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Medical Climatology

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ABSTRACT. The author in this article brings out the important role the climate plays on the health of human beings and some of the important problems facing the workers in the field of medical climatology and finally stresses the necessity of bringing co-operation between the medical experts and climatologists to work hand in hand in solving the meteoropathological problems.

Climate plays an important role in every sphere of human activity. The most important obstacles to progress in certain parts of the globe were, in the past, due to adverse climatic conditions in addition to other factors. The health and well-being of man depend to a greater extent both on the general climate and day-to-day changes in weather. The science dealing with the study of the direct and indirect effects of climate on man's health is called Medical Climatology.

From the public health point of view, the impact of climate is two fold: first, the limitations imposed by the climatic factors themselves on human activities, health and comfort; and second, the extent to which climatic factors, more specifically rainfall and temperature, influence the epidemiology, geographical distribution and severity of diseases in man. The most important elements of climate are the rainfall, temperature, wind and sunshine. Air of moderate humidity followed by intermediate temperature with medium wind and sunshine is more conducive for health. Climate is one of the factors which

exerts its influence on the spread of many diseases. It may help or retard the development of the germs which are the specific cause for the diseases and effect the growth of their carriers. It may also strengthen or weaken the individual's power of resistance against the attack of the germs. Most of the diseases prevailing in various parts of the world are, in some way or other, effected by the climatic conditions.

Malaria had long been recognized as a disease of world-wide incidence and the cause of a higher sickness and death-rate than any other disease. It is most prevalent and extremely common in the tropics with high infection rate, constant heat, moisture and water for the breeding of the anopheline mosquito and requisite temperature for the development of the parasite therein. As the poles are approached, the foci of endemicity gradually become less. Climatic conditions, particularly temperature and humidity effect the development of the parasite in the mosquito which forms the source of infection in man. A mean daily temperature exceeding

15°C is necessary for the development of the parasite. Mosquitoes avoid temperatures higher than 30°C. High humidities are suitable for the transmission of malaria and malarial outbreaks follow the rainy seasons.

Malaria was until recently endemic in India, the largest malarious country in the world. Almost all over the country, high rainfall favours the high incidence of malaria. It has been found in the deltaic regions of Bengal (Iyengar 1942), contrary to the conditions prevailing in other regions, area with a high subsoil water level during the wet season are comparatively free from malaria, while those with a low subsoil water level show a high incidence of the disease. This fact also finds support from the investigators in Ceylon (Rustomjee and Sivalingam 1941) who had shown that the dry part of Ceylon is chiefly a hyperendemic malarial zone, while the wet zone is healthy. The factors that would account for the malariousness of dry areas and healthiness of wet areas have not yet been clearly understood.

Cholera has been probably present in India since time immemorial. Some of the frequent outbreaks of the epidemic in this country, in the past, spread not only to the neighbouring countries, but also to the European and American countries. Recent bulletins of the World Health Organization indicate that the most important endemic centres of cholera in the world are found in the State of West Bengal, India and this area has been called "the major endemic home of cholera".

The incidence of the disease is associated with various factors in direct and indirect ways. Although it has long been recognized that climatic changes exert a profound influence on the incidence of cholera, temperature, humidity, rainfall and possibly other factors, interact in a complex manner that is not yet completely understood. In spite of the fact that the cholera vibrio is more sensitive to heat than to cold, it is almost during the warm season of the year that cholera becomes epidemic, the

incidence declining as the temperature falls. This is probably due to the increased consumption of raw water, cold drinks, fruits, salads and other cold foods during the hot weather. The greater prevalence of flies during the summer months is no doubt also an important factor. A high humidity appears to favour the spread of cholera, though whether the absolute humidity—as maintained by Rogers—or the relative humidity is decisive remains a matter of controversy (*WHO Chronicle* 1961). The rainfall acts indirectly on the incidence of cholera, through drinking water. Rainfall may influence cholera incidence in various ways, depending apparently upon the preceding circumstances and the duration of the fall. Thus occasional heavy downpours during a dry period will be likely to wash down infected material into the sources of the water supply. More continuous rain, however, will dilute the infected material and finally carry it away. Nevertheless, prolonged rain does not always inhibit the spread of cholera and in some areas epidemics have been known to continue or even to start during the wet season. Although the desiccation is unfavourable for the survival of the cholera vibrios, prolonged drought conditions may create particularly dangerous conditions because the scanty water supplies become very heavily contaminated and people are forced to make use of them. Rogers has claimed that in India epidemics frequently occur in years following failure or deficiency of the monsoon rains and he has pointed out, as an additional factor, that the deficient rainfall leads to widespread famine and that poor communications make it necessary to concentrate the starving people in large camps.

Even in the absence of public health measures to arrest the spread of the infection, cholera epidemics naturally tend to decline, after several months. This can be attributed in part to climatic changes, such as a fall in temperature or the onset of the rainy season. The most exhaustive statistical studies conducted so far have been those published by Russell and Sundararajan in 1928. Their

conclusions summarized in the following statement are still valid today.

"The association of high relative humidity with high temperature, accompanied by intermittent rains, forms the most favourable atmosphere for the development of the disease. The presence of endemic centres from which epidemics spring at short intervals is also a fact which must be accepted. No single factor, however, can be held responsible for the periodic waves of the disease...and it must be recognized that these waves are preceded by conditions too complex to admit of complete solution with the aid of the available data. Individual susceptibility, foci of infection, favourable atmospheric conditions, fairs and festivals, carriers and insanitary habits, all play their part in a manner which defies analysis".

Plague, which was a dread disease in India at the beginning of this century, now seems to be withdrawing in full retreat. The decline of plague throughout the world over the past 15 years has been large scale and rapid. It is known that the geographical distribution of plague is largely, but not entirely determined by the climatic conditions. Plague spreads to human beings from rats through fleas. In bubonic plague (this form is spread from man to man by fleas), the optimum conditions of temperature and humidity are approximately represented by a mean temperature of 68°—77°F (20°—25°C) in association with a relative humidity of the order of 60% and above. There is a marked decrease in the incidence of plague if the mean temperature rises above 90°F (or about 30°C). The largest number of cases in India are found to occur in years of highest relative humidity. It may thus be maintained that the climatic factors, by reason of their influence upon the transmission of infection, are capable of determining the season of the year in which plague epidemics will be most likely to occur. The season influences the numerical importance and longevity of rat fleas and multiplication of the plague organism in both rats and fleas.

At high latitudes the atmospheric temperature attains the critical level only during the late summer and early autumn, so that it is at this season of the year that a plague epidemic is liable to occur at that latitude. A decrease in latitude is associated with earlier occurrence. In the sub-tropical region, on the other hand, where either the temperature factor or humidity factor is unfavourable during the summer, the plague epidemic occurs periodically in spring as in northern India.

In India, the incidence of plague reaches its maximum at the end of the cold season and the disease drops greatly every year at the beginning of the hot season, because at that time the humidity is inimical to the survival of the rat flea and to its power to transmit infection. Long and difficult experimental work (Baltazard 1960) carried out by leading experts under varying climatic conditions had shown that heat, particularly when combined with drought, influences the multiplication of fleas, their infection by plague and their vector potentiality. This explanation, however, did not fit in certain facts: in certain countries, as for example Java, under climatic conditions practically identical with those obtaining during the monsoon season in India, plague was continuously present. One of the important things which has remained obscure in the epidemiology of plague is the phenomenon of "plague seasons".

Filariasis is mostly confined to the tropical belt. It is widely distributed in India and a major public health problem in this country. According to the latest health reports, about 64 million people are estimated to be residing in the filarious areas of the country. Climatic conditions particularly temperature and humidity play an important role in its distribution. Filariasis which is caused by the nematode worms, filariae, is spread by mosquitoes from man to man. High humidity followed by optimum temperature favours high

infection of mosquitoes with filariae. During the monsoon season, the mosquitoes become heavily infected while in winter, the infection rate is low. Filariasis is found to prevail predominantly in the areas like Coromandal, Northern Circars, Konkan and Malabar Coasts (sea-coast belt).

Trypanosomiasis (*i.e.*, sleeping sickness) is widely distributed in equatorial Africa. The disease, despite all efforts made to control it, remains one of the important health problems of Africa. This is particularly true of animal trypanosomiasis and it has been, without doubt, one of the greatest obstacles to economic development in many parts of the continent. But it is important as a human disease also. There are several instances in the history of Africa of the devastating effects of human trypanosomiasis. It is known that climate is an important factor in its distribution and there are two distinct types of the disease to be encountered separately in East and West Africa. Trypanosomiasis is caused by the presence of parasites, trypanosoma, in blood and spread by tsetse flies. Climatic conditions, especially temperature exerts profound influence on the tsetse flies. Relatively high temperatures, 75° to 85° F are favourable for the development of parasites in tsetse flies, while low temperatures, 60° to 70° F are inimical to development.

Climate seems to have little influence on the incidence of tuberculosis. It is believed that tuberculosis occurs more readily in moist climates than in cold dry ones. This is clearly shown in India where desert regions show a low mortality from pulmonary tuberculosis, the reverse being the case in the southwest coast where the rainfall is excessive and prolonged. Tuberculosis is more common in England where there is exposure to the rain-bearing southwest wind than in places with better shelter. It is a common experience in the sanatoria of India that excessive heat and humidity have a detrimental effect on the progress of T. B. patients. Whether excessive heat

and humidity help in converting a potentially immunizing tuberculous infection into tuberculosis disease and rendering the course of the disease more acute is not yet clearly understood (Ukil 1930).

Investigations have shown that acute infectious diseases occur almost twice as frequently in winter as in summer months, and there is a large seasonal variation in frequency of the acute respiratory diseases, which occur 4.5 times more frequently in the peak month of January than in the low month of July. Multiple sclerosis (morbid hardening, as of arterics) has been observed by investigators in the United States more often in cold than in warm climates, and may occur from 5 to 10 times more frequently in Northern States than in Southern States. There appears to be a marked seasonal variation in the incidence of skin diseases such as prickly heat, bullous impetigo (acute inflammatory skin disease), and hydrademitis (inflammation of the sweat glands).

Temperature changes effect asthma patients who experience an increase of symptoms during sudden drops in temperature. It was reported that, in the year 1960-61, there prevailed an asthma epidemic in Cuba and it was attributed to a drastic change in the temperature brought about by heavy afternoon rain. In a study of the incidence of appendicitis, a combination of suddenly rising or high temperature and falling or low barometric pressure was found to coincide with an increase in the rate and severity of attacks. Tetanus also occurs more in warm climates than in cold ones. Poliomyelitis is a seasonal one and generally, rainy season is the time for it. Polio epidemic broke out unusually during summer of 1961 in Guntur and Krishna districts, India.

According to one school of thought man's well-being is determined in part by the effects of climate on the heat economy of the body. During the metabolic process,

heat will be produced and it must be dissipated for the smooth running of the body functions. Any hindrance to heat loss, such as high temperatures of a tropical climate depresses body functions, lowers general vitality and makes man susceptible to infectious disease. On the other hand, temperate climates stimulate vitality and quicken body functions. In management of patients with chronic bronchitis and asthma, a favourable climate is considered by some to be an effective form of therapy than any other. Others, however, do not feel that a change will necessarily be beneficial in the treatment of allergic diseases, such as asthma and hay fever.

The relationships between the climatic factors and various diseases will provide a clue for forecasting of the epidemics and thus enable the Public Health Departments to take timely preventive measures for the eradication of the same. So intensive investigations must be carried out to find more precise interrelations between the climatic factors and the prevailing diseases in various parts of the world.

The climatic considerations are more important in the development of health resorts. Therefore, scientific research should be undertaken on an intensive scale to investigate the climatic conditions existing at various places in different parts of the world and their stimulating or curative effects in the case of many illnesses so that suitable places might be developed as good health resorts. Air pollution is one of the important problems facing many countries where there is rapid industrialisation. The waste products such as vapours and gases coming out of the industrial plants mix with the atmospheric air. The atmospheric contaminants are harmful to human health and influence certain heart diseases. Among the possible effects is the stimulation of cancer (*WHO Chronicle* 1960). A Special Committee appointed by the W.H.O. has been doing valuable work in this direction. Much more remains to be found out about

the effects of the atmospheric contaminants on the human body.

Active interest has been shown in the study of the various aspects of medical climatology in Germany, U.S.A. and U.K. Very few national meteorological services maintain a service of Medical Climatology. Systematic or basic research in this field is mostly carried out by a few specialised institutes. In 1956, an International Society for Bioclimatology was established. The purpose of the society is to facilitate the further development of Bioclimatology of which Medical Climatology forms a part. In India, work was done by medical experts in respect of the effect of climate on a few diseases only. It is now necessary to undertake more intensive investigations in diverse aspects of meteoropathological problems.

Medical Climatology, being a borderline field between the medical sciences and climatology, the problems in it are too complicated because of the very complex nature of the climatic factors involved. Satisfactory solutions are only possible when the medical scientists and climatologists work with mutual co-operation and good will. Climate and its changes do not respect the political boundaries. Similar climatic conditions effect the incidence and distribution of the diseases in a more or less similar way in countries situated in the same latitudinal belt. So international co-operation has become necessary in tackling the problems in medical climatology, and the same has been possible through international organizations like the World Meteorological Organization and World Health Organization.

The W.M.O. is taking active interest for the promotion of medical climatology. It has encouraged its member nations to undertake scientific research in this field. The W.H.O., since its formation in 1948, has been rendering valuable service to the less developed countries in eradicating the

deadly diseases like Malaria, Plague, Cholera, Tuberculosis, Leprosy, Small Pox and Cancer etc. Due to its valuable efforts, the health of the people in those countries has been considerably improved. India is one of those countries which has benefited in that way. One of the objectives of the W.H.O. as mentioned in its convention is to encourage research in medical sciences and allied fields, with the international co-operation of the medical scientists and others

interested in public health problems, and according to the same, it has been rendering valuable service for the promotion of medical sciences. The problems in medical climatology are in no way less important than any other health problems. It may not, therefore, be too much to draw the attention of the W.H.O. to encourage research in diverse aspects of this fascinating field of science by collaborating in all possible ways with the W.M.O.

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