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Study on Malaria Disease in Developing Countries And Linking Malaria Cases With Climatic Situations

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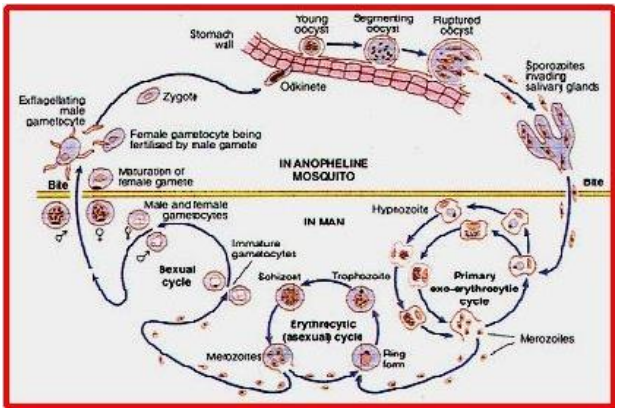
Abstract - In the present paper we have done study on mosquito-borne infectious disease 'MALARIA' in human body. This disease is spread by an infected female Anopheles mosquito, which breeds in open water beds. Factors which affect the transmission of disease are climatic conditions which include Rainfall, Vegetation, Temperature and Humidity, Biological factors. Data statistic of malaria cases registered, is been analyzed for the developing countries for example 'INDIA'. Further we looked at the average number of people per year suffering from malaria between the years 2011 to 2016. And its association with one of the Environmental factor- Rainfall. We also used Pearson's product moment Correlation Coefficient to study the relation among them.

Keywords — Anopheles, Coefficient of correlation, Parasite, transmission, Zoophilic species.

INTRODUCTION

MALARIA EPIDEMOLOGY: Malaria is a mosquito-borne disease that affects human and other animals. It is a life-threshing disease caused by bite of infected Anopheles mosquito. Parasites which are affecting humans are as follows- P. Falciparum, P. Vivax, P. ovale, P. malariae, and P. knowlesi. Among all these five the high impact, with more complications in human body is P. falciparum. The main vector of malaria is Anopheles culicifacies mosquito, zoophilic species. Its breeding places are rainwater pools and puddles, river bed pools, rice fields, wells, pond margins, irrigation channels. The symptoms of malaria are high fever, prostration, breathing problems, low hemoglobin level, vomiting. [1][2][3]



LIFE CYCLE OF MALARIA PARASITE IN MAN AND MOSQUITO [1]

A. MALARIA RISK AND PREVENTION:

There are four types of malaria risk and its prevention: Type I – Low transmission settings. For this type, only mosquito bite prevention is sufficient. Type II- P. falciparum, P. vivaxor with no evidence to resistance to chloroquine. For this type mosquito bite prevention and chemoprophylaxis with chloroquine is suitable. Type III - P. falciparum P. vivaxor and chloroquine resistance. For this type mosquito bite prevention and chemoprophylaxis with chloroquine and proguanil is suitable. Type IV – High risk- transmission settings by P. falciparum and antimalarial drug resistance or moderate or low-transmission with high antimalarial drug resistance. For this type mosquito bite prevention and mefloquine or doxycycline or atovaquone or proguanil is suitable.[5]

B. MALARIA DIAGNOSIS: Early diagnosis and treatment of malaria will help in reducing disease and also prevents deaths. The best way of diagnosing the malaria suspected cases must be done by using parasite based diagnostic testing. These are Rapid diagnostic test (RDTs) or light microscopy test. If any person is suffering from fever for more than a week, in this situation he has to go to a qualified laboratory for rapid diagnostic test and consult a doctor before consuming any kind of medicines.[6]

C. MALARIA TREATMENT: Treatment of malaria is possible with anti-malarial medications. It depends on various parameters, such as the type of malaria parasite, which we have discussed before in types of malaria risk and prevention. As well as the severity of the disease and the

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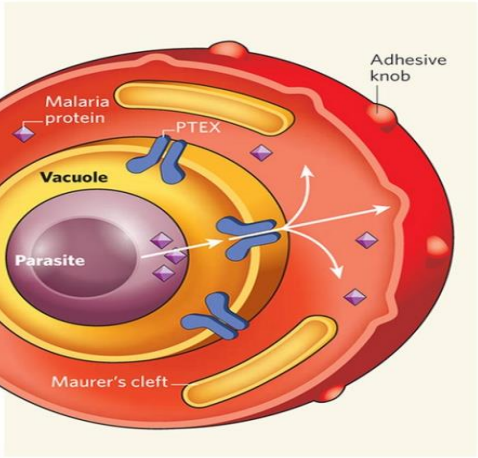
age of the person. Person having diabetes, liver cirrhosis, pregnant ladies, children under the age 5 are most vulnerable, because of less immunity power. And the process of recovery is also very slow in them.

Details for antimalarial drugs are available in following website:
onlinehttp://www.who.int/malaria/publications/world_malaria_report_2012/wmr2012_no_profiles.pdf.

IMAGE OF BLOOD CELLS INFECTED BY MALARIA:[4]



HISTORY OF MALARIA IN DEVELOPING COUNTRIES

Every year around 219 million cases are reported around the world. As the data provided by World Health Organization, there has been an increase in the number of estimated malaria cases; in 2015 there are 211 million cases registered, where as in the year 2016 this number is increased to 216 million. In overall world there are around 109 countries which are now free from malaria, but still some of the countries are highly affected. [7]. Countries where the majority of people are in poverty line, are more likely to get infected by this disease, since the home construction in the rural areas of developing countries will not spend much on the protection against mosquitoes. They are unable to pay for transportation, healthcare facilities and medicines. Unawareness of malaria prevention, like covering of eatable items and water stores to prevent mosquito breeding, all these factors contributes in countries facing high rates of malaria. India is one of the developing countries, it is at fourth place with 7 percent of deaths cases registered, among the top 15 countries affected by malaria.

FACTORS AFFECTING TRANSMISSION OF MALARIA: One of the most important factors of malaria transmission is Environment. Climate affects a lot to the infectious diseases, this fact is true for viruses, bacteria and parasites, and reason is these climatic factors which are more prone in one region of the country than the other helps the female Anopheles mosquito to multiply successfully. The Environmental factors which increases or reduces the spread and transmission of malaria parasite in a human body include climatic factors such as vegetation, rainfall, temperature, humidity and biological factors, it is a reason why malaria will only continue to infect millions of people annually. If every individuals, communities and nation come together for contribution to global climate change, then the effects will be beneficial to the world population. [8]

DISCUSSION: As we have discussed before the climatic factors are the major reason for mosquito breeding, so we now discuss in detail on some of the factors like – Rainfall, Temperature, and Humidity.

Rainfall: Rainfall is the amount of water that fall in droplets. Degree of rainfall united with the amount of water in a particular region is momentous to the transmission of malaria parasites. The female Anopheles mosquito which causes malaria in humans, lays its egg in water body. Areas that experiences high rate of rainfall provide the necessary water bodies to prosper the mosquito life cycle. The malaria infection is more in the areas of heavy rainfall compared to the desert areas where the rainfall is less.

Temperature: Degree of hotness and coldness of a particular environment at any time, identifies the temperature of that area. The regions where the temperature is low, there is freezing of water bodies, and temperate zones makes difficult for mosquito to grow. Therefore in cold regions is not possible for adult mosquito to become active. The warm and hot regions are good breeding habitat for mosquitoes, water bodies in these zones do not freeze, which allows mosquito to survive and produce adult mosquito. High temperature also enhances the increase in different stages of Plasmodium parasite inside the female Anopheles mosquito.

Humidity: The amount of water vapor present in air is called humidity, it indicates the likelihoods of precipitation, dew or fog to be present in atmosphere. High humidity areas develops moist and wet environment which favors the growth of malaria parasite inside the body of the insect vector, also it increases the number of blood sucking mosquitoes in that area.[8]

III. STATI STICAL ANALYSIS

In order to analyze the association between malaria case distribution and environmental factors in our study, we measure the association between the malaria cases and rainfall, by applying Pearson's product moment Correlation Coefficient (PCC) denoted by r. The statistical significant result r, identify the strength of association from -1 to +1(negative sign indicates perfectly inverse association where as positive sign indicates perfectly strong association).[9] [10]

Below table is the statistic data of rainfall (X) recorded yearly and malaria cases (Y) registered per year in India,

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Information provided by World Health Organization (WHO)

YEAR	rainfall (X)	malaria patients (Y)
2016	94895.04	1087285
2015	96927.32	1169261
2014	94527.75	1102205
2013	110313.93	881730
2012	92535.57	1067824
2011	99707.78	1310656

CALCULATION AND GRAPH:

X VALUES: SUM =588907.39; MEAN= M_X = 98151.232 ; $\sum(X - M_X)^2$ = 207120092.743

Y VALUES: SUM=6618961; MEAN= M_Y = 1103160.167; $\sum(Y - M_Y)^2$ = 97956737662.833

Combined X and Y; N=6; $\sum(X - M_X)(Y - M_Y)$ = -2197523035.702

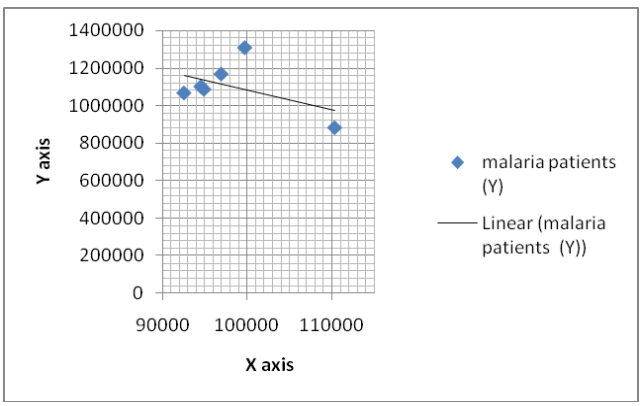
$r = \frac{\sum(X-M_X)(Y-M_Y)}{\sqrt{\sum(X-M_X)^2(Y-M_Y)^2}}$ = -0.4879

r=-0.4879

LINE OF REGRESSION

Y = -0.02243361 X + 122899.1

In statistics the correlation coefficient r measures the strength and direction of a linear relationship between two variables on a scatter plot. The above line of regression indicates a linear connection between the malaria patients and rainfall factor. The negative value of r shows that association between these is negative means when rainfall decreases then the number of malaria parasites will increase more, in this climatic condition. In the above calculation, the value of r = -0.4879 which is the situation of moderate downhill negative relationship.



IV.CONCLUSION AND RESULT

From the scatter diagram and the correlation coefficient, it is clear that the coefficient of correlation is likely to be negative. The negative value of r indicates that the malaria cases registered and rainfall per year are inversely associated. Reason behind this is government deploys malaria programs and research, malaria prevention, diagnosis and treatment, surveillance and lot of control programs are taking place yearly. Facts on these approaches should provide national government with cost benefits plans, that increases in global support for effective malaria control. Further correlation testing can be done by using sample test via t-distribution test and other tests.

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