Trans. Inst. Indian Geographers
Vol. 29, No. 2, 2007

Malarial Incidence in Mangalore City – A Geographical Analysis

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Abstract

Mangalore is a prominent port city of Karnataka and is known for administrative, commercial, educational and industrial activities. The city is developed on the banks of the river Gurupur in the north, river Nethravathi in the south and the Arabian Sea in the west. It experiences tropical moist climatic condition with maximum rainfall by monsoon winds.

Due to the growth of industrial activities and commercial activities the population of the city has multiplied by many times and the urbanization process also becomes at its fastest ever. This process of urbanization and population growth influences both positively and negatively on the nature of the "city environment". In Mangalore after the inception of the malaria eradication program in 1976, the incidences came to a very lower level. However, in recent years malarial incidences are increasing at an alarming rate, i.e., 3739 positive cases in 2002 and 5207 positive cases in 2003. It has posed a serious threat to the health care and health services of the city administration. It is assumed that the urbanization, industrial activities and its related activates are strongly responsible for the worst situation created due to the increase in malarial incidences in the city. To tackle the problem efficiently it is essential to understand the spatial, seasonal character of the malarial incidence, in relation with demographic variables (such as age, sex, and occupation), and the better knowledge about the geo-medical factors are very essential.

Introduction

Malaria is a communicable disease caused by "sporogoon" parasites of the genus 'plasmodium and transmitted to man by certain species of infected, female anopheline mosquitoes. The disease is characterized by periodic chills and fever. It is established that malaria is a tri factor complex involving man as host, anopheles mosquitoes as vector and plasmodium as the causative agent.

In Mangalore culicifacies, fluviatilis, Stephensi are regarded as primary vectors. Stephensi stand first ranking vector in respect of malarial incidence in the city. Malaria is transmitted by the bites of certain species of infected female, anophaline mosquitoes. The mosquito is not infective unless the sporozoites are present in its salivary glands (Park 1985). Malaria in man is caused by four species of the malaria parasites like P. vivax, P falciparum, and P Malariae and P. ovale. In Mangalore infection is more due to P. vivax (about 81 percent) and due to P.faliciparum (19 percent).

Malaria was regarded a major public health problem in many parts of India, Mangalore is not exceptional to this. After implementation of malaria eradication programme the Malaria incidence and

mortality caused due to malaria has significantly came down. However, in recent times the rate of malarial incidence in Dakshinna Kannada district is at an increasing fashion. The similar trend also prevails in Mangalore, the costal city of Karnataka. It is assumed that the trend is prevailed due to the natural and cultural factors like physiography, location, relief, water bodies, population increase, urbanization, industrialization, and migration.

Study Area

The historical records prove that Mangalore existed even before 2076 B.C. The city derives its name from antique temple of 'Mangaladevi' the goddess of luck. Mangalore is one of the fastest growing and the major port city of Karnataka. It is also a district headquarters of Dakshina Kannada. The city has developed to its present stage after the establishment of all weather port by the government of India during 1974. The Mangalore port area is humming with activity of considerable economic significance and holds the promise of generating an atmosphere which would change the physical structure of the city as well as the region. Further, the setup of Mangalore Refineries and Petrochemicals Ltd., (MRPL) and the Commissioning of Konkan Railway had given maximum impetus for the growth of Mangalore city. The city is an administrative, commercial, educational and industrial centre. These activities and consequent influx of population has resulted in several problems, among them the health services and health care is becoming the most serious problem to the city administration.

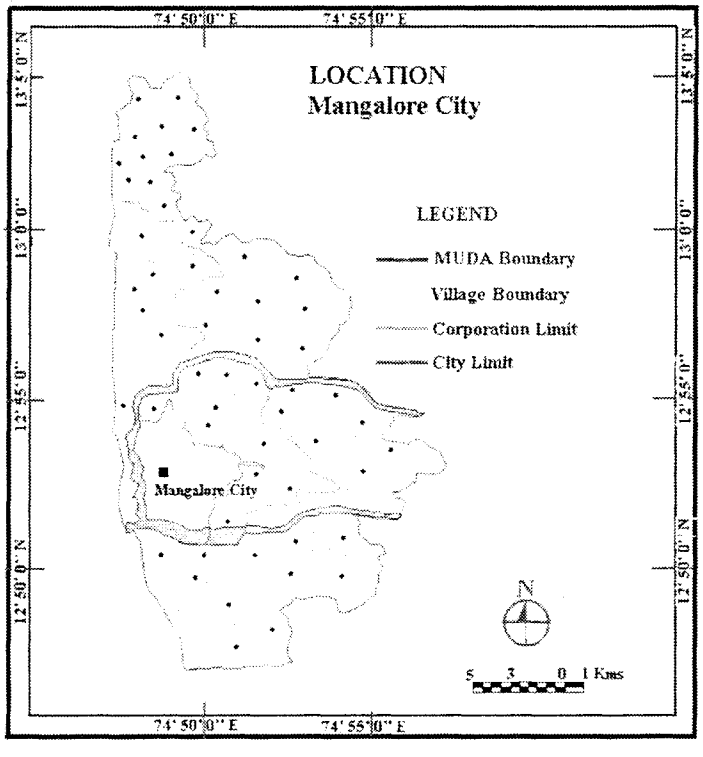

Fig. 1: **Location Map of Mangalore City**

Mangalore city has developed at the confluence of the two legendary rivers called the Nethravathi and the river Gurupura (Fig 01). Latitudinally the city extends from 12^0 51' 0" North to 13^0 2' 15" North and longitudinally from $74^0$48'0"East to $74^0$54'30 East. Total geographical area of the Mangalore city (corporation area) is 117.67 Km^2 with a population of 3.98 lakhs according to 2001 census.

Objectives

The present research paper confines itself to

a. Understand the spatial distribution and seasonal distribution of malarial incidence in Mangalore city.
b. Find out the geo-medical factors responsible for the malarial incidence despite the efforts made by the city administration to tackle the malarial incidence.
c. Relate the malarial incidence with various demographic variables.

Methodology

The spatial and demographic information of malarial incidences are not available in the Malaria control cell, Mangalore City Corporation. Therefore, the spatial and demographic information of malarial incidences have been compiled with the help of the residential addresses maintained in the Registers of the hospitals, Nursing homes and medical labs. The monthly malarial incidence information has been collected from the malarial control cell, Mangalore City Corporation for the year 2002 and2003. With this information, a simple percentage of malarial positive cases to the total blood smear collected have been worked out every month.

The above information are compiled and analyzed with simple statistical and analytical methods. Suitable maps, graphs and charts are prepared to represent the spatial and seasonal distribution of malarial incidence. The researcher also made personal observation and field survey to gain the ground reality.

Malarial Incidence in Mangalore-Spatial Pattern

The locational factors and climatic factors of Mangalore and its environs are most ideal (table -02, fig-01) for the process of malaria transmission. In the year 2003, 5207 malaria positive cases were found in Mangalore city. However, the number of malarial incidence is not similar in all the regions. Based on the number of malaria positive cases recorded, a choropleth map has been prepared to represent the spatial distribution of malarial incidence. (Fig. 02).

In southern parts of the city maximum numbers of malarial incidences were recorded. The area like urva, kodialbail, falnir, Car Street, Kasababengre, Mangaladevi and Jeppu are the worst effected areas where more than 350-662 positive cases of malaria were recorded in the year 2003. (Table-01) Among these places the first ranking area was Mangaladevi, Jeppu and Attavar area where more then 662 positive cases registered. In the previous year the same areas registered 490 positive cases and it was maximum for the previous year also. The Urva area comprising kodikal, urva church, lady hill, Ashokanagar, Boloor, Mannagudda and Kambla new road ranks second with 644 positive malarial incidences during the year 2003.

The spatial distribution pattern of malarial incidence clearly indicates that the south and south western part of the city is worst effected area. The region is comparatively low lying area and the region is situated on the banks of the river Nethravathi. This topographical character is one of the dominant factors (water bodies, agricultural land and open space)

Table 1: **Spatial Pattern of Malarial Incidence-Mangalore-2003**

Sl. No.	Locality	Name of the Area	No. of Malaria Positive Cases-2003
1	Kunjathbail	Kuloor, Kuloor-Kavoor Road, Panjimogru	320
2	Derebail	Kottara Chowki, Gandhinagar, Derebail, Kuntikan, Konchady	130
3	Shaktinagar	Shaktinagar, BikarnaKatta, Yeyyadi, Kulashekara-Nantoor Road	110
4	Urva	Kodikal, Urvachurch, Lady Hill Ashoknagar, Boloor, Mannagudda	644
5	Bejai	Kadri, Mallikatta, Nantoor, Bejaichurch areas and Pinto lane	143
6	Kodialbail	Bus stand.(K.S.R.T.C.) Lalbagh, Kodialguthlu, Bunts Hostel, Canara college Road, PVS Junction	637
7	Falnir	Kankanady, Bendoor Well, Balmatta, High land, Kaprigudda, Shivabagh	523
8	Carstreet	Kudraoli, Car Street, Alake, Dongarakeri, Hampanakatta, Bunder Road, Venkataramna Temple, Rosario Church Area.	464
9	Kasaba bengre	Bengre Kasba and North Sand Pit	320
10	Mangaladevi and Jeppu	Pandeshwara, Mangaladevi, Jeppu, Hoige bazaar, Monkey Stand	662
11	Milagres and Hampanakatta	KMC hospital, Light House, St. Aloysius College, Hampanakatta Milagres Church Area.	140
12	Bajal	Bajal, Adyar, Jeppinamogaru, Jeppu bappal, Alape, Padil	160
13	Kankanady	Fr. Muller hospital, Light house Roshni Nilaya, Gorigudda, Pump Well Circle, Sooterpet	314
14	Kottara	Urva store, Kottara, Kottarachowki, Bengrakuloor	160
15	Bondel	Kavoor KEBarea, Bondel Church Area, Pachanady	162
16	Panambur	Panambur, Baikampady, Tannir Bavi, NMPT Area , Suratkal	318

Source: Compiled by the researcher from the records of the government and private hospitals and nursing homes, Mangalore 2003.

influencing high Malarial incidence. Further the pattern of land use in these regions is also responsible for this pattern. The older and core areas of Mangalore city have

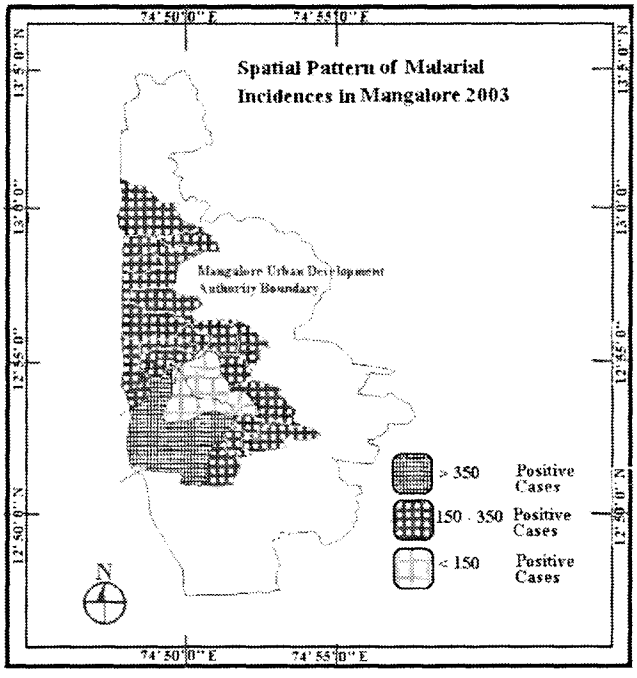

Fig. 2: **Spatial pattern of Malarial Incidence in Mangalore 2003**

comparatively registered more number of malarial incidences to their neighbors or their counterparts. This is very well evident from the figure (Fig. 02) that the maximum numbers of malarial incidences occurred in Mangalore city, particularly in the older settlement region. This phenomenon is probably due to the higher population concentration in the region, failure of city administration and the publics in respect of maintaining good civic amenities. The open wells, the uncovered over head tanks, multistoried construction sites, haphazard market centers, unscientific waste management etc; lead to the creation of "focal points" for breeding mosquitoes.

Therefore, these factors are very much responsible for the maximum occurrence of Malaria cases in Mangalore city.

The moderate Malarial incidences, i.e.; between 150 to 350 positive cases during the year 2003, were found predominantly in the northern part of the city right from Suratkal in to Kasaba Bengre and north sandpit which is, lower elevation region of the coast. Further, the similar trend can be observed on the eastern margins of the city starting from Jeppina mogaru to Kunjathbail and Panjimogaru. These regions are comparatively less Urbanised and the population is less.

The natural factors like open spaces, low lying areas, agricultural lands, water bodies are responsible for this kind of distribution. In between high and moderate malarial areas a low incidental area can be observed, where less than 150 persons were reported to be Malarial positive. The places like Derebail, Shaktinagar, Bejai, Milagres and Hampanakatta belong to this category. Among these places, Milagres and Hampanakatta lies in the center of the Mangalore city, where the residential house holds are very low and, commercial establishments are more. Therefore, the incidence of Malaria in the region is very less. However the other places far from the center of the Mangalore city are residential in character and the areas are recent settlements. They are clean and neatly maintained, the people are highly educated and they are very much aware about the Malaria. Therefore, the numbers of incidences in the region are very less. Further, the region is comparatively more elevated and far from the low lying areas.

The farm land and the open space availability in the region is also very less. This factor is very significant in lower registering of Malaria incidence in the Mangalore city.

Seasonal Trend of Malarial Incidences

The study clearly reveals few facts in respect of seasonal distribution of malarial incidences. The numbers of malarial incidences are more during the monsoon period i.e.; July (15.7 percent) – October (19.4 percent).The increasing tendency of malarial incidences are positively correlated with the onset of rainy season. (Fig. 03, Table 02). The normal temperature (mean daily maximum temperature) during June- October in Mangalore city is between 29degree Celsius to 30 degree Celsius. In the remaining season the temperature is always beyond 31degree Celsius. Therefore, it is evident that the season prevailing mean daily maximum temperature between 29-30 degree Celsius during June and October months registered maximum number of malarial incidences.

The month between July and March are considered as the 'more prone period' so far as malaria is concerned in Mangalore city, as incidence of malaria is maximum during this period. However, we can observe the continuous downward trend from the month of March to June. The lowest incidence can be observed in the month of May and June. Therefore, it is certain that the dry season in Mangalore city is the period of 'less prone' in respect of Malaria. The steady progress in malarial incidence can be observed during the early rainy months, i.e. June (10.5%) October(19.4%). From October onwards the malarial incidences are at a decreasing rate. A very steep increase of malarial incidence can be observed in the month of June and July the beginning of the rainy season. In June the percent of malaria incidences are only at 10.5 percent. However, it sharply leaped to 15.7 percent in the month of July, a variance of about 5 percent in a month's period. This is attributed to the fact that the onset of rainy season favors the required conditions for the malarial incidences around the Mangalore city.

Malarial Incidences and Demographic Variables

The demographic variables considered for analysis in the present work are **Age structure**, **sex ratio** and **occupational characteristics**. This study is based on the information for the year 2003 collected for all the months from the records of various hospitals, nursing homes and Medical labs (Table 03). In Mangalore city, about 23 percent of Malarial incidence occurred among the age group below 15 years and 21 percent among over 45 years age group.

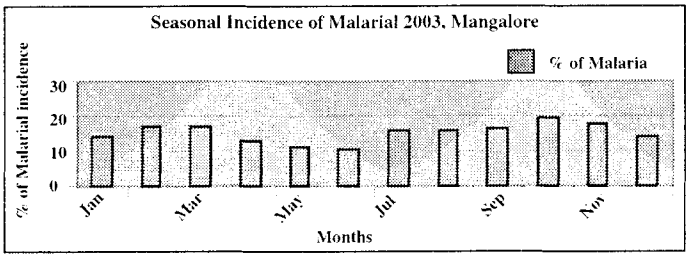

Fig. 3: **Seasonal Incidence of Malarial 2003, Mangalore**

The severity is among the 15-45 years age group. Whose percent of malarial incidence are at 56 percent with this, it is very clear that the productive and the dynamic population group is more susceptible to

Table 2: **Mean monthly Rainfall, Temperature and Incidence of Malaria – Mangalore City**

Months	Rain-fall (m.m.)	Max. Temp. (°C)	Maleria Positive Cases 2003 Percent	Total
January	4.5	31.6	14.4	335
February	2.1	31.2	17.0	232
March	6.9	32.0	16.8	293
April	35.9	32.8	12.9	237
May	149.5	32.6	11.3	286
June	1016.3	29.2	10.5	342
July	1270.2	28.6	15.7	534
August	775.1	28.7	15.7	648
September	339.9	28.9	16.5	537
October	227.8	30.0	19.4	571
November	87.3	31.7	17.5	577
December	16.9	31.7	14.2	615

Source: Compiled by the researcher.

malaria. However, the younger age group (0-15 years) is nearly equal to that of the older age group (over 45 years). The trend of malarial incidence with regard to Age group is very similar in all the parts of the Mangalore city.

The sex wise incidence of Malaria in Mangalore shows that the male populations are more affected and the difference is also much. Nearly 66 percent of the total malarial incidences are among the male population and the rest of 34 percent among the female population. The male populations of labor and worker class are out of their home for most of their time. Due to lack of sufficient living space in their residences and non affordability of the houses or shelter by these groups, members especially the male population of these classes are more susceptible for the malarial incidences. The similar trend exists in all the regions.

Table 3: **Malarial Incidence with Demographic Variables, Mangalore**

	Malarial Incidence Nos.	%
Age		
<15 Years	1196	23
15-45 Years	2916	56
>45 Years	1065	21
Sex		
Male	3436	66
Female	1771	34
Occupation		
Bussiness Officials	572	11
Officials*	260	5
Bank Employees	261	5
Workers and Labour	3436	66
Others	678	13

*(Govt. Semi Govt. Cooperative Employees)

***Source**: Compiled by the Researcher from the Records of various Hospitals, Nursing Homes and Medical Labs, Mangalore-2003.*

The different occupational groups like business, Government and semi government employees, banks and private services, laborers and workers, and others have been considered for the study. This reveals the fact that the government and bank employees are the group susceptible very less (each 5 percent) to Malaria. The business community affected to the extent of 11 percent. The maximum number is among the laborer and working group i.e. about 66 percent. This clearly indicates that the people who are economically and socially good are less susceptible for the malaria. The lower and poor working, labor class are economically weak and more often these groups are susceptible for the Malaria incidence. These groups of people do not have adequate shelter in the city and majority of the migrant laborers

are houseless and live in open spaces. Therefore, these groups are more frequently and easily affected by malaria and they are considered as the "potential malaria group" of the city.

Summary and Conclussion

The foregoing discussion leads us to arrive at the following conclusions. South and South-Western part of the Mangalore city experiences highest number of malarial incidences due to the water logging in the region and its situation on the banks of river Nethravathi, Further, the failure of corporation authorities and the publics in maintain the basic civic amenities like drainage, sanitation, maintenance of open wells and over head tanks, monitor on huge construction sites etc, in the areas of older settlements with high density of population have made responsible for intensifying the problem. The problem of malarial incidence is moderate in the northern and eastern part of the city. However, it is less in the central region of the city. The incidence of malaria has a close association with the seasons. It is very high during the monsoon season i.e. between July and October. Therefore, this period has been considered as "More prone period". The lower incidence can be observed between March and July; the period is dry and almost rainless. A sharp leap in malarial incidence is between June and July, during the beginning of the monsoon rains.

The problem is very severe among the population groups of economically productive, dynamic and mobile. However, the children and the aged are less susceptible and almost equal in respect of the malarial incidences. The male populations of the workers and labors are "the more prone groups" who registered maximum number of malarial incidences in the city. Therefore it is very essential that the planners, administrators and the medical authorities to prepare a comprehensive plan at micro level to tackle the "malarial incidence" by understanding the spatial, seasonal and demographic characteristics. The department of health, Mangalore City Corporation has to take immediate steps to eradicate the malaria in the city.

Reference

Awash T. and R.J.H. Pushpa. 1991. The Mosquito : Public Enemy No. 1 *World Health Magazine. pp. 21.*

Bedi. Y.P. 1956. *Preventive and Social Medicine*, Anand publ., Amritsar, pp. 219-225.

Jagadish Singh. 1993. *Medical Geography of Saryurpar Plain, Institute for Rural Economic Development, 234, Daudpur*, Gorakhpur, India.

John Maurice and Anna Marina Pearce. (eds.).1987. *Tropical Disease Research*: A global partnership, WHO, Geneva. pp. 1-33.

Mac Donald. G. 1: *The Epidemology and Control of Malaria.* Oxford University Press. London.

Nakajima, H. 1991. *Breaking the Fatal Cycle of Transmission*. WHO. pp. 2-3.

Park. J.E. 1985. *A Textbook of Social and Preventive Medicine*, Banarasidas Bhanot publishers, Jabalpur. p. 26.

Raghunathan K. 1993. *Back to Bio-control Methods–malaria.* The Hindu. Survey of Environment. pp. 95-99.

UNDP/World bank/WHO. 1983. *Tropical Disease Research*, Seventh Programme report. WHO. Geneva.

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