Prevalence of malaria in the population of Purnia Distrit, Bihar

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Abstract

Prevalence of malaria was studied in Purnia district of Bihar. Various factors such as environmental factors (temperature, rainfall and humidity etc), nature of houses, location of houses, habits of sleeping outside, rearing of animals as well as drainage system were correlated with the prevalence of incidence of malaria. The study indicates the incidence of malaria is more due to abundance of swampy areas in the district, earthen walls of the hut, poor sanitation and poor drainage system. Prevalence of malaria was found more in males in comparison to females which is possibly due to their outdoor activities and habits of sleeping outside the house. The findings of this study indicate that families living in houses with the poorest construction and close to the vector breeding sites should be the primary target for the provision of bed nets. Further the frequency of malaria was more in persons belonging to blood group O.

Keywords: Environmental factors | Outdoor activities | Malaria | Swampy area and Blood group 'O'

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Introduction

Malaria is one of the oldest and major public health problems of the world and is number one killer of children, pregnant women and elderly persons (Greenwood and Mutabingwa, 2002). It has now been identified as the disease most likely affected by climate change (WHO/WMO/UNEP, 1996). In 2008, there were an estimated 243 million cases of malaria, the vast majority of cases (85%) occurring in the African Region. In 2008, malaria accounted for an estimated 863,000 deaths (WHO, 2009). According to a report published in the Lancet, 20th Nov., 2010, In India, malaria causes 205000 deaths per year before age of 70 years (55000 in early childhood, 30000 at ages 4 – 5 years, 120000 at ages 15 – 69 years) and 90% of death occurs in rural areas. Many factors affect increases in malaria cases, including changes in land use, drug resistance, malaria control programs, socioeconomic issues, and climatic factors. The geographical condition and climate of India is favourable to transmission of malarial infection. No study has examined the relationship between malaria epidemics and climatic factors in Purnia district of Bihar. The present paper deals with incidence of malaria in relation to pattern of settlement, environmental factors and socioeconomic condition in Purnia district (Bihar).

Methods

Purnia is one of the oldest districts of Bihar located at a height of 350meters from the sea level. The district is rich in flora and fauna. It is popularly known as poor's men Darjeeling. Once upon a time it was popularly known as 'Kala Pani'. Monthly malaria case data from June 2010 to May 2011, monthly rainfall, temperature and humidity were recorded in different villages of Purnia district. Literacy was measured as the number of individuals that can both read and write as a percentage of the total population. Purnia has very high vector species diversity and vectors suited to these habitats may be responsible for the observed results.

Results and Discussion

Climate, local ecology, and active control affect the ability of malaria parasites and their anopheline mosquito vectors to coexist long enough to enable transmission. The frequency of transmission, or endemicity, depends on the density and infectivity of anopheline vectors. These features depend on a range of climatic, physical, and population characteristics, for example, rainfall, location of human settlements near or at rivers or other mosquito larval breeding sites, and the density of human populations in a village. The most significant determinant of the intensity of parasite transmission is climate (Snow and Omumbo.2006).

Meteorological factors are important drivers of malaria transmission by affecting both malaria parasites and vectors directly or indirectly (Abebe *et al*., 2011). The three main factors that affect malaria are temperature, rainfall and relative humidity (Pampana, 1969) and, therefore, with spread of the disease. Changes in temperature, rainfall, and relative humidity due to climate change are expected to influence malaria directly by modifying the behaviour and geographical distribution of malaria vectors and by changing the length of the life cycle of the parasite. (Abebe *et al*., 2011). Climate change is also expected to affect malaria indirectly by changing ecological relationships that are important to the organisms involved in malaria transmission (the vector, parasite, and host).

The ambient temperature plays a major role in the life cycle of the malaria vector. Temperatures within the range of 20°C–30°C affect malaria transmissions in several ways: (a) Development of *Anopheles* is shortened

(b) Biting capacity of mosquitoes is increased, and

(c) Mosquitoes survive long enough to acquire and transmit the parasite.

Temperatures lower than 16 °C or higher than 30 °C have a negative impact on the growth of the mosquitoes (Yang, 2000).

Development of the parasite within the mosquito (sorogonic cycle) is dependent upon temperature. It takes 9 to 10 days at temperature of 28^0C, but stops at temperatures below 16 ^{0}C. The minimum temperature for parasite development of *Plasmodium falciparum and P. vivax* are approximately 18 ^{0}C and 15 ^{0}C respectively (Craig *et al*., 1999).

The daily survival of the vector is also dependent on temperature. At temperature between 16^{0}c and 36^{0}C, the daily survival is about 90%. According to Craig et al., (1999) and Jonathan et al., (2006) at temperatures between 28^{0}C – 32^{0}C the high proportion of vectors surviving the incubation period is observed. In the present study temperature ranges was quite favourable for the survival of the vector (Table – 1).

Table 1- Mean temperature, rainfall and humidity of Purnia district (Bihar).

Season	**Temperature**	**Rainfall** (mm)	**Humidity** (%)
Winter	18.73^{0}C	0.80	78.32
Rainy	24.14^{0}C	9.70	83.66
Summer	27.69^{0}C	5.48	67.52

Rainfall plays an important role in malaria as it increases relative humidity and thereby the longevity of the adult mosquitoes, besides providing water as the medium for the aquatic stages of the mosquitoes (McMichael and Martens, 1995). No doubt, rainfall provides breeding ground of the mosquitoes, if it is moderate while it destroys breeding sites and flush out larvae, when it is in excess. Rainfall provides breeding sites for mosquitoes to lay their eggs, and ensures a suitable relative humidity of at least 50 to 60% to prolong mosquito survival (Reiter, 2001). Many workers have reported a positive correlation between rainfall and the incidence of *Plasmodium falciparum* (Gupta, 1996 and Bouma *et al*., 1996). However, in the present study average relative humidity was 76.5% which is much suitable for the survival of mosquitoes. Excessive rainfall does not always trigger an epidemic. Gonzalea *et al*, (1997) have observed a negative correlation between rainfall and malaria incidence in a nine years study on Colombian Pacific Costa. According to Hicks and Majid (1937) it was high humidity and not the total rainfall which was key factor leading to an epidemic. A weak correlation between number of rainy days and incidence of malaria has been observed by Singh and Sharma in Madhya Pradesh (2002). However, no such correlation was observed in the present investigation. Rainfall also affects malaria transmission because it increases relative humidity and modifies temperature, and it also affects where and how much mosquito breeding can take place. *Plasmodium* parasites are not affected by relative humidity, but the activity and survival of anopheline mosquitoes are. High relative humidity allows the parasite to complete the necessary life cycle, so that it can transmit the infection to several persons (Pampana, 1969). If the average monthly relative humidity is below 60%, it is believed that the life of the mosquito is so shortened that there is no malaria transmission (Mouchet *et al*., 1998). The average relative humidity in the present study was found quite suitable for the completion of the life cycle of the mosquito. When the relative humidity drops below 60%, it is believed that malaria transmission cannot occur because of the reduced lifespan of mosquitoes. The peak of malaria incidence during present study was found between September – November, pointing out that increase in vector breeding results in increase incidence of malaria. Thus pointing out that cases of malaria increases in later part of the rainy season (Madhavan *et al*., 2000).The findings of this study support the results of Wagbatsome and Ogbeidae, 1995; Craig *et al*., 1999; Thomson and Connor, 2001; Mc Michael *et al*., 2003; Thomson *et al*., 2005a and 2005b that transmission of malaria varies by weather, which affects the ability of the main carrier of malaria parasites, anopheline mosquitoes, to survive or otherwise. Tropical areas including Nigeria have the best combination of adequate rainfall, temperature and humidity allowing for breeding and survival of anopheline mosquitoes. The burden of malaria varies across different regions of the world and even within a country. This is driven by the variation in parasite– vector–human transmission dynamics that favour or limit the transmission of malaria infection and the associated risk of disease and death.

The extremes of both low and high population density modify malaria transmission and have profound consequences for estimates of its public health burden (Snow *et. al*., 1999 and Robert *et al*., 2003). There is strong association between malaria incidence and type of house construction (Gamage-Mendis et al. In the present study it was noticed that prevalence of malaria was more in the villages having poorest type of house characterized by incomplete construction with thatched roofs and walls made up of mud in comparison with houses made up of bricks and cement. Further the incidence of malaria was more where number of persons living in a room was more (4 – 5 persons).The risk of malaria was found to be 2.5 fold higher for people living in poorly constructed houses than for those living in houses of good construction. In the present investigation the frequency of malaria was found more in persons whose houses were located near the swamps, river beds and agricultural fields. Frequency of malaria was found more in adult males, as they work in fields located near river beds or swampy areas, suggesting an occupational risk. Forest degradation, increased housing in the local forest and climate changes are strong influences on *Anopheles* populations (Paulo *et al*., 2011) Deforestation changes microclimates, leading to more rapid sporogonic development of *P. falciparum* and to a marked increase of malaria risk (Aw *et al*.,2008). Natural climatic disasters such as floods and cyclones may also have significant relationship with malaria outbreaks (Epstein, 2005). Flood is the regular feature of this zone causing outbreak of the malaria. Further these populations belong to low socio-economic group having very low literacy and as such they are unable to manage preventive measures against bite of mosquitoes and spread of malaria. The prevalence of malaria was found more in persons belonging to blood group O.

Thus the study clearly indicates that in addition to climatic factors, many other variables such as environmental modification (e.g. deforestation, increases in irrigation) blocked swamp drainage), pattern of settlement,, type of houses, population growth, socio-economic condition and limited access of health care system affect malaria transmission.

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