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EFFECT OF GLOBAL WARMING AND CLIMATE CHANGES ON VECTOR BORNE DISEASE, MALARIA IN SOME COASTAL DISTRICTS OF TAMIL NADU, INDIA

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ABSTRACT

Increase global warming and climate changes affect disease transmission by shifting the vector's geographic range and by shortening the pathogen incubation period in the children, the elderly and communities living in poverty. Severe climate sensitive vector-borne diseases are accompanied by increases in the incidence of the disease. The present investigation aimed to investigate regional analysis of malaria in some coastal districts of Tamil Nadu, India. Totally 120 samples were collected from both male and female (age range of 20 to 50 years) of during the period of monsoon (from September 2006 to November 2009) in Thanjavur, Nagapattinam and Cudallore districts of Tamil Nadu, India. Malaria was diagnosed by a thick film and thin film blood smears method. Later on blood smears were stained with 10% Giemsa stain and examined microscopically to identify the *Plasmodium* species. Malaria has reemerged as a major public health problem in India during the past few years. It out breaks was observed in certain regions of Tamil Nadu. Totally 120 samples were collected from both male and female (age range of 20 to 50 years) of during the period of monsoon (from September 2006 to November 2009) in Thanjavur, Nagapattinam and Cudallore districts of Tamil Nadu, India. 72 malarial infected individuals were identified. Out of 120 samples collected, 72 cases were malarial cases. Malaria is caused by protozoan parasite of the *Plasmodium genus* (*P. falciparum*, *P. vivax*, *P. ovale* and *P. malariae*) that develops to maturity inside certain species of mosquitoe, *Anopheles stephensi*. The samples contain only two species of parasites namely *P. falciparum* and *P. vivax* in different stages in the smears of malarial positive cases. Among 72 malarial cases, 42 male and 30 female identified. The maximum number malarial cases were observed in Cudallore than Thanjavur and Nagapattinam districts. Preventive measures like reduction of carbon dioxide, methane, nitrous oxide and burning of plastics and reforestation directly reduce the global warming which indirectly decreases many mosquito borne infectious diseases, especially malaria.

Keywords: Global warming, Climate changes, Vector borne disease, Malaria, Coastal districts, Tamil Nadu.

INTRODUCTION

The increase temperature of the Earth causes global warming and changes the climate. One of the biggest problems facing the world today is global warming. The global temperature is now 1°C higher than in 1900. Atmospheric concentrations of greenhouse gases, which include carbon dioxide, methane and nitrous oxide are increasing, mainly due to human activities, such as use of fossil fuel, land use change the agriculture (Watson *et al.*, 1998). It is estimated that average global temperatures will have risen by 1.0-3.5°C by 2100 (Watson *et al.*, 1996.), increasing the likelihood of many vector-borne diseases. The temporal and spatial changes in temperature, precipitation and humidity that are expected to occur under different climate change scenarios will affect the biology and ecology of vectors and intermediate hosts and consequently the risk of disease transmission. The risk increases because, although arthropods can regulate their internal temperature by changing their behaviour, they cannot do so physiologically and are thus critically dependent on climate for their survival and development (Lindsay and Birley, 1996). One of the biggest problems facing the world today is global warming. Many scientists believe that production of carbon dioxide and other greenhouse gases having heating effect on the atmosphere, and this could be very dangerous for human life. By 2100 it is estimated that average global temperatures will have risen by 1.0-3.5°C, increasing the likelihood of many vector-borne diseases in new areas. For many diseases these lie in the range 14-18°C at the lower end and about 35-40°C at the upper end. Climate-related increases in

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temperature in sea surface and land surface level would lead to higher incidence of vector borne diseases (Venkataramanan and Smitha, 2011).

Climate change is likely to change the frequency of extreme weather events, such as tropical cyclones, floods, droughts and hurricanes, and may destabilize and weaken the ecosystem services upon which human society depends. The greatest effect of climate change on transmission is likely to be observed at the extremes of the range of temperatures at which transmission occurs. For many diseases these lie in the range 14-18°C at the lower end and ca. 35-40°C at the upper end. Warming in the lower range has a significant and non-linear impact on the extrinsic incubation period (Watts *et al.,* 1987) and consequently disease transmission. Climate change is also expected to affect animal, human and plant health via indirect pathways: it is likely that the geography of infectious diseases and pests will be altered, including the distribution of vector-borne diseases, such as yellow fever, malaria and dengue, which are highly sensitive to particular environmental conditions, seasons and climates (Haines and Patz, 2004).

The World Health Organisation (2000) estimated the global warming due to anthropogenic climate change of the past 30 years. Many prevalent human diseases are linked to climate fluctuations due to altered transmission of infectious diseases. One of the many side effects of global warming may be the increase in the size and range of the disease-carrying mosquito species such as the *Anopheles gambiae complex, A. funestus, A. darlingi, Aedes aegypti, A. Albopictus, Culex quinquefasciatus,* etc. are responsible for transmission of most vector-borne diseases, and are sensitive to temperature changes as immature stages in the aquatic environment and as adults. If water temperature rises, the larvae take a shorter time to mature (Rueda *et al.,* 1990) and consequently there is a greater capacity to produce more offspring during the transmission period. The development rate of viruses, bacteria, protozoan and multicellular parasites (*Plasmodium* sp. *and Wuchereria* sp.) within vectors typically increases with temperature. The increase temperature could indirectly contribute to malarial, dengue and filariasis in tropics and subtropics countries.In warmer climates, adult female mosquitoes digest blood faster and feed more frequently (Gillies, 1953), thus increasing transmission intensity. Similarly, malaria parasites and viruses complete extrinsic incubation within the female mosquito in a shorter time as temperature rises (Turell, 1989), thereby increases the proportion of infective vectors. Warming above 34°C generally has a negative impact on the survival of vectors and parasites (Rueda *et al.,* 1990).

There is emerging evidence that, in addition to seasonal extreme climatic events, there is a general elevation of mean temperatures and, in some cases, precipitation (Carter and Hulme, 1999). For example, the mean rate of temperature change in Africa over the period

1901-95 was 0.39°C per century. Such changes are likely to support rapid development of malaria vectors and parasites in regions where there has previously been a low-temperature restriction on transmission.

Destruction of forests to create new human settlements can increase local temperatures by 3-4°C (Hamilton, 1989) and at the same time create breeding sites for malaria vectors. These phenomena can have serious consequences on malaria transmission in the African highlands. Since 1988, there have been numerous reports of malaria epidemics in east and southern Africa. For example, climate-linked malaria epidemics have been reported in Rwanda (Loevinsohn, 1994).

It is ever present in the tropics and countries in Sub-Saharan Africa, which account for nearly 90 percent of all Malaria cases. An increased risk of malaria due to rise in global temperatures was found in Africa for the past 25 years. The majority of the remaining cases are clustered in India, Brazil, Afghanistan, Srilanka, Thailand, Indonesia, Vietnam, Cambodia and China. It is responsible for over 300 to 500 million clinical cases and more than a million deaths each year. In Africa, it accounts for 25 percent of all deaths of children under the age of five (WHO, 2008).

Around the world, climate change is impacting human health from recent floods in India, Nepal and Bangladesh that have caused widespread waterborne disease that the U.N. attributes to global warming, to malaria-infected mosquitoes migrating to increasingly high elevations in the mountains of Africa. But over the past few decades, resurgence is being witnessed. Global warming is the one of the reasons for the resurgence malaria. Indirect effects of climate change on malaria might be important too; for example the effects of a warming climate on agriculture might cause people to migrate to urban areas, and this would affect transmission rates. In India, approximately 1.1 million positive cases were reported in the year 2000. Recent analyses have shown that El Niño events, triggered by large-scale changes in sea surface temperature in the Pacific Ocean and the western Equatorial Indian Ocean leading to climate anomalies, the malaria epidemic risk increases around five-fold (Russac, 1986).

The incidences of mosquitoes borne parasitic and viral diseases are most sensitive to climate. The development rate of parasites and pathogens within vectors typically increases with temperature and increase the rate of their development within the vector, thus producing more infectious bites per year. The increase temperature could indirectly contribute to more incidences of malarial, in tropics and subtropics countries. Increase global temperature affects the disease transmission by shifting the vector's geographic range and by shortening the pathogen incubation period in the children, the elderly and communities living in poverty. For example, the recurrent malaria epidemics which occurred in the Punjab have been related to excessive and failing monsoon rains (Venkataramanan and Smitha, 2011). In the wet part of Ceylon, failing monsoon rains caused rivers to pool,

creating more favourable breeding conditions. Climatic anomalies associated with the El Nino-Southern Oscillation

phenomenon and resulting in drought and floods are expected to increase in frequency and intensity. They have been linked to outbreaks of malaria in Africa, Asia and South America. The present investigation aimed to investigate regional analysis of malaria in some coastal districts of Tamil Nadu, India.

MATERIALS AND METHODS

After obtaining informed consent, totally 120 samples were collected from both male and female (age range of 20 to 50 years) of during the period of monsoon (from September 2006 to November 2009) in Thanjavur, Nagapattinam and Cudallore districts of Tamil Nadu, India. Malaria was diagnosed by a thick film and thin film blood smears method (Ginsberg and Staein, 2004). Later on blood smears were stained with 10% Giemsa stain and examined microscopically to identify the *Plasmodium* species.

RESULTS AND DISCUSSION

Malaria has reemerged as a major public health problem in India during the past few years. It out breaks was observed in certain regions of Tamil Nadu. Totally 120 samples were collected from both male and female (age range of 20 to 50years) of during the period of monsoon (from September 2006 to November 2009) in Thanjavur, Nagapattinam and Cudallore districts of Tamil Nadu, India. 72 malarial infected individuals were identified.

Out of 120 samples collected, 72 were malarial cases. Malaria is caused by protozoan parasite of the *Plasmodium genus* (*P. falciparum, P. vivax, P. ovale* and *P. malariae*) that develops to maturity inside certain species of mosquitoe, *Anopheles stephensi*. The samples contain only two species of parasites namely *P. falciparum* and *P. vivax* in different stages in the smears of malarial positive cases (Figure 1-2). Among 72 malarial cases, 42 male and 30 female identified (Figure 3). The maximum number malarial cases were observed in Cudallore than Thanjavur (Figure 4) and Nagapattinam districts (Sujatha, 2011). The effect of gender on malaria susceptibility varied from area to area and from season to season (Giha *et al.,* 2000).

The strong effects of El Nino on equatorial Pacific Ocean and Indian Ocean are likely to intensify the transmission of malaria. Human migration resulting from drought, environmental degradation and economic reasons may spread disease in unexpected ways, and new breeding sites for vectors may arise due to increasing poverty in urban areas and deforestation and environmental degradation in rural areas. Climate change will exacerbate these effects.

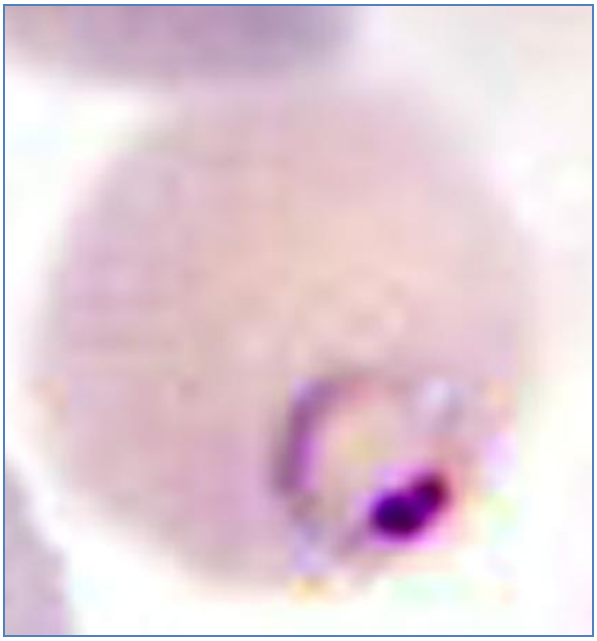

Figure 1. *Plasmodium falciparum*

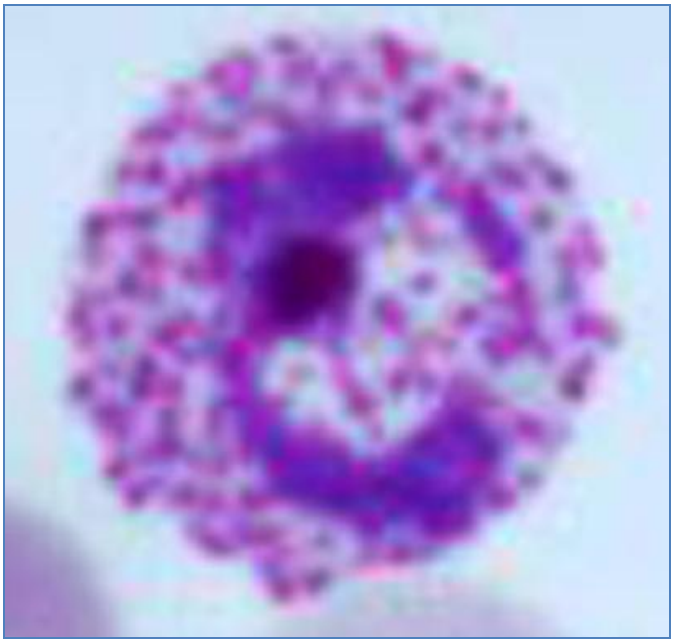

Figure 2. *P. vivax.*

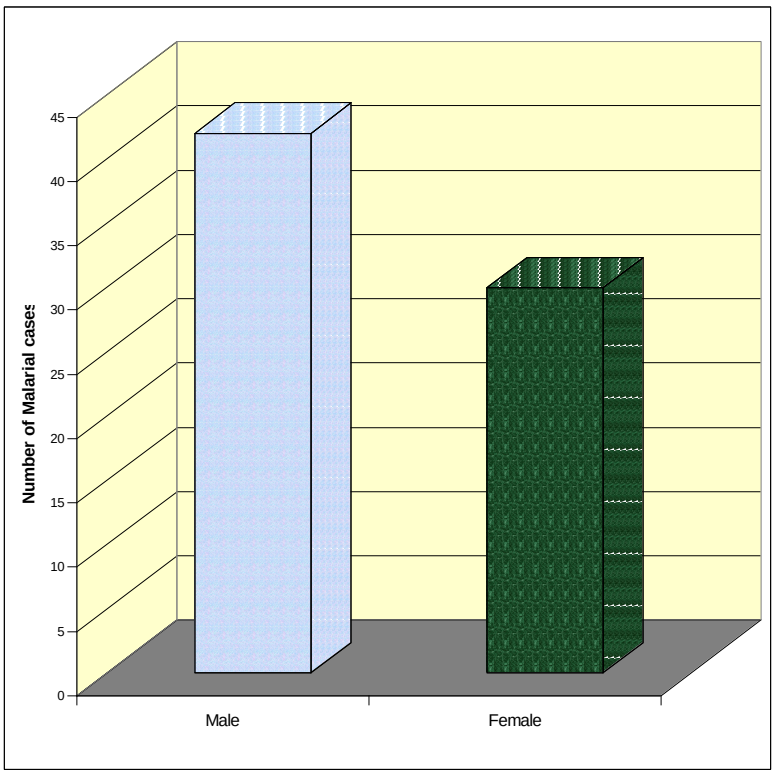

Figure 3. Histogram shows the malarial cases in male and female.

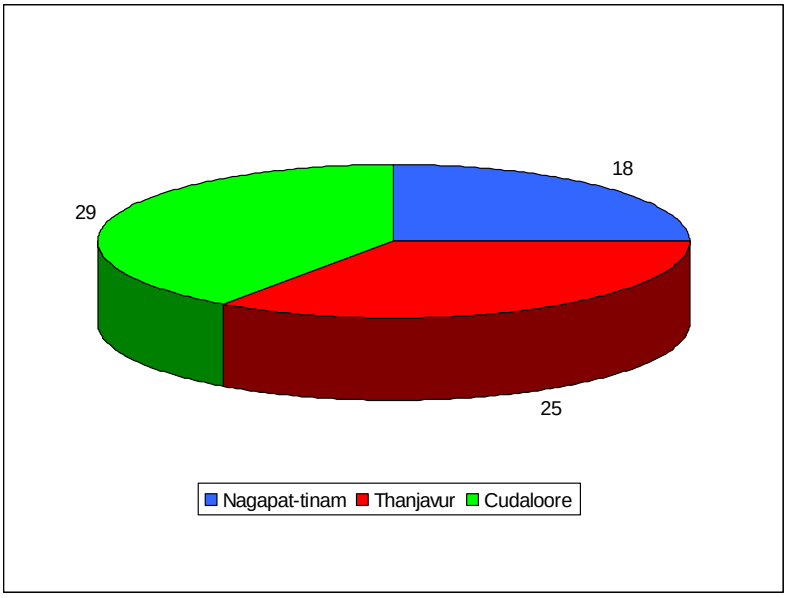

Figure 4. Pictorial diagram shows the malarial cases in some coastal pockets of Tamil Nadu.

CONCLUSIONS

Seasonal weather variation, socioeconomic status, vector control programmes, environmental changes and drug resistance and climate change are highly influence current vector-borne disease epidemiology. The climate change is emerging as one of the main challenges that humankind will have to face for many years to come. From a public health perspective, scientists anticipate that global climate change will have a range of impacts, mostly adverse, upon human health. Preventive measures like reduction of green houses gases like carbon dioxide, methane, nitrous oxide and burning of plastics and reforestation reduce the global warming, which indirectly decrease many mosquito borne infectious diseases, especially malaria.

It is certain that infectious vector borne diseases will have an increased impact on global health issues and their control will be a major factor in social wellbeing. Therefore, immediate management of climate-sensitive vector borne diseases is essential. Government plans to distribute mosquito nets to households in affected areas and

launch a public-education campaign. The present study provides baseline information to the future researchers to prevent and control the malaria.

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