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Situation analysis of malaria in Delhi

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Abstract
The present study was planned to know the recent trends of malaria in Delhi with an emphasis to highlight the pockets of its severity. Retrospective data of malaria from year 2011-14 was collected from Municipal Corporation of Delhi. The data was analyzed to obtain various parameters like age and sex wise distribution, peak months of malaria transmission and vulnerable zones of the state. Analysis of malaria cases in different municipal zones of Delhi showed that >60% cases are reported from four zones out of 12 zones. These zones are Shahdara north (42%), Shahdara south (29), Nazafgarh (40%) and Narela (25%). More than 80% of malaria cases have been reported from two age groups; 5-14 years and 15-59 years. Malaria data revealed that major malaria transmission in Delhi started from the month of May onwards that continued up to the month of November and few malaria cases were found during the months of December to February. Results of this study indicated that there is an urgent need for regular and effective mass surveillance and proper malaria control measures to be undertaken in these vulnerable zones. More emphasis on entomological surveillance is also required in different regions of Delhi as studies in this area are scarce.

Keywords: Malaria, transmission season, vector, Delhi, entomological surveillance.

1. Introduction

Malaria is caused by the biting of the female vector mosquitoes viz. *Anopheles culicifacies*, *An. stephensi*, *An. fluviatilis*, *An. minimus*, *An. dirus* and *An. sundaicus* the six primary vectors and *An.* varuna, *An. annularis*, *An. philippinensis* and *An. jeyporiensis* are four secondary vectors of malaria [1]. Of these malaria vectors, *An. stephensi* is responsible for malaria in urban and industrial areas while *An. culicifacies* is the vector of rural and peri-urban areas [2-4]. In addition to these, *An. subpictus* has also been reported as a malaria vector [5]. Malaria is caused by a protozoan parasite of genus *Plasmodium*. Four species of the *Plasmodium* are responsible for the disease of which *P. vivax* and *P. falciparum* are the most prevalent parasites in India.

Malaria continues to be a major public health problem in India since long, affecting 36% of the world population in 97 tropical and sub-tropical countries and 3.3 billion people are at the risk of being infected with malaria [6]. In India, malaria is a main cause of mortality and morbidity among human population as 1.07 million cases with 535 deaths were reported during the year 2014 by national vector borne disease control programme [7]. According to Kumar *et al.* (2007), there is a wide gap of 68% to 98% between reported malaria cases and the actual incidence of malaria in India [1]. Gupta *et al.* (2009) have also reported that many malaria cases treated at private facilities with self-diagnosis are not included in the official statistics or national malaria data reported by national Vector borne disease control programme (NVBDCP) and thereby resulting in underestimation of the malaria [8]. The vector control is a major component of the strategy for malaria control to prevent parasite transmission through interventions targeting adult *Anopheles* vector mosquitoes.

Delhi with an area of 1484 km^2 and is located at latitude 28°38' N, longitude 77°12' E. It has a length of 51.9 km and a width of 48.48 km with population of 17.8 millions [9]. The climate of Delhi city is most varied. The lowest temperature ever recorded was 2°C and highest 45°C, while relative humidity (RH) ranges from 20% to 86%. Delhi on an average receives a rainfall of 212 mm during the rainy season (July to October). Delhi state was endemic for malaria till year 2000; approximately five thousand malaria cases were being reported annually during 1990s. Year 2000 onwards cases of malaria started to decline and number of malaria cases came to hundred figures. Vector borne disease control programme of the state was benefited from the enhanced malaria control project (EMCP) funded by the World Bank from 1997[10]. Major area of the state is covered under the municipal corporation of Delhi (MCD) which is

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responsible for control of vector borne disease in Delhi. MCD was later trifurcated into three small municipal corporations namely East, North and South Delhi municipal corporations. The entire corporations are divided into 12 zones.

This study was planned to know the recent trend of malaria in Delhi with an emphasis to highlight the pockets of its severity. This information may be useful for finalize the strategy for malaria prevention and control or to eliminate the disease from the state.

2. Materials and Methods

Retrospective data of malaria from 2011-14 was collected from Anti malaria operation unit, health department of Municipal Corporation of Delhi. The data was analyzed to obtain various parameters like age and sex wise distribution, peak months of malaria transmission and vulnerable zones of the state using MS Excel 2007 programme. Trend of malaria during the last decade was also analyzed to get the trend of malaria in the state. In one of the most vulnerable zone i.e. Nazafgarh zone and an entomological survey was carried out to know the presence of mosquito species in the area. Indoor resting, adult mosquitoes were collected by using an aspirator and flash light from human dwellings/cattle dwellings in the morning (6:00 to 8:00 hours) and evening (19:00 to 21:00 hours). Collected adults were brought to the field laboratory and were identified as per standard keys of Wattal and Kalra (1961) [11] and Das (1990) [12]. In addition, mosquito larvae were collected from different breeding habitats of surveyed area in Nazafgarh zone. The collected larvae were reared in plastic bowl till emergence for proper identification.

3. Results

The malaria epidemiological data revealed that, more cases were reported from corporation's zones namely Nazafgarh and Shahdara north followed by Shahdara south, Civil lines, Narela, Central Delhi and Rohini in comparison to other zones of MCD. Malaria declined in Delhi as number of malaria cases came to hundred figures from five thousand of malaria cases in the year 2000. Analysis of malaria cases in different municipal zones of Delhi showed that >60% cases were reported from four zones out of 12 zones. These zones were Shahdara north (42%), Shahdara south (29), Nazafgarh (40%) and Narela (25%) in Table 3. Trend of malaria in different age groups has been presented in table 1 & figure 1. More than 80% of malaria cases have been reported from two age groups; 5-14 years and 15-59 years. In elderly peoples (age > 60 yrs) and infants percentage of malaria cases was very low ranging from 0-6%. Every year 3 to 5 cases were reported in the 1-4 year age group children. Annual trend of malaria showed that malaria cases have declined from >400 cases in 2004 to <100 cases in 2014. Month-wise analysis of malaria reported cases revealed that numbers of malaria cases started increasing from the month of May and reached peak during the month of September during all the last four years. Malaria data revealed that major malaria transmission started from the month of May onwards and continued up to the month of November and few malaria cases were found during the months of December to February (Table 3). The table 3 showed malaria transmission continued throughout the year.

Table 1: Percentage malaria prevalence in different age groups

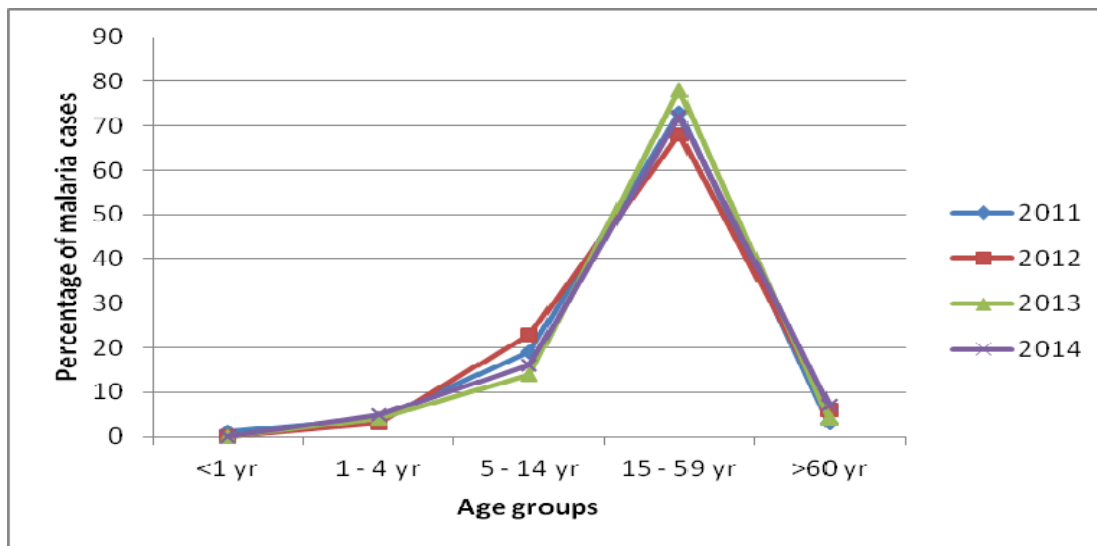| Year	Percentage of malaria cases in Delhi reported from different age groups				
	<1 yr	**1 - 4 yr**	**5 - 14 yr**	**15 - 59 yr**	**>60 yr**
2011	1	4	19	73	3
2012	0	3	23	68	6
2013	0	4	14	78	4
2014	0	5	16	72	7

Fig 1: Trend of malaria in different age groups of Delhi during year 2011-14

Table 2: Distribution of malaria cases in different months

Year	Monthly distribution of malaria cases in Delhi											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	0	1	1	5	7	24	42	41	78	52	11	4
2012	2	1	5	12	23	37	35	41	51	30	9	0
2013	0	1	0	3	13	15	18	28	62	51	8	1
2014	0	0	1	0	8	2	7	13	25	6	2	1

Table 3: Monthly average (2011-14) of malaria cases in different zones of Delhi

| Zone	Average monthly cases of malaria in different zones of Delhi												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Civil Line	0	0	0	1	1	3	2	4	4	5	1	0	19
Rohini	0	0	0	0	1	0	1	1	2	1	1	0	8
City	0	0	0	0	0	0	1	1	1	1	0	0	4
Sadar Paharganj	0	0	0	0	0	0	1	1	2	2	0	0	5
Karol Bagh	0	0	0	0	0	0	0	1	1	0	0	0	2
Narela	0	0	1	2	1	3	3	3	5	7	1	1	25
West	0	0	0	1	1	2	1	1	2	1	0	0	7
Central	0	0	0	0	1	1	1	3	3	2	0	0	10
South	0	0	0	0	0	0	0	1	2	0	0	0	4
Najafgarh	0	0	0	1	3	7	7	6	12	5	1	0	40
Shahdara north	0	1	0	1	2	3	7	6	11	9	3	1	42
Shahdara south	0	0	0	0	3	2	4	6	11	3	1	0	29
Total	1	1	2	5	13	20	26	31	54	35	8	2	
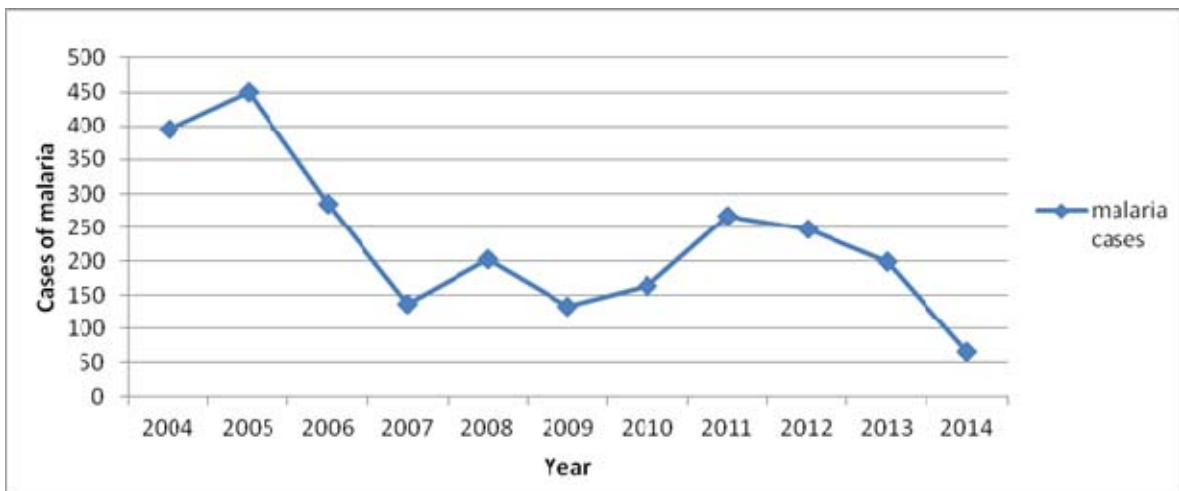
Figure 2: Annual trend of malaria cases in Delhi from 2004-2014

4. Discussion

Malarial transmission occurs in Delhi throughout the year. From the month of May onwards cases started to rise and reaching at peak in monsoon months of July to October. After the month of October, there was a decline in number of malaria cases and few cases of malaria were reported in winter months. This is in corroboration with the previous studies undertaken in Delhi [13-15]. The study shows that malaria is not prevalent among infants, children and females which indicate the non-endemic nature of malaria in Delhi. Maximum numbers of malaria cases were reported from 15-59 years age group persons followed by 5-14 year age group persons. Children of 1-4 year age group suffered with 3-5 cases of malaria each year. Presence of malaria cases in children, although low in numbers, points out the possibility of ongoing local malaria transmission in Delhi. After the year 2005 onwards, the malaria cases began to decline and from the year 2007 to 2013 there was stability in malaria cases.

During the year 2014, malaria cases reached less than hundred and decline in malaria cases might be due to more awareness regarding malaria and other vector borne diseases in Delhi. In the twentieth century, Delhi has seen major development in terms of both infrastructure and per capita income. These factors might have played a key role in decline of malaria cases. Most of the malaria cases are being reported from outer regions of Delhi i.e. Nazafgarh, Shahdara north, Shahdara south and Narela MCD zones. The main reason for this may be the migratory population which mainly resides in these regions of Delhi.

In a recent study by Savargaonkar et al. 2015 more than 400 malaria cases were reported at Malaria clinic of National Institute of Malaria Research, Delhi during the year 2011-14 [16]. About 50% reported cases were from Raj Nagar-II and Bagdola area of Nazafgarh zone mainly. During this period, only about 41 cases of malaria were reported by the MCD from Raj Nagar-II and Bagdola area. Moreover, all the MCD

zones of Delhi reported 777 malaria cases with 161 cases in Nazafgarh zone under which Raj Nagar-II and Bagdola area falls. It shows that the malaria cases are being under-reported by MCD surveillance and actual number of malaria cases in Delhi is much higher than the presently reported cases. In a recent report, underreporting of the death cases with malaria and dengue in Delhi was figured out [17]. Further earlier researchers have also reported under reporting of the malaria cases from the country [1, 8]. As India is moving forward to achieve the goal of malaria elimination, proper reporting of malaria cases is essential for the identification and removal of the focus of malaria in Delhi.

During a field study undertaken in Delhi, both the vector species of malaria, *An. culicifacies* and *An. stephensi* were found in the various zones of MCD (unpublished data). Similar studies carried out by earlier researchers on presence of *An. culicifacies* and *An. stephensi* and both the malaria vector species were also reported from state of Delhi [15, 18]. However, entomological surveys conducted in a recent study have shown presence of *An. stephensi* only [16]. It might be due to the limitation of the surveyed area as it was undertaken mainly in Raj Nagar-II and Bagdola area of Nazafgarh zone.

5. Conclusion
Results of this study indicate that there is an urgent need for regular and effective mass surveillance and proper malaria control measures to be undertaken in these zones which contribute most of the malaria cases in Delhi as Nazafgarh, Shahdara north, Shahdara south and Narela to eliminate the disease from the state of Delhi. More emphasis on entomological surveillance is also required in different regions of Delhi as studies in this area are scarce.

6. Acknowledgement

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