



Review Article

Environment Change: Broaden of Diseases

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ABSTRACT

Keywords

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All of us know that the environment is changing at a very rapid rate due to the interference of human activities with the natural resources, ecological systems and atmosphere. Due to these human activities temperature is getting change gradually to a level which became dangerous to our human race as well as for the whole world. These changes are related with various kinds of climatic forcings, mainly the destructive activities of human kind i.e. use of various appliances, automobiles, industries which are producing pollutants and particulate materials in environment and day by day raised the temperature of the earth / globe. Not only the temperature is going to be raised but also several adverse effects are evident from these changes i.e. melting of glaciers, elevation in sea level, vegetation on the high altitude mountains, and high intensity of sun rays etc. These all factors are affecting all forms of life including human. For example the high intense rays cause skin problems in man, high temperature favors the mosquito reproduction hence malaria etc. It is the time to wake up and prevent the destructive processes other wise the whole human race along with other organism on earth have to bear the harmful effects of these climatic changes.

Introduction

In past decades all of us thought that the spread of disease is based on the, human, social and behavioral changes, and global climate change was not responsible for spread of these diseases. Now a day, it is proved that a set of disease is also spread on the basis of global climate changes. zoonoses (disease transmitted by insects

i.e. an arthropods---mosquitoes, sand flies, and tick *etc.* or animals) are the diseases which are affected by the climate changes. Climate change may also affect diseases spread by water, such as cholera, due to changes in rainfall affects the flow of rivers, water level of lakes, increase sea levels (melting of ice on polar region).

Those infections which are spread by insects or animals, pathogen require a vector and reservoir for spreading disease in particular host.

Global climate change and the spread of disease

Infectious Disease

Change in Climate influences the transmission, frequency, types, and harshness of infectious diseases in humans. The interaction between climate and infectious diseases is based on the impact of climate on the pathogen (such as bacteria and viruses), human host, vectors, reservoir hosts and their ecosystems. Climate change can increase the probability of contact between humans and infectious organisms.

Vector-Borne Infectious Diseases

Vector-borne diseases are infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, triatomine bugs, sandflies, and blackflies. Arthropod vectors are cold-blooded (ectothermic) and thus especially sensitive to climatic factors. Weather condition affects survival and reproduction rates of vectors, habitat suitability, distribution and abundance throughout the year. However, climate is one of the many factors influencing vector distribution, such as habitat destruction, land use, pesticide application, and host density. Temperature and rainfall is a major source of infection, so it highly influences the abundance and distribution of insect vectors and animals. Global climate change is also affect the geographic distribution of animals and insects and could expand transmission of infectious diseases carried by insect and other animal

vectors. Geographic distribution of vectors due to change in climate also spread the disease from one place to another. Extreme events, such as flooding and hurricanes lead to displacement of populations from one geographical area to other geographical area. For a vector-borne disease to persist in an area, climatic conditions must support a complex interaction that may involve plants, animals, insects and human activities. Climate-related migrations could also contribute to the dissemination of previously localized diseases. Several vector-borne diseases have been increasing rapidly in recent years, including some that were previously considered to be under control, such as dengue fever and malaria. Strong support for public health programs both domestically and internationally would help to reduce this risk.

Dengue

Dengue is a human disease caused by dengue virus. Dengue virus has 4 serotypes (DEN-1, DEN-2, DEN-3 and DEN-4) and belongs to the family Flaviviridae. Dengue fever is a common affliction throughout the tropics, characterized by fever, rash, muscle and joint pains, and severe prostration especially in adults, but usually the disease is followed by complete recovery. Dengue hemorrhagic fever is a severe form found usually in children and most commonly in Asia. It is complicated by hemorrhage, shock and sometimes death. Dengue viruses are transmitted by *Ae. Aegypti* (a mosquito). When mosquito sucks the blood of infected human, virus gets enters in its GI Tract and replicates in its salivary gland to increase the number for further transmission. The incubation period of the pathogen in the mosquito is shorter if the

ambient temperature is warmer. The most frequent vector of this disease is *A.aegypti*, that is domesticated and breeds in and around human dwellings; in flower pots, water storage jars, cisterns, metal cans, discarded tires, and any other fresh water containers that people leave standing. *Ae. aegypti* does not stand freezing weather, thus, it is limited to tropical and subtropical regions. Dengue is the most important arboviral human disease, however, mainly due to nearly universal use of piped water. Dengue is frequently introduced into Europe by travelers returning from dengue-endemic countries but no local transmission has been reported since it would also depend on the reintroduction of its principal vector, the mosquito *Ae. aegypti* (also the yellow fever mosquito) which is adapted to urban environments.

Global warming affects the spread of this disease because temperature favors the growth of vector. The warming at night is especially favorable to *Ae. aegypti* because it is the extreme temperature for its activity and low temperature, which occurs at night, that is most harmful to the mosquito, thus for their activity.

This serious parasitic disease caused by three major species trematodes (i.e *Schistosoma mansoni*, *S. haematobium*, and *S. japonicum*). At acute phase infected patient suffers from weakness, skin rashes, fever, abdominal pain,. While chronic phase develops urinary tract, liver, lung, or intestinal disease, according to the species of schistosome, and patients may leads to death after several years, usually by urinary tract obstruction, carcinoma of the bladder, portal or pulmonary hypertension, or some other complication. The life cycle of the parasite is digenetic and completes in two host : *snail*, and

human beings. The life cycle of pathogen is susceptible to environmental change, especially in water-associated stages. The infective stage of pathogen is cercariae (larvae) in human, which emerge from infected snails into water. These larvae gets penetrate in the intact human skin, and migrate through the tissues to find target sites in the human host. In target sites, they became mature into adult worms, and reproduce. The female deposits eggs in the venous systems of the bladder or liver of host. The eggs migrate to the ureters or intestines, are excreted in urine or feces, and hatch in the water as miracidia (larvae) that swim to find and enter a snail host. In the snail, the parasite undergoes two generations of sporocysts and emerges as the cercariae. The populations of snail are dependent on temperature, water, and water currents.

The ecological conditions needed by snails for survival have been changed due to the climatic warming. The snail vector of *S. mansoni* had an optimum temperature of 25° to 28°C and lived at 7°C for several days; but at 42°C they became died after 2 hours. The emerge of cercarie (larvae) is also based on the temp. Below 13°C and above 41°C shedding become ceases. Few snails are died when removed from water, but few survived in the region of high humidity.

The snail, which transmits *S. japonicum* in contrast, survived dessication for several weeks, and died at temperatures above 30°C and below 0 to -5°C. The optimum temperature of snail reproduction was 26°C. These studies established that ambient temperature is an important limiting factor of the survival of snails and of the shedding of cercariae. These snails are hermaphrodite in nature and after self-fertilization, they increase in number, once

transported from one geographical region to another through a normal water flow or flooding. As the global climate changes the glaciers are melting, and increase the water level which spread the snail population and transmitted disease. Global warming also favors the growth of snails due to increase atmospheric temperature.

Visceral Leishmaniasis

Temperature and humidity plays an important role in survival of sand flies which is the vector of Visceral *Leishmaniasis*. Sand fly (*Phlebotomus argentipus*) passes cold temperatures in diapauses situations (over wintering), which is initiated by a combination of low temperature and reduced daylight and can last 4 to 8 months depending on location. Change in temperature also affects the activity and growth of parasites (*Leishmania donovani*). The worldwide distribution of sand flies is considered to be confined to areas that have at least one month with a mean temperature of 20°C. Sand flies are sensitive to sudden temperature changes and usually prefer those regions where small differences maximum and minimum temperatures are slightly differ.

Sand fly survival can be reduced if the climate gets too hot and dry, even though the flies may rest in cold, humid places during the daytime. Few species of sand fly live in tree holes and trunks. Peridomestic species rest on walls and, at hot times of the day, retreat into cracks and crevices. Poroton stone buildings provide favourable condition for sand fly growth because they store humidity during night and evaporate during day.

Non-Vector-Borne Infectious Diseases

The causal organism of diseases such as cholera, dysentery, diarrhea and other food & water borne diseases, are flourishes due to change in water temperatures and proliferation of other aquatic microorganisms. Cholera epidemics are typically associated with sea coasts and rivers, for instance, where the cholera causal organism, (*Vibrio cholerae*) survives by sheltering under the mucous coating of tiny invertebrates called copepods. These hosts, in turn, respond both to water temperature and to nutrients (fertilizer, wastewater) in stream runoff. Higher temperatures contribute to faster reproduction by disease organisms. Rates of genetic mutation also increase in times of stress. Furthermore, disease-causing organisms are remarkably resilient and can respond rapidly to changes in the physicochemical environment. Climatic and other environmental changes are contributing to the selection and emergence of genetic strains that are resistant to drugs and other controls.

Direct Effects on Human Health - Heat Stress

Elevation in average temperature increases the heat waves in the regions. This would cause an increase in illness and death, particularly among the young, the elderly, the fragile, especially in large urban areas. In fact, Heat-related mortality may prove to be the largest direct health threat from global climate change. The deaths of 726 people that were attributed to a heatwave in Chicago in the summer of 1995 may be an extreme example. People in mid-latitude cities might also acclimatize to air conditions.

The air conditioner can mitigate perhaps 25 percent of heat-related mortality and also emits green house gases. In addition, summer mortality increases might be partially offset by declines in winter mortality.

Effects on Human Health Food Production and Nutritional Health

Global climate changes also affect the productivity of agriculture, live stocks and fisheries. In various geographical areas, global climate change may lead to droughts, flooding, and the appearance of new plant diseases. Over 800 million people are chronically undernourished today, particularly in the developing world, and malnutrition is an underlying cause of childhood mortality. Population growth, malnutrition may increase the vulnerability of these populations to endemic diseases and epidemics.

Fresh Water Quality and Quantity

Due to climatic changes about 1 billion people lack access to clean and abundant drinking water, and even more are without adequate sanitation. Adjustments to water shortages can be managed where physical infrastructure (reservoirs, pipelines, and canals) and water management institutions exist. Increasing populations dependent on limited sources served by isolated systems are at more risk. Landscapes may erode or stabilize as precipitation alters vegetative cover, thus affecting runoff and transport of sediment and pollutants.

Air Pollution and Allergens

Various industrial processes are involves in the production of green house gases and also emit a large number of particulate materials in the environment particularly

in urban areas, and these particulates are causing serious health troubles. Fine particulates are also released from fossils fuels and wood smoke and change the climate. In the future, as global increases in energy production lead to higher levels of particulates, and increases in temperature and ultraviolet radiation accelerate the reactions that produce ozone and other secondary pollutants, the health effects of air pollution on a global scale could be staggering. Higher temperatures and humidity may also lead to higher concentrations of plant pollen and fungal spores that cause allergic disorders such as asthma and hay fever.

Weather Disasters and Rising Sea Level

Long-term climate change over the entire planet may result in an increase in extreme weather events, such as droughts, floods, and cyclones. These events could increase the number of deaths and injuries and the incidence of infectious diseases and psychological disorders, as well as causing indirect effects through food shortages and the proliferation of disease vectors. A 40-centimeter rise in sea level would approximately double the number of people who are currently exposed to flooding each year in areas like Bangladesh. It could also contribute to the loss of coastal and delta farmland, as in Egypt, and to the destruction of food supplies. Rising sea level also increases the vulnerability of costal cities, low-lying areas, and small islands to damage during storms.

The increase in global temperature has direct impact on the various resources, animals, plants and other living organisms. It has raised the melting of glaciers / ice on mountains and thus elevating the level of sea to a limit of danger. In the same way,

high temperature have also affected the human health and increased the spread and prevalence of various diseases globally. For example; the higher temperatures have increased the level of dead / decomposed organic matter (humus), which is required for the growth, development and reproduction of lower organisms that causes the disease i.e. sand flies, house flies, mosquito etc. Thus higher the temperature more is the organic matter and higher will the prevalence of the diseases. The rise in the temperature has also affected the non vector born disease due to contamination in various resources i.e. cholera etc. thus higher temperature contribute in the faster reproduction of the disease causing organism and thus the diseases.

References

- Bouma, M.J., H.E. Sondorp and van der Kaay, J.H. 1994. Health and Climate Change. *Lancet*. 343: 302.
- Bradley, D. J., 1993. Human tropical diseases in a changing environment. In *Environmental change and human health*, CIBA Foundation Symposium 175. New York: John Wiley and Sons. pp. 146-170
- Burgos, J.J., S.I. Curto de Casas and Carcavallo, R.U. 1994. Global Climate Change in the Distribution of Some Pathogenic Complexes. *Entomologia. Vector*. 1: 69-82.
- Lederberg, J., R.E. Shope, Oaks, Jr. SC, 1992. *Emerging Infections: Microbial Threats to Health in the United States*. Washington D.C.: National Academy Press.
- Levins, R., T. Awerbuch and Brinkman, U. *The Emergence of New Diseases*
- Loevinsohn, M.E., 1994. Climatic warming and increased malaria incidence in Rwanda. *Lancet*. 343: 714-718.
- Martens, W.J.M., 1995. *Modelling the Effect of Global Warming on the Prevalence of Schistosomiasis*. GLOBE Report Series No. 10 RIVM Report No.461502010, Bithoven: Global Dynamics and Sustainable Development Programme.
- Martens, W.J.M., L.W. Niessen and Rotmans, J. 1995. Potential impact of global climate change on malaria risk. *Environ. Health. Perspect*. 103: 458-464.
- Martens, W.J.M., T.H. Jetten and Rotmans J. 1995. *Climate Change and Vector-Borne Diseases: a Global Modelling Perspective*. *Global Environ. Change*. 5: 195-209.
- Martin, P.H., and Lefebvre, M.G. 1995. *Malaria and Climate: Sensitivity of Malaria Potential Transmission to Climate*. *Ambio*. 24: 200-207.
- McMichael, A.J., M. Ando and Carcavallo R. 1995. *Human Population Health*. In IPCC Working Group II Second Assessment Report. Geneva: World Meteorological Organisation/United Nations Environment Programme.
- McMichael, A.J., and M.Y. Beers. 1994. *Climate Change and Human Population Health: Global and South Australian Perspectives*. *Trans. Royal Society. South Aust*. 118: 91-98. ;
- Monath, T.P., 1993. *Arthropod-Borne Viruses*. In Morse, S.S, editor. *Emerging Viruses*. New York: Oxford University Press. 138-148.
- Morse, S.S., 1995. Factors in the emergence of infectious diseases. *Emerg. Infect. Dis*. 1: 7-15.

- Morse, S.S.,1995. Factors in the emergence of infectious diseases. *Emer. Infect. Dis.* 1: 7-15
- Myers, N., and Kent, J. 1995. *Environmental Exodus: An Emergent Crisis in the Global Arena.* Washington D.C.: The Climate Institute.
- Shope, R.E., 1991. Global Climate Change and Infectious Diseases. *Environ. Health Perspec.* 96: 171-174.
- Shope, R.E., 1991. Global Climate Change and Infectious Diseases. *Environ. Health. Perspect.* 96: 171-174.
- Sutherst, R.W., 1993. Arthropods as disease vectors in a changing environment. In *Environmental change and human health*, CIBA Foundation Symposium 175. New York: John Wiley and Sons.pp.124-140.
- Sutherst, R.W., 1994. Climate change and arbovirus transmission. In Uren MF, Kay BH, editors. *Arbovirus Research in Australia, Proceedings 6th Symposium.* Brisbane: CSIRO/QIMR, 1994: 297-299.
- Sutherst, R.W.,1994. Climate change and arbovirus transmission. In Uren MF, Kay BH, editors. *Arbovirus Research in Australia, Proceedings 6th Symposium.* Brisbane: CSIRO/QIMR.pp.297-299.