



Research Paper

Urban Ecology and Resurgence of Malaria in Kolkata, West Bengal in India

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ABSTRACT: Kolkata is an important urban centre of eastern India. Urban environment is an anthropogenic set-up, developed by the interaction between the physical, biological and socio-cultural elements of the existing surroundings of a region. Urbanization is a man-induced dynamic process. Through which transformation has occurred in the natural environment. With the process of transformation man creates his own setup, called Urban Environment. Urbanization creates transformation not only in the geographical landscape but also into the behaviour of the inhabitants of the region. In the British period Kolkata remained as capital of India. Growth of the city was not followed any city plan. Kolkata is still growing haphazardly and the natural environment of this metropolis cannot cope with the speedy rate of alteration into it by the human intervention. As a result, there is deterioration in the quality of the land, water, air and other elements of the natural environment. Kolkata has identified now as one of the most polluted city in the world. Over population is the biggest problem of Kolkata. Due to the overpopulation Kolkata has suffered from shortage of open spaces, as well as green spaces and greeneries, shortage of quality water, inadequacy of municipal activates, traffic congestion and associated problems, and so on. Small Scale industries, specially the chemical industries are developed here side by side in the residential areas. These situations steadily deteriorate the quality of the environment of the city. The degraded environment helps to generate favourable ecological setup for the growth of disease causing microbes and the vectors (carriers) in the city and its adjoining areas. Unwanted alteration of the physical environments by the city's pseudo urbanization along with negligence and ignorance of the society increases the rate of attack by different infectious and parasitic diseases in Kolkata. Biologists are claiming that disease causing parasites are continuously changing the nature of attack by their genetic mutation. As a result attack and death by different infectious and parasitic diseases are now arising as serious health problems of Kolkata. Before independence Bengal delta was the endemic zone of Malaria. After independence Malaria, was eradicated from the land by the systematic eradication measures taken by the Central and State Governments. But it is resurging again in a furious manner since mid seventies. At present malaria creates serious health menace in the disease scenario of the city.

Objective: The work is an attempt to present an overview of the nature and causes of the resurgence of Malaria in Kolkata.

Methodology: Collection of secondary data from School of Tropical Medicine, Kolkata, ID & BG Hospital, Kolkata, offices of Kolkata Municipal Corporation, State Bureau of Health Intelligence, Government of West Bengal. Collection of Primary data by field survey. Application of statistical and techniques and excel work for final illustration and completion of the analysis are the methodologies on the basis of which the work has been developed.

Key Words: Malaria, Resurgence, Tropical diseases, Urbanization, Unwanted alteration.

I. Introduction

Kolkata is situated in the Bengal Delta region of India which is hub of different Tropical Diseases. Tropical diseases are infectious and communicable in nature. These are developed by the entry of disease causing parasites into the healthy human body. The means of transmission of these diseases are different. Some being transmitted directly from one person to other, while others pass through one or more intermediate carriers, called vectors. But the generation and also the spread of infection must be supported by the optimum environmental conditions for transmission of pathogens.

The hot and humid environment is congenial for spread of different infectious diseases. Kolkata is a vulnerable zone for the attack of various infectious and communicable diseases. Risk of this attack is aggravated with the unwanted alteration by the accelerated rate of human intervention into the physical environment. Urban set-up of Kolkata is controlled by the human being to fulfill their different needs like construction of houses, high rise buildings, roads, industries, markets, business, and commercial units and so on. Rapid population growths in the cities and towns are the major characteristic features in India since 20th century. In general urban development provides the opportunities of higher standard of living, education, housing, cultural satisfaction, and public health. People prefer to dwell in cities and towns in search of their livelihood and also getting the facilities of other higher standard of living. Rapid increase of the population creates the problem of overpopulation. An associated problem of population congestion develops serious stress on the carrying capacity of the physical and socio-cultural environment of the urban areas. As a result degradation of urban environment has now become one of the most challenging problems in Indian cities like Kolkata. Where the environment is sufficiently saturated with complex chemical emissions, aerosols, toxic effluents, sewage, pesticides, solid wastes, polluted rains and surface runoff, dusts, and radiation. (Saxena, Khan). That deteriorates the quality of the natural environment. This has changed the natural habitat which is responsible for generation of new infectious and communicable diseases like Japanese Encephalitis, Hepatitis, Gastro enteritis, Swine flu etc and also resurgence of some eradicated infectious diseases, for example Malaria, Kala-azar, Dengue, Chikungunia in the city of Kolkata.

II. Disease Ecology

Ecology denotes the relationship between organism to organisms of the same communities, different communities and the relationship between organisms with the prevailing environment. Natural environment is the creator of the disease causing microbes as well as vectors. The anthropogenic set up can facilitate the growth of these organisms with the deterioration of the quality of the environment on the other hand can control the growth of these organisms by different preventive measures. In this way disease ecology of an area is controlled both by the natural setup and also by the cultural setup.

2.1. Elements of Physical Environment of Kolkata:

Different physical elements influence the disease ecology of Kolkata. Climate is considered the most important one in this matter. Annual mean temperature of Kolkata is 24°C. In the dry spell temperature often exceeds 40°C. Kolkata receives 1,582 mm rainfall annually (IMD). Highest rainfall occurs in the monsoon season. Any change in temperature and humidity conditions over time and place may create optimum conditions for the propagation of different diseases caused by microbes and the carrier-insects. With the increase of temperature and humidity in the atmosphere microbes are activated. So the attack and death by different infectious fevers attain their highest maxima in Kolkata during the monsoon and post-monsoon months.

The city is characterized with alluvium soil which has high water retaining capacity and remains damp for long time. The organic body remains and the damp soil provide ideal conditions for the growth of micro organisms and the vectors responsible for spread of diseases.

Originally Kolkata is the hub of the Monsoonal Deciduous forests/ plants. Those plants are the good shelter for different native faunal communities of the area. Due to huge tree felling in the want of urban land use Kolkata is now furnished with planted trees. Kolkata Municipal Corporation now planted ornamental plants in the dividers of the road as a part of their beautification programme. But that helps to increase the breeding ground of some insects. There is the possibility for the migration and also extinction of native animal communities by the destruction of their habitat. And in the same time new species may appear by getting favourable ecology, developed by the alteration of the environment by anthropogenic activities of the region.

2.2. Socio-Cultural Elements of Kolkata:

Population is a dynamic element of nature. Man has changed the natural environment with the help of science and technology and created an environment where he becomes fall prey to different infectious and communicable diseases every year. The rapid growth of urban areas adjacent to this metropolitan city has also encouraged different infectious diseases to spread easily and sometimes go beyond control by the intervention into the natural drainage, waste disposal into the water bodies and rivers etc. .

2.2.1 Population Density --

There 4.5 million people were living in Kolkata in 2011. Influx of refugees from the East Pakistan, present Bangladesh was one of the important causes of the increase of population here. Kolkata is a prime city in the eastern India. It attracts thousands of people from the surrounding districts, states and the countries like Bangladesh and Nepal. Current population of Kolkata in 2016 exceeds 5 million. Negative economic pressure like landlessness, lack

of employments, poverty and hunger push the poor villagers towards Kolkata to get livelihood. They are vulnerable section of population of the society, get affected by different health hazards. A section of people belongs to middle or higher income groups of the outside areas are used to come to enjoy the amenities of urban and modern life of the city. These are the major causes of increase of population along with the natural growth of Kolkata. The poor people have to take shelter in slums or bustees areas of Kolkata. 1.5 million People were residing in the slums areas in 2011. There are 2011 registered and 3500 unregistered slums which covers only 10 percent areas of Kolkata.

Table 1. Density of Population in Kolkata since 1971- 2011

1971	1981	1991	2001	2011
30,276	31,651	23,670	24,718	24,760.

Source; Census of India

Kolkata has an alarming density of population. As the city is one of the largest commercial and trading centres of the eastern India; it provides job opportunities for the unskilled youth of the eastern region; they move to Kolkata and engage themselves in different informal services and live mostly in slums. This has been revealed that one – third of the city- population lives in slum areas. A section of the migrants live as pavement dwellers. Approximately Kolkata has 38000 pavement dwellers (in 2011). A good communication linkage encourages daily commuting that has too overburdened Kolkata’s transportation system and other municipal facilities.

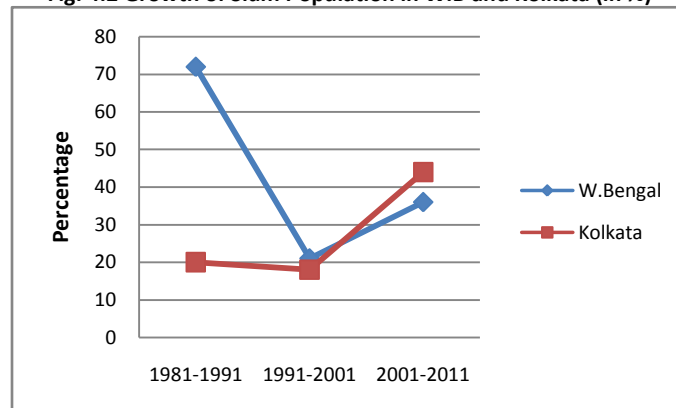
Apart from physical environment, the propagation and proliferation of the infectious fevers are caused by poor economic status of the population. Economic status is inversely related to incidence of infectious diseases. There is a vicious circle of poverty which plays a leading role to aggravate infectious diseases in Kolkata. **Like Poor income - > poor intake-> malnutrition ->adverse effect on immunity system -> prey to attack of different infectious diseases -> ill health->Poor income.**

2.2.2. Living Conditions Congenial for Infection:

As of 2011, 1.5 million resident of Kolkata lived in Slum areas. There are about 3,500 unregistered squatter and 2,011 registered slums are there. The authorized slums of the city have access to basic services like water, latrines, trash removal by the Kolkata Municipal Corporation. Slums are also been broadly divided into other two groups— (a) *Bustees*, in which slum dwellers have some long term tenancy agreement with the landowners; and (b) *Udbastu colonies*- settlements which had been leased to refugees of East Pakistan.

A slum is a plot of land with collection of hut without any size being specified. Scarcity of space becomes most acute amongst the slum and bustee dwellers. Slum areas are suffered from minimum hygienic level. This situation is congenial to develop different types of infectious and parasitic diseases amongst the vulnerable urban poor like malnourished, elderly people and children. That gradually spread infection from the affected person to healthy people. Unauthorized slums are suffered from the basic services, provided by the municipal corporation. Squatters are developed by encroachment of lands specially along the canals, railway lines and roads sides of the city.

Fig. 4.2 Growth of Slum Population in W.B and Kolkata (in %)



Source: Computed data, collected from Ministry of Home Affairs, Govt of India

Besides, ill- ventilated and dark poor houses with low or without sanitation facilities provide ideal resting places for both the parasite and mosquitoes. The infected people spread the disease to others. The diseases spread quickly in slums and unhygienic part of the city and even it has also been found that these disease also attack planned areas such as Salt Lake where mostly high income people live.

2.2.3 Pavement Dwellers:

Pavement dwellers are those ‘homeless people’ who stay everywhere where ever it is possible. They are living without having any land ownership, in the Kolkata Municipal Corporation. They live somehow near road crossing, under the road side, corner of the parks, corner of retail markets, bus shed, under buses or trucks, on the over bridges, into the concrete pipes lying down along the road side, under cable rolls lying on the road. Pavement dwellers are associated problem of the urban development in four major capitals of India, Delhi, Mumbai, Chennai and Kolkata.

2.2.4 Malnutrition:

In the time of field investigation it is found that average food intake of the slum population is far from being a balanced one due to poverty or by the habit of unscientific dieting. Poor people mainly depend on high carbohydrate, marginal intake of protein, while vitamins and minerals fall far short of the desirable levels. So the deficiency in diet is not only quantitative but also qualitative. Continuous consumption of imbalanced diet exposes the people to malnutrition. Nutritional deficiency diseases are mostly associated with the vulnerable segments of people like pregnant women, infant, children and nursing mothers. Under nourished body has less immunity to fight against the diseases. So they are generally suffered from different types of infectious diseases which make them more anaemic and malnourished.

Malnourishment of the women creates a serious problem health problem in the city. Women play a pivotal role in the family. Health statistics of Government of West Bengal clear that there are 74 lakh persons are suffered from acute malnutrition. 13 lakh are pregnant women and remaining 61 lakh are children. Malnourished are become the victim of anaemia, different types of infection and other diseases. Women should consume around 2000 calories and men should 2200 calories per day for their good health. In the time of primary survey it is found that average family size of the slum household is 5 to 10 members. Early marriage is the other cause of the malnourishment specially in the women of poor economic class. Malabsorbtion and unscientific dieting are the other causes of the malnourishment. These are other causes of malnourishment associated with middle and higher income group.

3. Malaria and Its Regeneration in Kolkata;

Malaria is a tropical disease, widespread in tropical and subtropical regions. It is a mosquito- borne disease caused by parasites of the genus Plasmodium. It develops with the bite from an infected anopheles (vector) mosquito. Four common types of malaria in Kolkata are 1 *Plasmodium Falciparum (Malignant type)*, 2. *Plasmodium Malariae*, 3. *Plasmodium Ovale* and 4. *Plasmodium Vivax*. . Typical symptom of these diseases is fever with chills and headache, in severe case it progress to coma and death. Bengal delta is an endemic zone of malaria in the early years of the 19th century. India has a long history of attacking malaria. Official statistics suggest that *P. falciparum* accounts for about 50% of the clinical cases of malaria in India (Learmonth & Akhtar).

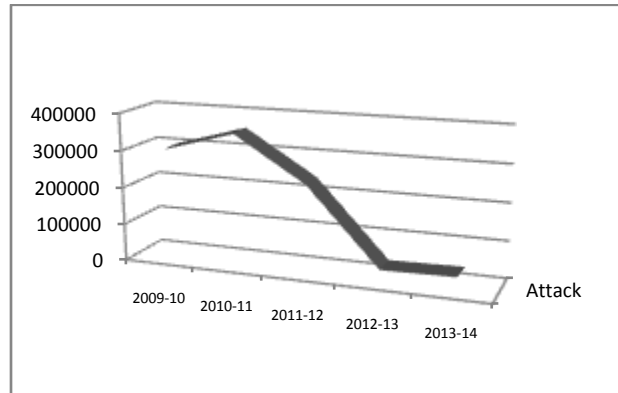
Table 1. Share of Malaria Attack of Kolkata in West Bengal from 2007 -2015 (in %)

2007	2008	2009	2010	2011	2012	2013	2014	2015
37.95	38.99	61.91	71.73	64.37	58.54	48.47	37.06	52.42

Source: Directorate of Health Service Govt.of W.B. and KMC

After independence malaria was said to be eradicated with the first comprehensive Malaria Control Scheme with residual insecticides (DDT) and indoor -residual spraying scheme up-to 1952-53. In 1953-54 the State Govt. adopted the National Malaria Control Programme in collaboration with the Government of India and the United States helped to eradicate the malaria from West Bengal. These programmes were originally very successful in India and had brought malaria near elimination by 1961. After 1970, malaria is gradually resurging in West Bengal. In 1985 there about 46,510 were affected by malaria in southern districts of West Bengal. Of which 17 persons were died in that year. Fortunately, with the help of medical care death incidence of this disease becomes negligible in Kolkata and also in India (De M).

Fig 1 Attack of Malaria in Kolkata Since 2009 to 2014



Source: KMC & State Bureau of Health Intelligence, DHWB,2016

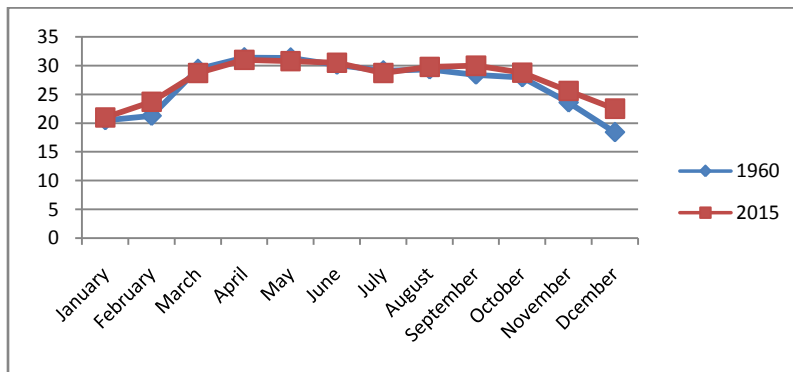
4. Causes of the Resurgence of fevers in Kolkata:

4.1 Climate Change: Kolkata is becoming a heat island by the alteration of the natural environment by the development of the urban environment. Kolkata is situated in the hot and humid tropical climatic region in India. The climate become hot and humid during the summer and it becomes pleasant in winter. April and May are the hottest months where as December and January are the coldest months of the city.

With the rapid as well as unplanned urbanization along with industrialization, changing nature of tertiary activities and above all by the population explosion drastic changes has taken place in the physical environment of Kolkata. According to the recent assessment of World Health Organization Kolkata gets the fourth position in the most polluted cities of the world. Density of population per square kilometer was 24,806 in 2011. Now it would be exceed 30,000 per square kilometer. One third of the total population is residing in the slum areas. Density of population here sometime exceeds 100,000 populations per sq. Km. Slums are the major pollution generating units of the city. Causes of the deterioration of the natural environment of the city has already discussed in previous chapters.

From the figure 2 [below] it is observed that the average monthly temperature conditions of the city is remained more or less same from months of March to August in both the years. But it shows evidential increases from the month of September to February in 2015.

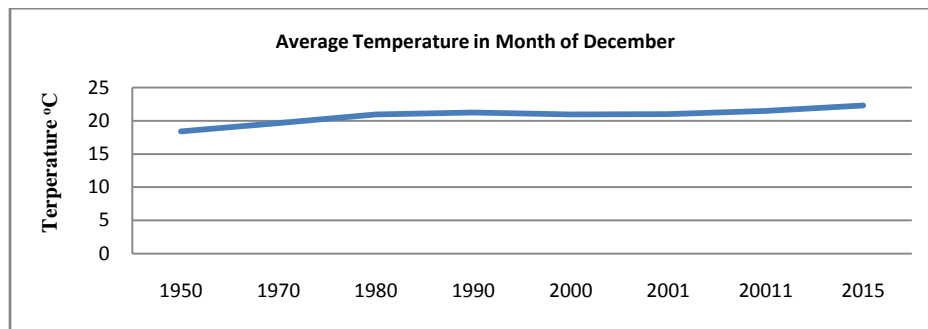
Fig.2. Monthly Average Temperature Conditions of Kolkata City in 1960 and 2015⁰c



Source: : India Meteorological Department, Eastern Region, Kolkata

It is evident from the Fig 3 that the mean monthly temperature in the month of December is showing an increasing trend from 1960 to 2015. In 1960 average temperature of December was 18.39°C in Kolkata. There after a sharp increasing trend has been set in. The average increase of temperature between 1960 to 2015 is 3.91°C. It is a local warming, mostly generated by the anthropogenic causes. In the last few years Kolkata experienced mild- warm winter and severely hot—humid summer. It is become a heat island mostly 7 days to 10 days in a year the residents of Kolkata experience the child condition in a winter season. This creates an alarming situation not only for the city population but also for the adjoining areas of Kolkata. Most sufferers of this ‘heat island effect’ is observed on the local biodiversities. The friendly species are giving place to the parasitic harmful species. Because the harmful species of parasites have abilities to adjust with the harsh environment. As a result the urban ecology of Kolkata creating a negative environment not only for its biosphere but also for the human communities of Kolkata.

Fig 3 Rising Average Temperature in the Month of December, since 1960- 2015



Source IMD, Eastern Region, Kolkata

Water Vapour is one of the important Green House Gases which trap the outgoing solar radiant energy and helps to increase the air temperature. The share of relative humidity of atmosphere is also showing an increasing trend in the recent period of Kolkata. Climate change has the potential influence on the biological systems of the earth. Though the effects of climate change on human health are not well defined. Developing nations with limited resources are expected to face a host of health effects due to climate change, including vector-borne and water-borne diseases such as malaria, cholera, and dengue.

4.2. Other Factors:

Infectious disease distribution involves complex social and demographic factors. These include human population density and behaviour, housing type and location, water supply, sewage and waste management systems, land use and irrigation systems, availability and use of vector control programmes, access to health care, and general environmental hygiene. Meteorological factors that influence transmission intensity of infectious diseases include temperature, humidity, and rainfall patterns. Social and demographic factors such as population growth, urbanization, immigration, changes in land use and agricultural practices, deforestation, international travel, and breakdown in public health services have been mainly responsible for the recent resurgence of infectious diseases. The Intergovernmental Panel on Climate Change noted in its 2007 report that climate change may contribute to expanding risk areas for infectious diseases such as dengue and may increase the burden of diarrhoeal diseases, putting more people at risk.

From one report of Health Department, Government of West Bengal about 30 percent of the women and 18 percent of the men in Kolkata are obese. Kolkata has the highest percentage (55 percent) of women who are having anaemia among the surveyed cities, while 20 percent of the men in Kolkata are anaemic. Large number of people suffers from diseases like diabetes, asthma, goiter and other types of thyroid disorders. Tropical diseases like malaria, dengue and chikunguniya are prevalent in Kolkata, though their incidence is decreasing.

Global climate change is a phenomenon that is now considered strongly associated with human activities. Atmospheric carbon dioxide levels, which have remained steady at 180-220 ppm for the past 420,000 years, are now close to 370 parts per million [ppm] and rising. Due to improvements in meteorology, we are now able to better understand long-term changes in climate. Natural and the urban environments are becoming congenial to generate different infectious diseases in Kolkata. No specific causes for the resurgence and the growth of these fevers have been identified so far. Outbreak of different infectious diseases in Kolkata may be associated with the following facts:-

4.1. Growth of Slums and Unhygienic Condition-

Over population is considered as one of the major causes of the deterioration of environment and increased morbidity and mortality rate of different infectious and communicable diseases in Kolkata. Most of the slums of the city are suffered from the basic amenities like pure drinking water, concrete drainage/sewerage system, street light garbage disposal facilities etc. Where density of population is very high, sometimes 10,000 persons per sq.km. One dwelling unit is often shared by more than 5 to 10 members of a family. These dwelling units are multifunctional. Most of these are unhealthy. These units are not airy and devoid of sunlight and as a result not ideal for human living. Most of areas are waterlogged during heavy rainfall and one third of which remain damp throughout the year. The slums of low- lying areas like Kadapara, Nawapara, Bantala, Kalabagan, Tollygunj, Jadavpur, Kalighat etc are the endemic zones of different infectious diseases which spread the disease to other parts of Kolkata Metropolitan area. Once a person is being affected by any type of infection he/ she have spread the infection to the people who are coming in contact with him/her regularly and also by the vectors.

4.2. Pressure of Uncountable Population:-

There are about 138,000 and more uncountable population of Kolkata. They are comprises of pavement dwellers and daily commuters. Besides, there are some people who are stayed at rental houses, mess, and hostels, are not registered themselves as the residents of Kolkata and also not considered in the time of counting of population. But they are regular user of the infrastructural facilities of the city and also take part in the unwanted alteration of the environment of Kolkata. Apart from that commuters acts as carriers of infection both from their affected residential areas to Kolkata on the same way carry the infection from Kolkata to their home districts.

4.3. Non functional Natural Drainage System

It is observed that overcrowded low-lying badly drained areas suffer more severely by the infectious diseases than the well drained areas. Kolkata is situated on the eastern bank of Hooghly River and its general slope is towards the east. The outlet of the main drainage channel is gradually being silted up which causes acute water logging problem in the city. The eastern part of the city is bounded by the marshy tract, named Salt- Lake and part of which has been reclaimed for the human settlement long way back. This creates obstruction in the surface flow during the time of heavy rain. This problem has been further aggravated by the unplanned urban expansion, construction of new roads, high-rise housing complex, buildings, hotels, etc along the eastern and the southern fringes of the city, blocking the former out fall channels. Encroachments of water bodies have made the natural drainage non functional that was previously existed.

4.4. Old Sewerage System

The metropolitan sewerage system was originally designed to serve one million people or slightly more than that. Despite the improvement of the sewerage system about 40 percent of the city still remains without proper sewer facilities. Multistoried housing complexes create additional burden on the already choked sewers.

4.5. Health ,Nourishment and Food habit

Above 50% of the total population of Kolkata is poor. Naturally their regular food intake is far from balanced diet. Their daily diet is consisted of carbohydrate along with small amount of protein. As a result there is considerable deficiency in vitamins and minerals. So a large section of the population like children, aged persons and pregnant woman become malnourished and susceptible to various diseases easily.

V. Conclusion

In 1998 WHO, the World Bank and several charitable organizations launched the Roll Back Malaria (RBM) Partnership, a global initiative that coordinates actions against malaria. Asymptomatic infection mainly by *Plasmodium falciparum* is an important obstacle to reach the goal. Asymptomatic carriers do not seek treatment for their infection and, therefore, constitute a reservoir of parasites and creates a real public-health risk. Disease causing microbes are becoming resistant to the drugs and vaccine with the mutation of their genes. It is found (in few cases) that *Plasmodium Vivax* (less fatal) has turned into Cerebral Malaria (deadly) through genetic mutation. If it becomes true then malaria would be appeared as more serious health hazard than the present condition in near future in Kolkata. But it is too early to come to a conclusion in this matter.

The attack of Malaria can be checked by constant attention and comprehensive control schemes, adopted by different departments particularly the health departments, and Municipal Corporations. They must be careful about the sanitation, spraying insecticides to disinfect the places to protect their localities from different infectious fevers and other types of infectious diseases. Government arrangements should have to be more active to send life saving medicines to all the government and private health units to fight against these diseases from Kolkata and also from West Bengal. There is an urgent need to build up a data bank by Kolkata Municipal Corporation authorities in this regard which will be helpful to manage and control such type of diseases in future. Awareness generation into the population regarding the disease generation, symptoms and controlling measures may help to reduce the rate of attack of Malaria in Kolkata.

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Kolkata is suffered from population congestion. Density of population of the city in 2011 was 24.760/ sq. km. One – third of this population lives in slum areas. Living spaces of the poor quarters of the city are cramped and unhealthy in nature. According to one estimate of the Kolkata Municipal Corporation there 38000 people were lived in Kolkata as pavement dwellers. More and more people are coming to the city in search of jobs and their demands to utilize the civic amenities of the city. Beside these more than 1 lakh commuters commute from their home lands to the city for their jobs and other activities like business, work as casual laboureres, beggars etc. This population provide extra burden on the ecology of the city. The situation naturally creates an unhygienic environment for its citizens. Natural environment, specially the hot and humid climate with high water holding capacity of the alluvial soil of Bengal delta make the region an endemic and epidemic zone of several infectious and communicable diseases of India.