IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 9 Ver. IV (Sep. 2017), PP 45-50
www.iosrjournals.org

A Three Years Cross-sectional Study in a Tertiary Care Hospital Reflecting Recent Resurgence of Malaria in Northern Fringe of Kolkata

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Abstract: *A three years cross-sectional study was designed based on laboratory diagnosis and hospital records of fever patients attending a tertiary care hospital.*

Objectives: *To assess the distribution of malaria in terms of age, sex and time amongst the patients attending a tertiary care hospital situated at northern fringe of Kolkata as well as to evaluate the recent trend of malaria within the study population.*

Materials and Methods: *Malaria was diagnosed by Leishman stained thick and thin peripheral blood smears examination and detection of dual antigens of Plasmodium vivax and Plasmodium falciparum by immunochromatographic method. Data were compiled from the hospital records. Data analysis and presentation were done according to the standard statistical techniques.*

Discussion: *There is a surge in malaria prevalence of both P. vivax and P. falciparum malaria in 2016 as compared to 2014 and 2015, with a post monsoon peak from August to September. Slide Positivity Rate was almost double in 2016 as compared to the previous two years. Male preponderance has been noted. Age group of 10-30 years is mostly affected.*

Conclusion: *The call of the hour is to re-strengthen the vector control measures, accentuate the treatment of fever cases and ensure the treatment compliance as well as to expedite the detection of drug resistance to combat this unanticipated flutter of resurgence.*

Keywords: *malaria, resurgence, slide positivity rate, rapid diagnostic test*

Date of Submission: 05 -09-2017 Date of acceptance: 13-09-2017

I. Introduction

Malaria is a mosquito-borne disease affecting humans and other animals caused by *Plasmodium* spp. The history of malaria stretches from prehistoric origin until this 21st century. A widespread and potentially lethal human infectious disease, at its peak malaria infested every continent, except Antarctica. Majority of complications and mortality are caused by *P. falciparum* because *P. vivax*, *P. ovale* and *P. malariae* generally cause benign malaria. *Plasmodium knowlesi* has been known since the 1930s infecting Asian macaque monkeys and as experimentally capable of infecting humans. In 1965, a natural human infection with *P. knowlesi* was reported in a soldier returning from the Pahang Jungle of the Malaysian peninsula[1]. More than a century ago the city provided Sir Ronald Ross an opportunity to establish the transmission cycle of the disease. The transmission cycle of malaria is yet to be interrupted permanently. In urban India, the predominant vector for malaria is *Anopheles stephensi* which breeds in water containers in domestic and peridomestic situations such as tanks, wells, cisterns, which are more or less of permanent nature and hence can maintain density for malaria transmission throughout the year. Increasing urbanization and industrialization with consequent migration, deficient water and solid waste management (tyres, containers, junk materials, cups, etc.) give rise to mosquito-friendly environment and contribute to the spread of vector borne diseases[2].

Global Malaria Action Plan (GMAP) outlined the strategies, goals, timelines and expenditure for global malaria control and elimination. The GMAP was developed by the Roll Back Malaria (RBM) Partnership and endorsed at the Malaria Summit on 25th September, 2008, in New York City. The GMAP outlines a three-part global strategy[3]:

1. Control of malaria to reduce the current burden and sustain control as long as necessary,
2. Comprehensive approach to eliminate malaria Research for new tools and approaches to support global control and elimination efforts.

The National Vector Borne Disease Control Programme (NVBDCP) is an umbrella programme in India for prevention and control of vector borne diseases viz. mosquito borne Malaria, Japanese Encephalitis (JE), Dengue, Chikungunya, and Lymphatic Filariasis and sandfly borne Kala-azar. The States are responsible for implementation of programme, whereas the Directorate of NVBDCP, Delhi provides technical assistance, policies and assistance to the States in the form of cash & commodity, as per approved pattern. The transmission of vector borne diseases depends on the prevalence of infective vectors and human vector contact, which is further influenced by various factors such as climate, sleeping habits of human, density and biting of vectors etc[4].

In India, the problem of malaria was virtually eliminated in the mid-sixties but resurgence led to an annual incidence of 6.47 million cases in 1976. Modified Plan of Operation was launched in 1977 and annual malaria incidence started declining. The cases were contained between 2 to 3 million cases annually till 2001and after that, the cases have further started declining[5]. The main reasons for malaria epidemics were inadequacy in surveillance, and insufficient anti-larval measures in urban areas, antimalarial resistance amongst the parasite and acquisition of resistance amongst the vector against the control measures. Kolkata is still considered the most malaria prone district of West Bengal, India[6]. New tools for malaria prevention and control were introduced under NVBDCP i.e., monovalent Rapid Diagnostic Tests (RDTs) for *P. falciparum* detection in 2005; Artemisnin Combination Therapy (ACT) in 2006; long-lasting insecticidal nets (LLINs) in 2009; antigen detecting bivalent RDTs for detection of both *P. falciparum* and *P. vivax* in 2013; and newer insecticides and larvicides in 2014-15[7].

Keeping these facts in mind the present study was designed to justify the following objectives:

1. To assess the prevalence of malaria amongst the patients attending a tertiary care hospital situated at northern fringe of Kolkata.
2. To determine distribution of Malaria in terms of age, sex and time.
3. To evaluate the recent trend of malaria within the study population.

II. Material methods

The cross-sectional study was performed in the department of Microbiology, College of Medicine &Sagore Dutta Hospital, Kamarhati, Kolkata from January 2014 to December 2016 with clinically suspected malaria cases attending this tertiary care institute. Patients previously diagnosed as malaria within past four weeks were excluded from the present study. Fever cases with established infectious and non-infectious aetiologies were also excluded.

Following laboratory evaluations were performed:

(i) Microscopy**:** Both thick and thin blood films were prepared from venous blood, stained with Leishman stain, and examined under microscope for detection of malarial parasites and speciation.

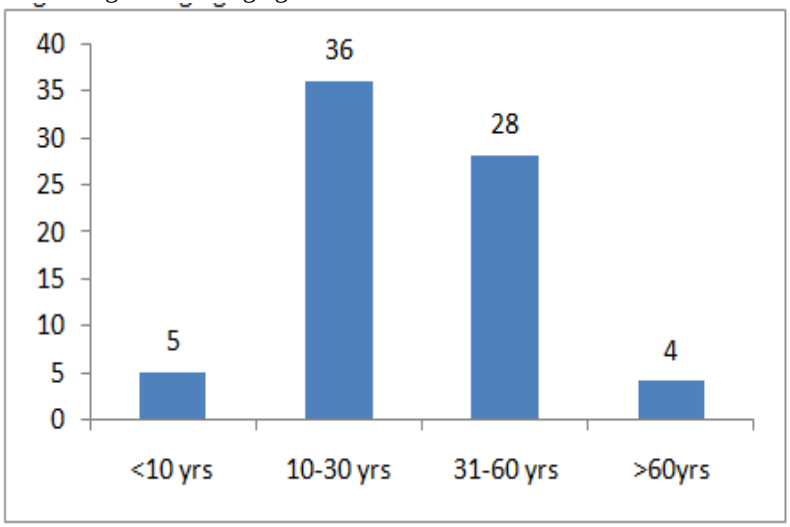
(ii) RDT-based diagnosis**:** RDT(dual antigen test) was performed with a Immunochromatographic lateral flow assay kit containing a monoclonal anti-*P. falciparum* histidine-rich protein II (HRP-II)-specific antibody and an anti-*Plasmodium vivax* p-LDH-specific antibody.

All collected data was subjected to statistical analysis by parametric & non-parametric test(s). For comparison of means of two groups, student's t test (sample size <30) or Z test (sample size>30) and for ≥3groups, Analysis of Variance or ANOVA was done. Qualitative data analysis was done by Chi-square test or Fischer's test (smaller sample size). Null hypothesis was rejected when p value <0.05. Results were presented as pie diagram, bar diagram and trend lines. Standard statistical software packages like SPSS, SAS & R was utilised. There was no ethical controversy and conflict of interest.

III. Results

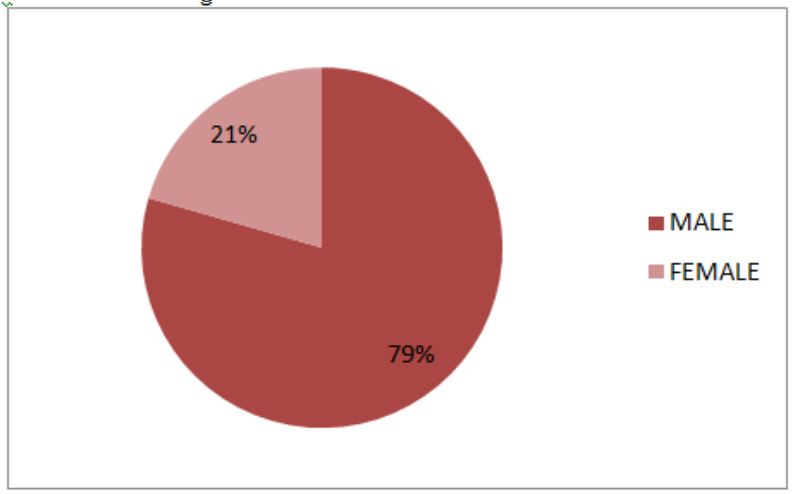
A total number of 5826 fever cases were tested from January 2014 to December 2016 for peripheral blood smear examination and dual antigen test; out of which, 73 (1.25%) cases were found to be positive. Amongst those 73 malaria positive cases, 61(84%) were caused by *P. vivax*. Male preponderance (79%) was noted in the infected population. Highest Slide positivity rate (1.8) was noted in 2016.

Figure-1: Bar diagram showing age wise distribution of malaria cases from 2014-1016 (n=73)



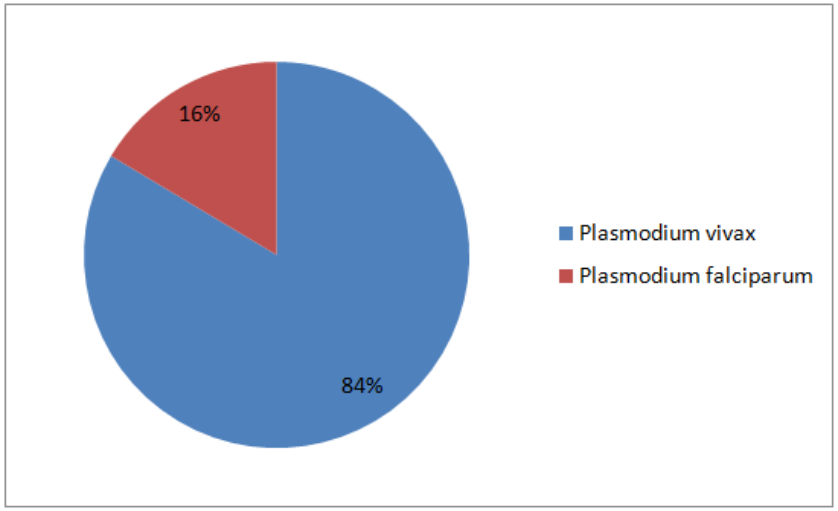
Almost half (49.3%) of the positive cases are within the age group of 10-30 years whereas lesser number of cases have been reported from extremes of the ages.

Figure-2: Pie chart showing sex wise distribution of malaria cases from 2014-1016 (n=73)



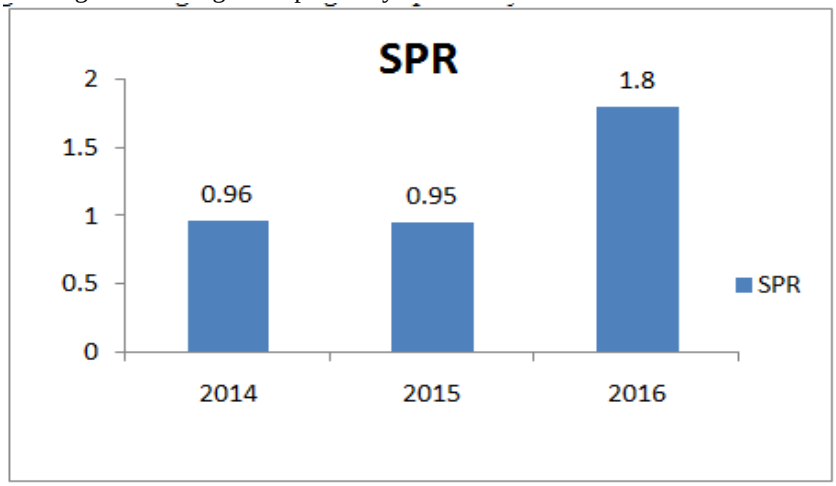
Majority of the established cases were reported from the male population

Figure-3: Pie chart showing species wise distribution of malaria cases from 2014-1016 (n=73)



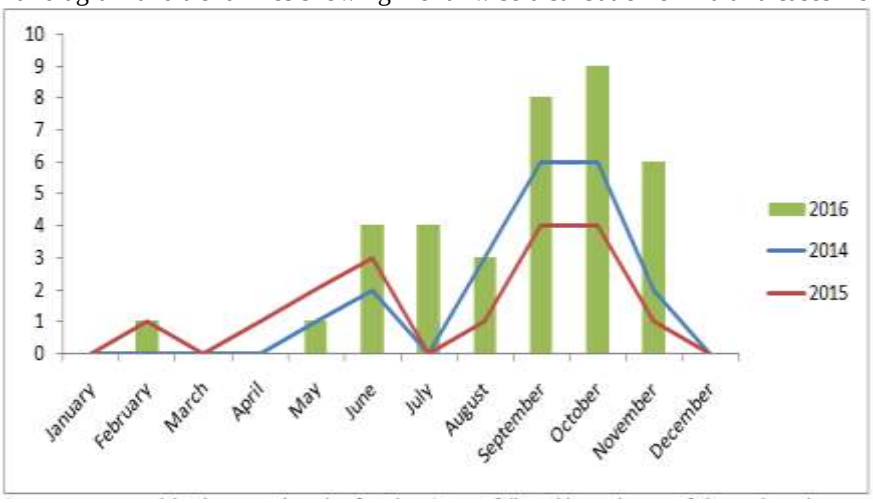
P. vivax cases (84%) outnumbered *Plasmodium falciparum* cases (16%) through out the study period.

Figure-4: Bar diagram showing Slide positivity rate of Malaria from 2014-16



Resurgence was indicated by the highest Slide positivity rate (1.8) in 2016.

Figure-5: Bar diagram and trend lines showing month wise distribution of Malaria cases from 2014-16



A post monsoon peak has been noted starting from late August, followed by attainment of plateau through September and October and sharp decline during November and December throughout the consecutive three years (2014-16).

IV. Discussion

This is a three years cross-sectional study to outline the prevalence and recent trend of malaria, one of the major vector borne diseases prevalent in India. Similar studies on Indian population has been documented in past by Kumar A. et al[8], Saha et al [9] etc. As evident from the present study, the malaria scenario in the northern fringe of Kolkata showed a plateau in 2014 and 2015 followed by drastic upsurge in 2016. WB Government records from Kolkata Municipal Corporation reflect that malaria cases drastically came down from 16828 in 2013 to 9445 and 9428 in 2014 and 2015 respectively. This improvement happened due to extensive vector control activities carried out by the health department of WB in 2013 and 2014 following the outbreak of dengue that occurred here in 2012. But, the data of 2016 show abrupt increase in number of malaria cases upto 16498. It is worth mentioning that case load of 2016 is astonishingly similar to that of 2012[10]. This upsurge of 2016 noted in our study as well as in government records is a reflection of the fact that the ongoing vector control measures, though extensive, are turning practically inefficient. The cause may be vector resistance to insecticides as documented by Liu N et al[11]. Another cause may be the resistance against the antimalarial drugs acquired by the malarial parasites as apprehended by Saha P et al[12]. Several publications have established multiple crests and troughs in Malaria trends all over the country. A plunge into history of malaria trends depict that there are resurgences in Kolkata and surroundings as documented by Biswas D et al[13].

We noted that *P. vivax* cases vastly out numbered *Plasmodium falciparum* cases through out the study period. In concordance with our findings, Anvikar AR et al has reported that malaria in India was predominantly caused by *Plasmodium vivax*, accounting for 53% of the estimated cases. After the spread of drug-resistant *Plasmodium falciparum* in the 1990s, the prevalence of the two species remained equivalent at the national level for a decade. By 2014, the proportion of *P. vivax* has decreased to 34% nationally, but with high regional variation. In 2014, *P. vivax* accounted for around 380,000 malaria cases in India; almost a sixth of all *P. vivax* cases reported globally. Urban malaria is predominantly caused by *P. vivax* [14]. There is paucity of data regarding such studies in urban outskirts.

Several workers[15] have reported monsoon peak of overall malarial incidence whereas in this study, a post monsoon peak has been noted in consecutive three years (from 2014-16). According to this present study, male preponderance is reported in all age groups and majority of the cases are within the age group of 10-30 years. This may be because male population has more chance of exposure to the vectors. As per Kumar A[8], most of the point prevalence studies done in India regarding outbreak and epidemic investigations; there is very limited information on age and sex-specific seasonal prevalence of malaria in different paradigms in the country. In our study, 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-gangetic plains, the situation was reversed as per Kumar A et al[8].

Slide Positivity Rate (SPR) in this study for the year 2014, 2015 and 2016 were 0.96, 0.95 and 1.8 respectively. The urban high-risk criteria considers slide positivity rate 10% and above during any of the last 3 years. For a single year data in an urban area of population not less than 50,000, SPR should be more than 5% or the ratio of clinical malaria cases to fever cases should be more than one-third as per hospital or dispensary statistics during the last calendar year. Malaria is well known for its debilitating, demoralizing, and impoverishing consequences, and therefore, both estimation of its true burden and control are essential to not only make public health sense but also economic sense in the present era of sustained socioeconomic growth in India[8].

V. Conclusion

The call of the hour is to strengthen the vector control measures, accentuate treatment of fever cases, and ensure the treatment compliance as well as expedite detection of drug resistance and reinforce surveillance measures to combat this unanticipated flutter of resurgence.

Limitation of the study:

Further genetic studies such as mutation among *Plasmodium* spp. against antimalarial drugs, vector resistance to conventional control measures, is to be performed to explain the cause of resurgence. Also we could not take into account the asymptomatic undiagnosed cases while estimating the case load.

Acknowledgements:

The authors express sincere gratitude to the Principal, Medical Superintendent & Vice Principal and Dean of students' affairs of College of Medicine & Sagore Dutta Hospital, Kolkata for their active support and co-operation throughout the study period. The authors specially extend their thanks to all of the staff of the department of Microbiology of College of Medicine & Sagore Dutta Hospital.

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