matched OR	95 % CI	P value[5]
Don't use Antimosquito	17	38	17	12	1.41	0.57-3.4	0.60
Recent travel	4	57	18	5	3.6	1.17-11	0.04
Family malaria	1	73	9	1	9	0.98-82	0.06
Mine work	6	66	6	6	1	0.25-3.9	0.74
Mud room	16	22	28	18	1.55	0.76-3.1	0.30
Pets at home	30	20	20	14	1.42	0.62-3.2	0.53
Water body near home	35	18	21	10	2.1	0.84-5.2	0.17
Juliflora near home	67	1	13	3	4.33	0.83-22	0.12

[5] MH Chi Square corrected p value

Table-3 Dose response of pond and prosopis juliflora near home with malaria cases, block Banar, Jodhpur, Rajasthan, India, 2008

Exposure	Disease status			
	Case (n=42)	Control (n=84)	Unmatched OR	95% CI
Pond and juliflora both present	28	39	2.87	0.50-21
Pond present but juliflora absent	0	6	0.00	0.00-8
Pond absent but juliflora present	12	31	1.55	0.24-12
Pond and juliflora both absent	2	8	Reference	Reference

Table-4 Odd's ratios of the selected exposure factors in the conditional logistic regression analysis, block Banar, district Jodhpur, Rajasthan, India, 2008

Exposure factors	Odd's ratio	95% Confidence Interval	Coefficient	P value
History of recent travel	4.89	1.33-17.93	1.5872	0.0167
Presence of prosopis juliflora near home	4.90	1.0025—23.97	1.5897	0.0496
History of malaria in family member	11.76	1.11—124.41	2.4652	0.0405

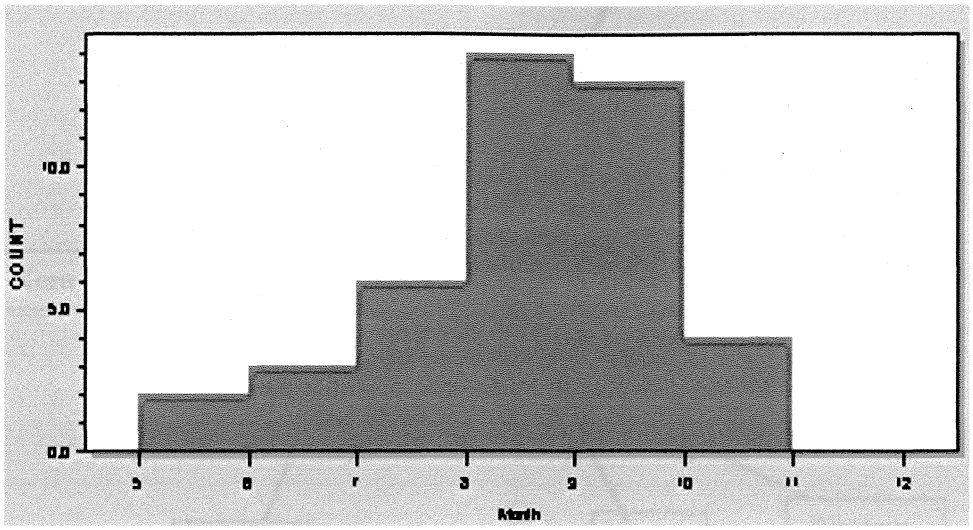

Fig. 1 Time distribution of malaria cases in block Banar, district Jodhpur, Rajasthan, India, 2008

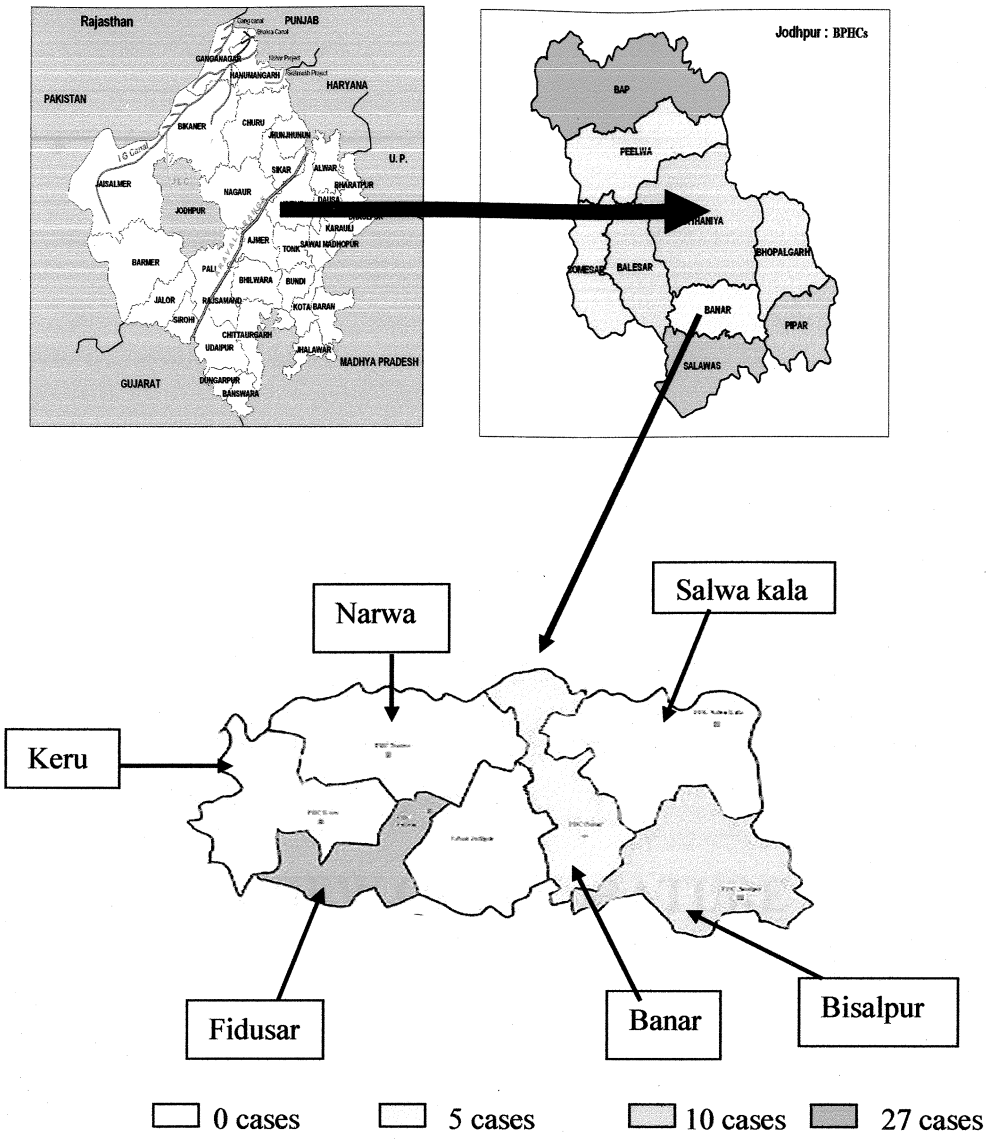

Fig.2 Place distribution of malaria cases in primary health centres of block Banar, district Jodhpur, Rajasthan, India, 2008

SECTION -2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

History of malaria

Malaria is probably one of the oldest diseases known to mankind that has had profound impact on our history. History of malaria and its terrible effects is as ancient as the history of civilization, therefore history of mankind itself. Malaria seems to have been known in China for almost 5,000 years, (Men from ancient China, who traveled to malarious areas were advised to arrange for their wives to be remarried). Sumerian and Egyptian texts dating from 3,500 to 4,000 years ago mention about fevers and splenomegaly suggestive of malaria, (The enlarged spleens of Egyptian mummies are believed to have been caused by malaria)[1].

Intermittent fever, with high incidence during the rainy season, coinciding with agriculture, sowing and harvesting, was first recognized by Romans and Greeks who associated it with swampy areas. They postulated that intermittent fevers were due to the 'bad odour' coming from the marshy areas and thus gave the name 'malaria' ('mal'=bad + 'air') to intermittent fevers.[2]

It appears that *P. falciparum* had reached India by around 3,000 years ago. Malaria has been a problem in India for centuries. Details of this disease can be found even in the ancient Indian medical literature like the 'Charaka Samhita'. The Vedic (3,500 to 2,800 years ago) and Brahmanic (2,800 to 1,900 years ago) scriptures of Northern India (Indus valley) contain many references to fevers akin to malaria. They are also said to make reference to autumnal fevers as the "King of diseases". In 800 B.C. the sage Dhanvantari wrote, "Their bite is as painful as that of the serpents, and causes diseases... [The

wound] as if burnt with caustic or fire, is red, yellow, white, and pink color, accompanied by fever, pain of limbs, hair standing on end, pains, vomiting, diarrhea, thirst, heat, giddiness, yawning, shivering, hiccups, burning sensation, intense cold...". *Charaka Samhita*, one of the ancient Indian texts on Ayurvedic medicine which was written in approximately 300 BC, and the *Susruta Samhita,* written about 100 BC, refer to diseases where fever is the main symptom. Alexander the great, Genghis Khan and Sultan Muhammed Bin Tughluk are few among many famous persons, which believed to be died because of malaria[1].

Current magnitude

There were an estimated 247 million malaria cases among 3.3 billion people at risk in 2006, causing nearly a million deaths, mostly of children under 5 years. 109 countries were endemic for malaria in 2008. Estimated figures for cases and deaths due to malaria were 21 million and 35000 respectively for South East Asia region in year 2006[3]. National vector borne disease control programme of India reported 1.47 million cases and 1173 deaths in the country in the year 2007. For the Rajasthan state figures were 55000 and 46 for the cases and deaths respectively in 2007[4].

Epidemiology

1.Agent

a. Discovery

In 1716, Italian physician Giovanni Maria Lancisi first described a characteristic black pigmentation of the brain and spleen in the victims of

malaria. In 1796, John Crawford, physician living in America, wrote a series of essays contradicting the bad-air theory. He asserted that malaria was "occasioned by eggs insinuated, without our knowledge, into our bodies." These eggs, laid during a mosquito bite, hatched in the wound and migrated through the host's body, producing the manifestations of malaria. But contemporaries considered these notions as absurd and the local medical journals summarily rejected all of Crawford's articles. Soon he was being disparaged so loudly that his medical practice began to suffer. Fearing ruin, he carried his ideas no further[1].

On December 24, 1880 in Italy, Laveran communicated the identification of pigmented erythrocytic cells in 26 malaria patients. Laveran wrote a letter to the Academy of Medicine in Paris, communicating his discovery. [Laveran, A. 1880. A new parasite found in the blood of malarial patients. Parasitic origin of malarial attacks. Bull. mem. soc. med. hosp. Paris. 17: 158-164] The observations were quickly confirmed. Later on Camillo Golgi identified the human malarial parasites Plasmodium vivax and Plasmodium malariae in Rome in 1886. Sequentially Ross made his epoch-making observations in Secunderabad on 20 August 1897. Ross conclusively established that the mode of transmission of the disease required the intermediacy of the Anopheles mosquito. He decisively identified the presence of the parasite in the guts of mosquitoes fed on malarial blood of a patient, Husein Khan, who was paid one anna for each bite[5].

In due course of time following four parasites identified – *Plasmodium falciparum, P.vivax, P.malariae,* and *P.ovale.* Out of these four species *P.falciparum* and *P.vivax* are the most common. *P.falciparum* is by far the most deadly type of malaria infection[6]. It was established that the life cycle of

the parasite requires two distinct hosts, the mosquito and the human. Even in the human, the parasite resides at different stages in two distinct cells, the hepatocytes in the liver and the erythrocytes in the blood[5].

b. Diagnosis

(I) Clinical

Clinical diagnosis is made on a clinical suspicion of the disease based on fever and other signs and symptoms[7]. Typical case of malaria presents with sudden onset of high fever with rigors and sensation of extreme cold followed by feeling of burning, leading to profuse sweating and remission of fever by crisis thereafter. The febrile paroxysms occur every alternate day. Headache, body ache, nausea, etc. may be associated features. In atypical cases, classical presentation as mentioned above may not manifest. Hence, any fever case in the endemic areas during transmission season may be considered as malaria[8].

(II) Microscopy

A confirmatory diagnosis requires evidence of the presence of parasites. Evidence of the presence of parasites can be made by the examination of a stained blood smear by light microscopy or by the detection of parasite products by rapid diagnostic techniques (RDTs). However, in areas with intense transmission, it is of limited value for children and to some extent for adults, as asymptomatic parasite carriers may be common[7].

The accepted laboratory practice for the diagnosis of malaria is the preparation and microscopic examination of blood films stained with Giemsa, Wright's, or Field's stain. Blood obtained by pricking a finger or earlobe is the

ideal sample because the density of developed trophozoites or schizonts is greater in blood from this capillary-rich area. Blood obtained by venipuncture collected in heparin or Sequestrine (EDTA) anticoagulant-coated tubes is acceptable if used shortly after being drawn to prevent alteration in the morphology of white blood cells (WBC) and malaria parasites. Both thick and thin blood films should be prepared. The thick blood film provides enhanced sensitivity of the blood film technique and is much better than the thin film for detection of low levels of parasitemia and reappearance of circulating parasites during infection recrudescence or relapse. The morphological identification of the parasite to the species level is much easier in thin film and provides greater specificity than the thick-film examination. The thin blood film is often preferred for routine estimation of the parasitemia because the organisms are easier to see and count. Most routine diagnostic laboratories *generally achieved a lower sensitivity of detection (average, 0.01% RBC infected, 500 parasites/micro l)*[9].

(III) Fluorescence microscopy

Certain fluorescent dyes have an affinity for the nucleic acid in the parasite nucleus and will attach to the nuclei. When excited by UV light at an appropriate wavelength, the nucleus will fluoresce strongly. Two fluorochromes have frequently been used for this purpose, acridine orange (AO) and benzothiocarboxypurine (BCP), which are both excited at 490 nm and exhibit apple green or yellow fluorescence. Rhodamine-123 is also useful for assessing the viable state of parasites, since its uptake relies on an intact, working parasitic membrane. Quantitative buffy coat (QBC) combines an AO-coated capillary tube and an internal float to separate layers of WBC and platelets using

centrifugation. Parasites can be viewed through the capillary tube using a special long-focal-length objective (paralens) with a fluorescence microscope. Although AO is a very intense fluorescent stain, it is nonspecific and stains nucleic acids from all cell types. Consequently, the microscopist using AO must learn to distinguish fluorescence-stained parasites from other cells and cellular debris containing nucleic acids. Particular care is needed when there are Howell-Jolly bodies in the field in blood from patients with hemolytic anemia. With experience, the various stages of malaria seen in the peripheral blood may be located in defined areas of the centrifuged buffy coat (QBC), but specific identification of species remains difficult without seeing the RBC morphology and parasite inclusions[9].

(IV) Polymerase chain reaction

PCR cannot strictly be considered a rapid technique for the initial diagnosis of malaria. Its value lies in its sensitivity, with the ability to detect five parasites or less/micro l of blood. Methods using nested PCR and reverse transcription-PCR enable all four species to be identified. The small-subunit 18S rRNA and circumsporozoite (CS) genes have been used as targets for the differentiation of *Plasmodium* spp. The major advantages of using a PCR-based technique are the ability to detect malaria parasites in patients with low levels of parasitemia and identify them to the species level. Infection with five parasites or less per micro litre can be detected with 100% sensitivity and equal specificity[9].

(V) Immunochromatographic tests

Immunochromatography relies on the migration of liquid across the surface of a nitrocellulose membrane. mmunochromatographic tests are based on the capture of parasite antigen from peripheral blood using monoclonal antibodies prepared against a malaria antigen target and conjugated to either a liposome containing selenium dye or gold particles in a mobile phase. A second or third capture monoclonal antibody applied to a strip of nitrocellulose acts as the immobile phase. The migration of the antigen-antibody complex in the mobile phase along the strip enables the labeled antigen to be captured by the monoclonal antibody of the immobile phase, thus producing a visible colored line[9].

Malaria antigens currently targeted by RDT are HRP-2, pLDH, and *Plasmodium* aldolase. HRP-2 is a water-soluble protein produced by asexual stages and young gametocytes of *P. falciparum*. It is expressed on the RBC membrane surface, and because of its abundance in *P. falciparum*, it was the first antigen to be used to develop an RDT for its detection. pLDH, an enzyme found in the glycolytic pathway of the malaria parasite, is produced by sexual and asexual stages of the parasite. Different isomers of pLDH for each of the four *Plasmodium* spp. infecting humans exist, and their detection constitutes a second approach to RDT development. Several other enzymes of the malaria parasite glycolytic pathway, notably aldolase, have been suggested as target antigens for RDT for species other than *P. falciparum*. HRP-2 has been shown to persist and is detectable after the clinical symptoms of malaria have disappeared and the parasites have apparently been cleared from the host. The reason for the persistence of the HRP-2 antigen is not well understood and may reflect the

presence of latent, viable parasites (possibly the result of treatment failure or circulating antigen-antibody complexes). For OptiMal a panel of monoclonal antibodies that can bind to active pLDH was developed from *P. falciparum*-infected erythrocytes. Two of the monoclonal antibodies are panspecific, recognizing all four species of malaria; a third monoclonal antibody is specific only for *P. falciparum* LDH. Monoclonal antibodies produced against *Plasmodium* aldolase are panspecific in their reaction and have been used in a combination test with HRP-2 to detect *P. vivax* as well as *P.falciparum* in blood[9].

c. Antimalarials

In the long battle against malaria the first sign of a possible treatment appeared in the 17th century, when Jesuit priests brought back to Europe the knowledge that the bark of the cinchona tree appeared to alleviate the symptoms of the disease. The alkaloid quinine, was the first widely used antimalarial. Chloroquine, in many respects a wonder drug, appeared much later. Later on many drugs were added to this category[1].

Other important antimalarials are Amodiaquine, Mefloquine, Proguanil, Primaquine, Sulphadoxine, Pyrimethamine, Dapsone, Tetracyclines and Artemisinin derivatives. Primaquine kills the hepatic stages of malaria. Other drugs are effective against blood stages of parasite[10].

(I) National drug policy

The first line of treatment is chloroquine and the second line is ACT (Artesunate+Sulpha Pyrimethamine) combination. In case resistant to these formulations and to treat severe and complicated malaria quinine will be the drug of Choice. Microscopically positive Pf cases should be treated with chloroquine in therapeutic dose of 25 mg/kg body weight over three days and single dose of Primaquine 0.75 mg/kg bw on the first day. Microscopically positive Pv cases should be treated with chloroquine in full therapeutic dose of 25 mg/kg body weight over three days. Primaquine can be given in dose of 0.25mg/kg bw daily for 14 days under medical supervision only to prevent relapse. ACT is the first line of antimalarial drug for treatment of *P.falciparum* in chloroquine resistant areas. The dose is 4mg/kg bw of artesunate daily for 3 days + 25mg/ kg bw of sulphadoxine/sulphalene + 1.25 mg per kg bw of pyrimethamine on the first day. The cases resistant to CQ and SP-ACT, oral quinine with tetracycline or doxycline can be prescribed. Mefloquine should only be given to chloroquine/multi resistant uncomplicated *P.falciparum* cases only in standard doses as prescribed by WHO. This drug is to be made available through the depot system and only to be provided to patients against the prescription of medical practitioners supported by laboratory report showing asexual stage of *P.falciparum* parasite and not gametocyte alone and other species. Primaquine is contra indicated in pregnant woman and infants. Chemoprophylaxis is recommended inPregnant women in high-risk areas. In chloroquine sensitive areas, weekly dose of chloroquine will be given but in chloroquine resistant areas it should be supplemented by daily dose of proguanil. In severe and complicated *P.falciparum* malaria cases intra-venous Quinine/parenteral Artemisinine

derivatives ***(for adults and non-pregnant women only)*** are to be given irrespective of chloroquine resistance status[8].

2. Host

Out of the annual mortality attributed to malaria globally > 75% belonged to African children and expectant mothers. Most of the point prevalence studies in India have been carried out for outbreak/epidemic investigations. There is very limited information on age- and sex-specific seasonal prevalence of malaria in different paradigms in the country. In the available studies, age and sex classification used is arbitrary. The burden is generally higher in men than women in all age groups. Children in the states of Assam, Arunachal Pradesh, and Rajasthan had a higher incidence of malaria than adults, whereas in the indo-gangatic plains, the situation was reversed. From central India, it has been reported that pregnant women suffer significantly more from both *P. vivax* and *P. falciparum* malaria than non-pregnant women. In India, malarial deaths increased up to the age of 44 years in both sexes and declined thereafter. Although the deaths in infants and children < 14 years of age accounted for 20.6%, in older ages (15–54 years), they accounted for 56.1%, and the rest 23.3%, were in those > 55 years of age. Hence, most of the burden of malarial mortality was borne by the economically productive ages[11].

Analysis of three years of data from a malaria clinic operated by the Indian Council of Medical Research (ICMR) in the Government Medical College Hospital in Jabalpur, central India, showed a high malaria prevalence among pregnant women, which was statistically highly significant (P <0.0001) compared with the situation among nonpregnant women. The study also showed

that malaria infection was more frequent in primigravidae, falling progressively with increasing parity[12].

3. Environment

Environmental factors play a major role in transmission of malaria. These factors determine the likelihood of disease by the interaction of parasite with susceptible host in favourable environment to malaria. *Anopheles culicifacies* is the main vector of malaria in rural India and *Anopheles stephensi* in urban India. *Anopheles minimus* is an efficient vector in the North-Eastern region and *Anopheles fluviatilis* in hill and foot hill areas. It is a zoophilic species. When high densities build up relatively large numbers feed on human beings. Rests during daytime in human dwellings and cattlesheds . Breeds in rainwater pools and puddles, borrowpits, river bed pools, irrigation channels, seepages, rice fields, wells, pond margins, sluggish streams with sandy margins. Extensive breeding is generally encountered following monsoon rains. Most of the vectors, including *Anopheles culicifacies*, start biting soon after dusk. Therefore, biting starts much earlier in winter than in summer but the peak time varies from species to species[2].

There are many studies, which have find out the risk factors for malaria.

Travel history

In a scientific study done in the town of Quibdo, Colombia multivariate analyses showed that among residents of Quibdo, traveling to an endemic area 8–14 days before disease onset was the strongest risk factor for both *Plasmodium falciparum* (adjusted odds ratio [OR] = 28.96, 95% confidence interval [CI] = 13.9–60.32) and *P. vivax* (adjusted OR = 14.24, 95% CI = 5.27–38.46) malaria[13].

Moore Da et al in UK observed an apparent increase in severe falciparum malaria among travellers returning from The Gambia to the United Kingdom (UK) in the last quarter of 2000. They conducted a case-control study to investigate risk factors for malaria. The study participants had visited The Gambia between 1 September and 31 December 2000, travelling with the largest UK tour operator serving this destination. The main outcome measures were risk factors associated with malaria. Forty-six cases and 557 controls were studied. On univariate analysis the strongest risk factors for disease were: early calendar period of visit, longer duration of stay, non-use of antimalarial prophylaxis, non-use of mefloquine, lack of room air-conditioning, less use of insect repellent, prior visit to another malarial area and accommodation in 'hotel X'. After adjustment in multivariate analysis, the strongest independent risk factors for malaria were early calendar period (OR 5.19 [2.35-11.45] for 1 September to 9 November 2000 versus 10 November to 31 December 2000), prior visit to another malarial area (OR 3.27 [1.41-7.56]), and duration of stay (OR 2.05 per extra week [1.42-2.95])[14].

Scientists in Kenya studied of malaria patients admitted to a tea estate hospital. They estimated the risk of severe malaria acquired during travel away from the tea estates. From May 1998 to March 2000, 1,296 patients were evaluated with a case-control design and standardized questionnaire during their hospitalization. Death certificates from the tea estates were examined from 1964 to 1972 and 1986 to 1999. They found out that travel away from the tea estates during the 2 months prior to hospitalization (n = 432) was strongly associated with a diagnosis of malaria (odds ratio 2.7, 95% CI 2.1-3.5). They concluded travel

within Kenya is a significant risk factor for hospitalization owing to malaria on the tea estates[15].

Rogelio Danis-Lozano et al found out travel out side the resident village was a significantly associated factor in Oaxaca, Mexico. They conducted a population-based, matched case-control study from January 2002 to July 2003 and compared the the frequency of exposure to individual risk factors in subjects presenting clinical malaria and uninfected controls. A malaria case was defined as an individual living in the study area presenting malaria symptoms and a *Plasmodium vivax*-positive thick blood smear; controls were individuals negative to *P.vivax* parasites and antibodies of the same gender and with ± five years as the case. A standardized questionnaire was used to record information about the individual risk factors associated with malaria episodes in cases and two controls for each case. The frequency of traveling outside villages was higher among cases (23.5%) than controls (16.1%). Subjects who reported traveling compared to those individuals who did not travel had a two-fold increase (OR 2.11, 95% IC 1.08-4.12) in the risk of malaria, and a strong increased risk was observed among individuals who traveled before the onset of their malaria episode (OR 9.16, 95% IC 1.98-42.2)[16].

Family malaria history

Rogelio Danis-Lozano et al in their scientific study on malaria risk factors in Mexico has reported few risk factors. Family history of malaria in last year was one among these. The presence of malaria cases in the household in previous years was reported by 20.6% (49 of 238) of controls and by 57.1% (68 of 119) of

the cases, corresponding to an almost six-fold increase (OR 7.25, 95% CI 3.84-13.67) in the risk of malaria infection[16].

Vegetation

In large-scale malaria survey in Cambodia by Sandra Incardona et al risk of malaria with certain features found out by them. They carried out survey in three areas of multidrug resistant malaria, enrolling 11,652 individuals. Fever and splenomegaly were recorded. Malaria prevalence, parasite densities and spatial distribution of infection were determined to identify parasitological profiles and the associated risk factors useful for improving malaria control programmes in the country. Multivariate multilevel regression analysis identified adults and males, mostly involved in forest activities, as high risk groups, with additional risks for children in forest-fringe villages in the other areas[17].

A research article titled 'Forecasting malaria incidence based on monthly case reports and environmental factors in Karuzi, Burundi, 1997–2003' by Alberto Gomez worked out on one prediction model with certain predictors for malaria. The study was carried out in Karuzi, a province in the Burundi highlands, using time series of monthly notifications of malaria cases from local health facilities, data from rain and temperature records, and the normalized difference vegetation index (NDVI). Using autoregressive integrated moving average (ARIMA) methodology, a model showing the relation between monthly notifications of malaria cases and the environmental variables was developed. The best forecasting model (R2 adj = 82%, $p < 0.0001$ and 93% forecasting accuracy in the range ± 4 cases per 100 inhabitants) included the NDVI, mean maximum

temperature, rainfall and number of malaria cases in the preceding month. They found this model as a simple and useful tool for producing reasonably reliable forecasts of the malaria incidence rate in the study area[18].

Prosopis Juliflora

This is a thorny hardy species of plant. It produces a dense, impenetrable thickets of greenery. **Esther Mwangi,** Consultant to the World Agroforestry Centre (ICRAF) at the time of this study and **Brent Swallow,** Principal Scientist World Agroforestry Centre (ICRAF) Nairobi, Kenya published an article on assessment of the livelihood effects, costs of control, and local perceptions of the invasive tree, *Prosopis juliflora*, on rural residents in the Lake Baringo area of Kenya. *Prosopis juliflora* is in IUCN's new list of 100 world's worst invasive alien species. This study focuses on the impacts of *Prosopis juliflora* and the distribution of these impacts on local communities in two administrative locations of Baringo district, in Kenya's drylands. A semi-structured interview was administered to individuals who were selected to ensure representation of different gender, age, occupation, and wealth categories. Study report health problems in livestock, on the other hand , the incidence of malaria associated with the expansion of *Prosopis* thickets was the most frequently mentioned problem[19].

Rainfall

Rainfall data have potential use for malaria prediction. However, the relationship between rainfall and the number of malaria cases is indirect and complex. The statistical relationships between monthly malaria case count data series and monthly mean rainfall series (extracted from interpolated station data) over the

period 1972 – 2005 in districts in Sri Lanka was explored by Olivier JT Briët et al in four analyses: cross-correlation; cross-correlation with pre-whitening; inter-annual; and seasonal inter-annual regression. For most districts, strong positive correlations were found for malaria time series lagging zero to three months behind rainfall, and negative correlations were found for malaria time series lagging four to nine months behind rainfall. However, analysis with pre-whitening showed that most of these correlations were spurious. Only for a few districts, weak positive (at lags zero and one) or weak negative (at lags two to six) correlations were found in pre-whitened series. Inter-annual analysis showed strong negative correlations between malaria and rainfall for a group of districts in the centre-west of the country. Seasonal inter-annual analysis showed that the effect of rainfall on malaria varied according to the season and geography. They concluded that seasonally varying effects of rainfall on malaria case counts may explain weak overall cross-correlations found in pre-whitened series, and should be taken into account in malaria predictive models making use of rainfall as a covariate[20].

Type of house

DAVID M. SINTASATH et al investigated for the risk factors of malaria in Eritrea. They carried out a parasitological cross-sectional survey from September 2000 through February 2001 to estimate the prevalence of malaria parasitemia in Eritrea. A total of 12,937 individuals from 176 villages were screened for both *Plasmodium falciparum* and *Plasmodium vivax* parasite species using the OptiMal Rapid Diagnostic Test[21].

Yazoumé Yé et al in his article 'Housing conditions and *Plasmodium falciparum* infection: protective effect of iron-sheet roofed houses' reported associated factors with malaria. Housing conditions have been suggested as one of the potential risk factors. This study aims to further investigate this risk factor, and is focused on the effect of the type of roof on *Plasmodium falciparum* infection among children below five years in the North West of Burkina Faso. In a cross-sectional study design, 661 children aged six to 60 months were randomly selected from three rural and one semi-urban site at the end of the rainy season (November 2003). The children were screened for fever and tested for *Plasmodium falciparum* infection. In addition, data on bed net use and house characteristics was collected from the household were each child lived. Using adjusted odds ratios, children living in house roofed with iron-sheet were compared with those in house with mud or grass roof. Overall *P. falciparum* infection prevalence was 22.8 % with a significant variation between (Chi-square, $p < 0.0001$). The prevalence in Cissé (33.3 %) and Goni (30.6 %) were twice times more than in Nouna (15.2 %) and Kodougou (13.2 %). After adjusting for age, sex, use of bed net and housing conditions, children living in houses with mud roofs had significantly higher risk of getting *P. falciparum* infection compared to those living in iron-sheet roofed houses (Odds Ratio 2.6; 95% Confidence Interval, 1.4–4.7)[22].

Matthew J Kirby et al also find out the same association for malaria vectors in The Gambia. Mosquitoes were sampled using CDC light traps in 976 houses, each on one night, in Farafenni town and surrounding villages during the malaria-transmission season in The Gambia. Mosquito numbers increased per

additional person in the house (OR = 1.04, 1.02–1.06) or trapping room (OR = 1.19, 1.13–1.25) and when the walls were made of mud blocks compared with concrete (OR = 1.44, 1.10–1.87). This study demonstrates that the risk of malaria transmission is greatest in rural areas, where large numbers of people sleep in houses made of mud blocks[23].

Summary

Prevention and control programme for malaria are operating in India for long time. Under programme many prevention and control activities are being implemented at community level. In a resource poor setting like our country, knowledge on the associated factors of malaria may guide the programme planners to target the affected or susceptible groups for better impact. Many studies have find out different factors for malaria. This may be parasite specific, which may demand for different treatment guidelines as in case of plasmodium falciparum. Host factors highlights the most affected groups in community so that focused approach can be planed for these groups for health care delivery. Environmental factors are most important factors which provide conducive system for parasite to transmit from one person to an other. These factors may differ from one given setting to other. Practices of prevention activities in accordance with environmental factors can avert the problem of this age old disease. These factors may vary in different geographical distribution. Information on such factors in different ecological settings may provide valuable information pertinent to better control of malaria in that situation.

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SECTION -3

ANNEXURE

CONSENT FORM

Greetings, Dated: ____/___/___

I am Dr. Praveen Kumar Anand working with the Desert Medicine research center, Jodhpur, to look into factors that may put you at risk or protect you from Malaria. We are doing this research as a response to high mean monthly incidence rate of Malaria in Block Banar, district Jodhpur between January 2002 and March 2007. The National Institute of Epidemiology, Chennai is also working with us on this investigation.

To find out why people get Malaria, we need to ask questions to persons who had fever with positive Malaria slide examination and to persons who did not have fever. Thus, between 1st May 2008 and 15th October 2008, we will be asking the same questions to all the persons with Malaria, as well as to some non-fever patients attending at out patient department of primary health centres of the area. We would like to confidentially ask these few questions to you once. Answering these questions should take about 25 minutes of your time.

Taking part in this scientific study is voluntary. You can choose not to take part. You can choose not to answer a specific question. You can also stop answering these questions at any time without having to provide a reason. This will not affect your rights to health care in the primary health center, or any other rights. There is no specific benefit for you if you take part in the study. However, taking part in the study may be of benefit to the community, as it may help us to understand the problem, its causes and potential solutions. When the results will have been analyzed, a report will be shared with all the participants and the local health officials concerned with public health, so that the right measures can be taken to prevent and control Malaria in the area of block Banar, district Jodhpur.

The information we will collect in this study will remain between you and the doctor. We may ask questions about various specific things you do. This does not mean that we think that these things you do would put you at risk for Malaria. It does not mean either that we think that these things you do would protect you from Malaria. We will not write your name on this form. We will only use a code instead. Only the investigator will know the key to this code. It will be kept under lock and key. It will be destroyed after the project.

If you wish to find out more about this study before taking part, you can ask me all the questions you want. You can also contact Dr.P.K.Anand MAE-FETP Scholar (VIIth Cohort) and principal investigator of this study attached to the National Institute of Epidemiology, Chennai, at the Desert Medicine research center, Jodhpur on his mobile no. 9460774392 and he will feel happy to give you more details. If you agree to take part, we will go ahead now.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this study and understand that I have the right to withdraw from the study at any time without in any way it affecting my further medical care.

Name of the study participant or guardian (if minor) — Signature/Left thumb impression of participant or guardian

Name of witness — Signature of witness

Name of interviewer — signature of interviewer

Factors associated with Malaria in block Banar; district Jodhpur, Rajasthan, India, 2008

Personal identifier segment

Date: ___/__/__

Name of participant: _____Primary health center's name: _____

Age in complete years: ____ years

Gender: 1. Male 2. Female

Caste: 1. SC 2. ST 3. OBC 4. General

Religion: 1. Hindu 2. Muslim 3. Others

Participant's identifier code: | | | | |

First box is for PHC code & next three for volunteer's code. PHC's codes are given below:

Primary health center's name						
	Banar	Bisalpur	Fidusar	Keru	Narwa	Salwa kala
Codes	1	2	3	4	5	6

Tear from here

Questionnaire

Date: __/__/__

Participant's identifier code: | | | | |

Age in completed years: ..... Gender: 1.Male 2. Female Subcentre's name .....

Caste: 1. SC 2. ST 3. OBC 4. General

Religion : 1. Hindu 2. Muslim 3. Others

Case status: 1. Case 2. Control

1. Do you vote for Sarpanch election? 1. Yes 2. NO

Residence: 1. Rural 2. Urban

2. What is your occupation? .....

1. Manual 2. Sedentary 3. Non-earning

3. How many classes have you passed?.....

1. Primary 2. Secondary 3. Higher

4. What is your monthly income in Rupees? .....

5. Do you read newspaper? 1. Yes 2. NO

If yes, what is the frequency? 1. At least 4 days a week & 1 hour/day 2. Less than 4 days

6. Do you see television? 1. Yes 2.NO

If yes, what is the frequency? 1. At least 4 days a week & 1 hour/day 2. Less than 4 days

7. How the malaria spread in community?
(1) By the mosquitoes (2) By solid waste & dirty water
(3) By eating contaminated food (4) Others

8. How the malaria can be prevented?
(1) By use of bed net (2) By use of mosquito repellent (3) By use of mosquito repellent cream
(4) By eating warm food (5) by drinking pure water (6) others

9. Have you immigrated in your village after having stayed & slept for at least one night out of your residence within last month? 1. Yes 2. NO

10. Do you use any protection measure to protect yourself from bite of mosquito?
1.Yes 2.NO

If yes, what is the name of that measure?
(1) Impregnated net (2) Ordinary net (3) Repellent cream (4) Repellent liquid

11. How do you use the protection measure?
(1) Use of >1 measures each night (2) Use of 1 measure each night
(3) Use of any measure irregularly

12. Do you work in stone quarries? 1. Yes 2. NO

If yes, how frequently you have been working in last one-month period?
(1) Working off and on (2) Working daily for last 15 days
(3) Working daily for last 1 month

13. Had any member of your family suffered from Malaria in last one-month period?
(1) Yes (2) NO

14. Do you have any mud-thatched room in your house? 1. Yes 2. NO

15. Do you have any animal at your home? 1. Yes 2.NO

If yes, what animal do you have? Please tell number also
(1) Cow..... (2) Buffalo..... (3) Goat..... (4) Sheep.....(5) Other.....

16. Is there any stagnant water body/pond near to your house? 1. Yes 2. NO

If yes, please tell its approximate number

Within 0.5 kilometer of house a. 1 pond b. >1 pond

Away from 0.5 kilometer of house a. 1 pond b. > 1 pond

17. Is there any vilayati babool near to your house/work place? 1. Yes 2. NO

If yes, please tell its approximate number

Within 0.5 kilometer of house a. 1-5 b. 6-10 c. 11 & more

Away from 0.5 kilometer of house a. 1-5 b. 6-10 c. 11 & more

Signature of the interviewer