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RESEARCH ARTICLE

RECENT SCENARIO OF MALARIA IN LAKHIMPUR DISTRICT OF ASSAM, INDIA.

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Abstract

Malaria is one of the common diseases in Upper Assam, particularly in the Lakhimpur district. It is influenced by various climatic and host factors. It is regarded as one of the major epidemics in Assam. The annual reports provide evidence that the magnitude of malaria across Assam is high and varies with location. It contributes more than 5% of the total cases recorded in the country annually. The study primarily deals with malaria disease and the scenario of malaria in Lakhimpur district. Both Plasmodium falciparum and Plasmodium vivax occur in abundance, but Plasmodium vivax was the major parasite in the district. Amongst PHCs of Lakhimpur district, the Boginadi PHC, which is a tribal dominated and forest fringed area, was worst affected by malaria incidence.

Introduction:-

Malaria is one of the deadliest infectious diseases. Even though the disease has been investigated for hundred years, malaria is endemic in 91 countries with about half of the world population are at risk of malaria. It is predominantly present in the tropical countries, causing 300 million to 500 million clinical cases and more than 1.5 million deaths each year [Park, 1997]. The disease is caused by four species of Plasmodium pathogens, namely Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, and Plasmodium malariae. The general symptoms of man suffering from malaria parasite are paroxysms of chills, fever, headache, pain and vomiting.

India's geographic position and climatic conditions had been, for long, favourable to the transmission of malaria. Now, it is becoming even a greater problem than before. India accounts around 85% of the total reported cases in South-East Asia region in 1995. During 1996 also, India contributed 83% of total malaria cases in South-East Asia Region [Lal et al., 2004]. As per WHO report 2010, India contributes about 70% of malaria in the South East Asian Region. NBVDCP [2012] reported that 90% of malaria cases in the country for the year 2011 were reported from 12 states namely Odisha, Jharkhand, Chhattisgarh, Maharashtra, Madhya Pradesh, Gujarat, West Bengal, Uttar Pradesh, Assam, Rajasthan, Andhra Pradesh and Haryana. Another report of NVBDCP [2014-2015] revealed that during 2011, the malaria incidence was around 1.31 million cases, 0.67 million Plasmodium falciparum cases and 754 deaths; while during 2012, 1.01 million cases, 0.53 million Plasmodium falciparum cases and 519 deaths were reported.

At present malaria is a major public health concern in the northeastern states of India. In case of Assam also, it is regarded as one of the major epidemics in the region. The annual reports provide evidence that the magnitude of malaria across Assam is high and varies with location. It contributes more than 5% of the total cases recorded in the

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country annually. In Assam, both Plasmodium falciparum and Plasmodium vivax occur in abundance, but Plasmodium falciparum (the killer parasite) accounts for > 60% of the cases [Dev et al., 2004 &Dev et al., 2006]. Similar observation was also reported by Pal-Singh-Pardal et al. [2009]. According to 2012 annual report of NVBDCP [2012], approximately 72% and 73% of the total malaria cases were estimated to Plasmodium falciparum cases for the year 2010 and 2011 respectively. But, some particular areas of Assam (e.g. Nagoan district) were found having more Plasmodium vivax cases than Plasmodium falciparum cases [Gupta et al., 2014]. Almost all districts of Assam report malaria attributable morbidity and mortality every year. Every death reported to have been due to malaria was confirmed to have been associated with a Plasmodium falciparum infection. Approximately 36 and 45 people died in malaria in the year 2010 and 2011 respectively [NVBDCP, 2012].

Amongst the species of Anophelines, Anopheline minimus and Anopheline dirus, the major vector of malaria in North-eastern region of India [Das et al., 2007], but in Assam Anopheline minimus was most abundant [Dev et al., 2004 & Dev et al., 2006]. Interestingly, another study for Sonitpur district of Assam has resulted in a different report. This study captured seven species namely Anopheles annularis, Anopheline culicifacies, Anopheline dirus, Anopheline fluviatilis, Anopheline minimus, Anopheline philippinensis (Anopheline nivipes) and Anopheline varuna at varying densities depending on season. Of these, Anopheline philippinensis was found to be more predominated specie than other species [Baruah et al., 2007].

Transmission:-

The mode of transmission of malaria parasite to human is three types. First malaria is transmitted by the female Anopheles mosquito, one of the most capable vectors of human disease, from one host to another, which is called vector transmission. This was discovered by Ronald Ross in 1897, while he was working in Secunderabad (Andhra Pradesh, India) and a year later, in 1898, in Calcutta (now Kolkata). He received the Nobel Prize in 1902. The mosquito is not infective unless the sporozoites are present in its salivary glands. Secondly, malaria may be induced accidentally by hypodermic intramuscular and intravenous injections of blood or plasma, e.g., blood transfusion, which is called direct transmission. Blood transfusion poses a problem because the parasites keep their infective activity during at least 14 days in blood bottles stored at 4^0C. Persons who have lived in an endemic area and anyone who has had malaria should not be accepted as blood donor until three years afterwards. Thirdly, congenital infection of the newborn from an infected mother may also occur, but is comparatively rare.

Risk factors of Malaria incidence:-

The natural transmission of malaria depends on the presence of, and relationship between the three basic epidemiological factors: the agent, the host and the environment. However, the impact of these factors varies from time to time and place to place. From these, the most important risk factors are host and environmental factors. Host factors are age, sex, race, pregnancy, socioeconomic development, housing, population mobility, occupation, human habits, immunity etc. and environmental factors are season, temperature, humidity, rainfall, altitude and man-made malaria.

Malaria in Lakhimpur District:-

The name Lakhimpur is believed to be originated from the word “Lakshmi”, the goddess of prosperity. The district is mainly dependent upon agriculture and paddy. Lakhimpur District is situated on the North-East corner of Assam and on north bank of the river Brahmaputra. The exact location of the district is $26^0$48’ and $27^0$53’ northern latitude and $93^0$42’ and $94^0$20’ east longitudes (approx). The district is comprised of six block level primary health care centers (PHCs) – Dhalpur, Bihpuria, Nowboicha, Boginadi, Ghilamora, Dhakuakhana with about 10,40,644 population (2,11,098 of the population are tribal) in Lakhimpur district. The six PHCs have 156 sub centers. Most areas in the district have heavy rainfall, and floods occur every year.

From the report of the malaria cases during 2000-2011, Both Plasmodium falciparum and Plasmodium vivax occur in abundance, but Plasmodium vivax was the major parasite in the district, only for the year 2011, Plasmodium falciparum outnumbered the Plasmodium vivax cases. Out of 6 PHCs in the district, 3 PHCs, namely Boginadi, Nowboicha and Dhalpur share an interstate boarder. There is report of malaria cases form all PHCs in the district. If we compare Plasmodium falciparum and Plasmodium vivax cases for last three years PHCs wise then we find no Plasmodium falciparum cases for Nowboicha PHC, where as for the Bihpuria, Boginadi and both Dhakuakhana and Boginadi PHCs the Plasmodium falciparum cases outnumbered the Plasmodium vivax cases for the years 2009, 2010 and 2011 respectively.

In 2009, based on the annual parasite incidence (API), four PHCs reported less than 0.5 cases. For other two PHCs we had, API was > 0.5 (Viz. Boginadi and Dhalpur) . For the year 2010 we found that, API was ≤ 0.5 If we want to classify the areas of Lakhimpur District on the basis of Annual parasite incidence (API) given by district action plan on national vector borne disease control programme in village level then we get that for the year 2009 of the total of 1675 villages in the district, 759 villages reported less than two cases. For all other villages (55% of the total population), API was ≥ 2, (270 villages reported greater than 10 cases, 273 villages reported 5-10 cases and 373 villages reported 2-5 cases). While calculating the API sub centre wise, we saw that out of the total 156 sub centers in the district, 94 sub centers reported ≥ 2 cases, (where 17 sub centers reported more than 10 cases), a criterion which is considered to be a sensitive malaria metric indicator for residual spray interventions against vector population. Comparatively for the year 2010 we got lowest API, where out of the total 1675 villages, 1400 villages and of the total 156 sub centers, 131 sub centers reported less than one case.

Amongst PHCs, we saw that the Boginadi PHC, which is a tribal dominated and forest fringed area, was worst affected by malaria incidence. For the year 2009, we got 392 malaria positive cases out of which 312 cases are Plasmodium vivax and 80 cases are Plasmodium falciparum. In the same year out the total of 424 villages in Boginadi PHC, 53 villages API reported was greater than 10 cases, 125 villages reported 5-10 cases and 95 villages reported 2-5 cases. Comparatively we found lowest malaria positive cases in 2010, here we got 139 malaria positive cases, out of which 84 cases are Plasmodium falciparum and 55 cases are Plasmodium vivax. Also, we saw that out of the total of 156 sub-centers in the district, the malaria incidence cases were highest in Boginadi sub-centre, which is located within Boginadi PHC. Here we got 60 malaria incidence cases, out of which 15 cases were Plasmodium falciparum and 45 cases were Plasmodium vivax and out of 41 malaria incidence cases, 28 cases were Plasmodium falciparum and 13 cases were Plasmodium vivax for the years 2009 and 2010 respectively.

Comparatively PHCs of tribal- dominated population, particularly Boginadi (27% tribal population) was more malaria prone with API 1.71 and 0.5 for the years 2009 and 2010 respectively, than other PHCs, whereas in 2009 the PHCs of Ghilamora and Dhakuakhana (where the PHCs have only 7% and 4% tribal population) were least affected as is evident with API 0.04 and 0.09 respectively. In the year 2010, from PHCs we got least reporting with the lowest API (0.01 - 0.3). As many as 91 and 55 sub centers of the existing total of 156 and 733 and 605 villages of the existing total of 1675 have been identified as high risk area in 2009 and 2010 respectively, given by District Action Plan on National vector borne disease control programme of Lakhimpur District. In Lakhimpur district, approximately 39% and 36% of the total population was estimated to be at high risk for malaria for the year 2009 and 2010 respectively. Approximately 53.1% of the population (mostly tribal) of Boginadi PHC was considered at high risk for malaria and for other three tribal dominated PHCs, it ranges from 34% to 44%. For the remaining two PHCs, it was <22% of the population that was estimated to be at high risk.

For the year 2009 (2010), comparatively the PHCs, which share border with Arunachal Pradesh, particularly, Boginadi and Dhalpur were more malaria prone with API 1.71 (0.5) and 0.7 (0.3) respectively than the other PHCs (except Bihpuria) which share border with inter-districts. (API ranges from 0.01 - 0.1). In 2009, out of total blood smears checked for malaria parasite, the prevalence rates for those positive for malaria and those positive for Plasmodium falciparum (SFR) were 0.6% and 0.17% respectively, where as for the year 2010 we got only 0.18% and 0.08% respectively but these figures vary among PHCs in Lakhimpur district. In 2009 for two PHCs, namely Boginadi and Dhalpur, the Slide Positivity Rate (SPR) was > 0.6% and for other PHCs, SPR varied from 0.1% to 0.4%. Similarly for the year 2010 we got highest SPR (0.3) in Boginadi PHC and SPR varied from 0.01 to 0.2 in other PHCs.

Discussion:-

Malaria is one of the common diseases in Upper Assam, particularly in the Lakhimpur district. Plasmodium falciparum cases outnumbered the plasmodium vivax cases in Lakhimpur district [Sharma et al., 2014]. According to Nath et al. [2012] malaria is more prevalent in forest area than non-forest area. Similar report was also submitted by Wachira [2014]. Also, Dev et al. [2006] mentioned that hill districts were of higher risk for malaria transmission than other districts. But in Lakhimpur district either there is no comparative study on malaria incidence or a thorough rare study has been taken up. Malaria disease maps can also be used for targeted control and monitoring of the progression of disease. Therefore, a comparative epidemiological study to make the map of malaria incidence in Lakhimpur district is essential.

As mentioned earlier, malaria is influenced by various climatic and host factors. The impact of climatic factors on malaria incidence has been established by various malaria studies in the world as well as India. The relevant publications of the work were Chattopadhyay et al. [2004], Al-Mansoob et al. [2005], Chatterjee et al. [2009], Huang et al. [2011] and Nath et al. [2013] etc. These studies have revealed that climatic factors play an important role in malaria transmission. But, one climatic factor plays greater role in malaria cases occurrence or its transmission than others. Also, we have observed that the primary role of climatic factors vary from place to place. Similarly, according to the influence of host factors (age and sex) on malaria incidence has been studied by Dev et al. [2004], Das et al. [2007] and Wattanavadee et al. [2008] and various reports have been submitted. Though, various researchers traced the risk factors on malaria transmission for particular area, till now no one has published a specific report based on statistical analysis for Lakhimpur district. Therefore, tracing the risk factors of malaria incidence in Lakhimpur district is inevitable.

Amongst the factors of malaria incidence, age is one of the major factors. Wattanavadee et al. [2008] remarked that the prevalence of malaria was high among aged 15 to 39 year old. Kaewsompak et al. [2005] also submitted that prevalence of malaria was high amongst the people aged 39 years old. Various reports were given by Kleinschmidt et al. [2001], who suggested that malaria was more prevalent among children below 15 years old. Similar observations have also been reported by Dev et al. [2004] and Das et al. [2007]. The differences might be due to the transmission patterns, the climate and living condition which may be very peculiar from other tropical areas. Though, incidence of malaria cases varies from one age group to another, there were no report on similar kind of studies in Lakhimpur district. Therefore, a study is highly necessary to determine the impact of age (host factor) on malaria incidence in Lakhimpur district.

Various malaria studies in the world have established the impact of climatic factors on malaria incidence. Several researchers have revealed that climatic factors such as temperature, rainfall and relative humidity are the important factors which affect on malaria transmission directly [Huang et al., 2011]. Rainfall was found to play a primary role in characterizing malaria incidence by Nath et al. [2013]. Srimath-Tirumula-Peddinti et al. [2015] found that malaria was highly influenced by rainfall and monthly average minimum temperature and mosquito population by climatic variables. Similarly, Chatterjee et al. [2009] have suggested that temperature and humidity (both minimum and maximum) were the key factors, which play a crucial role in shaping the disease curve. Chattopadhyay et al. [2004] established the significant dependence of total number of malaria cases on minimum humidity and rainfall. Also, highly significant relationship between malaria incidence rate and climatic factors was found by Al-Mansoob et al. [2005]. Regression model is one of the suited models for modelling and prediction of malaria incidence based on available data on the incidence of the disease on climatic factors. Therefore, a study to analyse the influence of climate factors on malaria disease in Lakhimpur district is also important.

Malaria is a seasonal dependent disease. Several researches have carried out studies related to the effect of seasons on malaria disease in the world as well as India. Some of the relevant publications are by Srimath-Tirumula-Peddinti et al. [2015], Wattanavadee et al. [2008], Alemu et al. [2011], Srinivasu et al. [2014] and Chadsuthi et al. [2012]. Similarly, in Assam Nath et al. [2013] revealed that prevalence of malaria was influenced by season due to various rainfall patterns. In another study, Baruah et al. [2007] have suggested that density of malaria vectors varies from season to season. Though, several researchers worked on malaria incidence using seasonal index, till date there were no work done on malaria incidence using seasonal index in Lakhimpur district. Therefore, a study to analyse the seasonal index of climatic factors and malaria incidence in Lakhimpur district is inevitable.

References:-

1. Alemu A., Abebe G., Tsegaye W., Golassa L., *"Climatic variables and malaria transmission dynamics in Jimma town, South West Ethiopia",* Parasites & Vectors, 2011; 4(30): 1-11.
2. Al-Mansoob M. A. K., Al-Mazzah M. M., *"The Role of Climate on Malaria Incidence Rate in Four Governorates of Yemen",* Med J Malaysia, 2005; 60(3): 349-357.
3. Baruah I., Das N.G., Kalita J., *"Seasonal prevalence of malaria vectors in Sonitpur district of Assam, India",* J Vect Borne Dis, 2007; 44:149–153.
4. Chadsuthi S., Modchang C., Lenbury Y., Iamsirithaworn S., Triampo W., *"Modeling seasonal leptospirosis transmission and its association with rainfall and temperature in Thailand using time-series and ARIMAX analyses",* Asian Pacific Journal of Tropical Medicine, 2012; 539-546.
5. Chatterjee C. and Sarkar R.R., *"Multi Step Polynomial Regression Method to Model and Forecast Malaria Incidence",* Plos One, 2009; 4(3): e4726.

6. Chattopadhyay J., Sarkar R.R., Chaki S. and Bhattacharya S., *"Effects of environmental fluctuations on the occurrence of malignant malaria - a model based study",* Ecological Modeling, 2004; 177:179–192.
7. Das N.G., Talukdar P.K., Kalita J., Baruah I. and Sribastava R.B., *"Malaria situation in forest-fringed villages of Sonitpur district (Assam), India bordering Arunachal Pradesh during an outbreak",* J Vect Borne Dis, 2007; 44: 213-218.
8. Dev V., Dash A.P. and Khound K., *"High- risk areas of malaria and Prioritizing interventions in Assam",* Current Science, 2006; 90: 32-36.
9. Dev V., Phookan S., Sarmah V.P., and Anand S.P., *"Physiographic and Entomologic Risk Factors of malaria in Assam, India"*, Am. J. Trop. Med. Hyg., 2004; 71(4): 451-456.
10. Gupta T., Dey M., *"PREVALENCE OF MALARIA IN LUMDING TOWN, NAGAON DISTRICT OF ASSAM, INDIA"*, Int. J. Life Sc., 2014; 4(3): 109-117.
11. Huang F., Zhou S., Zhang S., Wang H., Tang L., *"Temporal correlation analysis between malaria and meteorological factors in Motuo County, Tibet",* Malaria Journal, 2011; 10(54).
12. Kaewsompak S., Boonpradit S., Choonpradub C. and Chaisuksant Y., *"Mapping acute febrile illness incidence in Yala province",* Songklanakarin Medical Journal, 2005; 23(6):683-696.
13. Kleinschmidt I. and Sharp B., *"Patterns in age-specific malaria incidence in a population exposed to low levels of malaria transmission intensity"*, Tropical Medicine & International Health, 2001; 6(12):986.
14. Lal S., G.S. Sonal G.S., Phukan P.K. *"Status of Malaria in India",* Journal of Indian Academy of Clinical Medicine, 2004; 5(1):19-23.
15. Nath D. C. & Mwchahary D. D., *"Malaria Prevalence in Forest and Nonforest Areas of Kokrajhar District of Assam"*, ISRN Public Health, 2012, 14: 20-37.
16. Nath D.C., Mwchahary D.D., *"Association between climatic variables and malaria incidence: a study in Kokrajhar district of Assam, India",* Glob J Health Sci., 2013; 5: 90–106.
17. NVBDCP: Annual report- *NATIONAL VECTOR BORNE DISEASE CONTROL PROGRAMME*, 2012.
18. NVBDCP: Annual report- *NATIONAL VECTOR BORNE DISEASE CONTROL PROGRAMME*, 2014-2015.
19. Pal Singh Pardal M., Bhalwar R., Mehta V.K., Mahendraker A., Mehta A.K., *"Malaria in Assam: A Challenge",* Indian Journal of Community Medicine, 2009; 34(2): 94-96.
20. Park K., "Preventive and Social Medicine", M/S Banarsidas Bhanot Publishers, 15-Edition (1997).
21. Sharma J., *"PREVALENCE OF MALARIA CASES IN TEA GARDEN AREAS OF LAKHIMPUR DISTRICT, ASSAM",* International Journal of Pharmacy and Pharmaceutical Sciences, 2014; 6(8): 571-573.
22. Srimath-Tirumula-Peddinti R.C.P.K., Neelapu N.R.R. and Sidagam N., *"Association of Climatic Variability, Vector Population and Malaria Disease in District of Visakhapatram, India: A Modeling and Prediction Analysis"*, Plos One, 2015; 10(6): e0128377.
23. Srinivasu P., *"Seasonal Prevalence of Malaria in Tribal Mandals of Visakhapatnam District, Andhra Pradesh, India",* IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS), 2014; 9(3): 15-19.
24. Wachira M., *"Modeling of Malaria Prevalence in Kisumu County Kenya Using Logistic Regression by Geoffrey",* Research project submitted to the School of Mathematics of the University of Nairobi, 2014.
25. Watanavadee S., Metta K., and Naratip J., *"Malaria in north western Thailand",* Songklanakarin Journal, 2008; 30(2): 207-214.