



Global Warming and Microorganisms: Brief Insights to the Emerging Diseases

Rashed Noor*, Bushra E Anjum, Saffat Reaz, Farhana Farin Tasnim, Kaneez Fatima, Mohammed Fahad Alam Saeed, Md Imran Khan Masum, Mahbuba Akther, Margia Hossain Rahi and Hafsa Jarin Snigdha

School of Life Sciences (SLS), Independent University, Bangladesh (IUB), Bashundhara, Dhaka, Bangladesh

***Corresponding Author:** Rashed Noor, School of Life Sciences (SLS), Independent University, Bangladesh (IUB), Bashundhara, Dhaka, Bangladesh.

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Abstract

The consequences of global warming as well as climate changes have recently been appearing as a huge threat round the globe because of the associated decline in the environmental sustainability which in turn is noticed to evoke the mass public health deterioration. Promulgation of re-emerging diseases has been connected by several groups of scientists to one of the ghastly effects of global warming. The significance of understanding the changes in the biodiversity; i.e., the variations in disease causing bacteria and viruses, vectors and hosts is noteworthy upon the environmental perturbations caused by the global warming and by the climate change as well. Such a study would benefit the overall public health globally. Present review concisely described environmental issues raised by the global warming and about the associated vector-borne re-emerging diseases.

Keywords: Global Warming; Microorganisms; Climate Change; Emerging and Re-Emerging Diseases; Vector; Biodiversity

Abbreviations

MERS-CoV: Middle East Respiratory Syndrome Coronavirus; SARS: Severe Acute Respiratory Syndrome; CHIKV: Chikungunya Virus; DENV: Dengue Virus; ZIKV: Zika Virus

Current situation of global warming and its impact on microorganisms

Recent scientific interest into global surface temperature variability and climate change impacts led to unravel (1) the incidences of summertime warm that is associated with the raise of sea surface temperatures and (2) the wintertime cold extreme that is linked with the atmospheric warming tendency [1]. Besides, the signs and signals of climate change is another serious concern for the scientists. Extreme weather events, melting of ice, elevated sea levels, acidification of the oceans, reduced fresh-water resources,

abnormal precipitation (heavy rainfall both in spatial and temporal patterns), increase in the atmospheric carbon dioxide (CO₂), the heightening of the greenhouse gases, heat waves, disruption and depletion of stratospheric ozone, the unpredictable intense weather conditions, soil degradation and the loss of productivity of agricultural land, desertification, and most importantly the decreased trend in the biodiversity with a concomitant increased rate of infectious disease emergence and re-emergence brought the interest of the scientists working especially in life sciences. Among them, the microbiologists are now focusing on the impact of global warming/ climate change on (1) the microbial consortium in the environment, especially in soil and ocean, (2) on the host - pathogen interactions followed by (3) the global burden of infectious and re-emerging diseases [2].

ticks) transmitting a particular pathogenic virus or bacteria; and hence elevate the rate of diseases like malaria, Chikungunya Virus (CHIKV) infection, Dengue Virus (DENV) infection, Lyme disease, Ebola virus infection, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection, Zika Virus (ZIKV) infection, yellow fever, West Nile Virus infection, Severe Acute Respiratory Syndrome (SARS), food borne illness, etc. [12,13]. These diseases are well known for causing the global fatality since appropriate vaccination strategies against these infections are still obscure.

Onset of re-emerging diseases due to global warming

Infectious diseases are actually thought to emerge due to (1) changes in their geographic ranges and (2) by the genetic changes in microorganisms infecting animals which in turn make the microorganisms further capable of infecting humans [13]. The emergence and re-emergence of infectious diseases is principally dependent on (1) the pathogenic survival and on the vector survival and reproduction; (2) microbial contamination of water and food; and to a great extent, (3) on the abundance of hosts. All factors are influenced by the environmental changes brought up by the global warming effects (Figure 2).

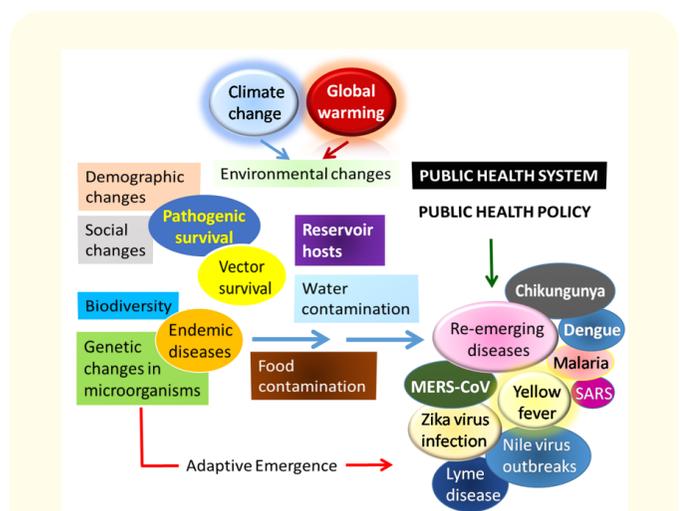


Figure 2: Proposed model of Global warming and re-emerging diseases. Along with the demographic- and social changes through the environmental deregulations caused by the global warming, the alteration in biodiversity as well as the changes in specific set(s) of gene(s) within the virulent microorganisms may trigger the onset of re-emerging diseases like CHIKV infection, DENV infection, ZIKV infection, etc. Such epidemics are expected to be augmented by the survival enhancement capacity of the infectious microorganisms and the associated vectors due to the altered/ favorable environment imparted by the global warming.

Earlier reports have shown that several countries round the globe are experiencing a range of disease outbreaks principally due to the natural dissemination of pathogenic bacteria and viruses into the environment [14]. Appropriate vaccination programs, defined chemotherapy may theoretically combat these emerging and re-emerging diseases; however, the microbiologists, the environmental scientists, the health professionals, and the people working with the climate change should focus on the clinical impacts of global warming which triggers the acceleration of these diseases within different geographical locations. From the discussion put above it is clear that a methodological maintenance of the environment is quite essential at least to pause the re-emerging infections since the appropriate treatment of diseases is not possible everywhere especially in the resource poor settings.

Besides routine clinical diagnosis, the medication strategies, measuring the drug-resistance traits of the infectious microorganisms, development of new drugs and vaccines, determining the rate of global warming using systematic tools (for example, by the process-based mathematical models to scrutinize the likelihood of the arthropod vector influx) may aid to forecast the disease epidemics and hence can help mass people to be aware of these infections [15,16]. Moreover, from the microbiological point of view, a handful of wet experiments using the affected cases demand to be conducted in order to project the future distribution especially of the vectors. Along with the global carbon emission, the environmental temperature - precipitation (rainfall) co-lineage for the vector survival as well as for the growth rates of the microorganisms is also in essence [16].

Conclusion

Together with the recent reports as well as from the above write-up, it is evidently clear that the global warming strongly influences the biodiversity as well as the infectious disease emergence and re-emergence. The mechanism behind such disease epidemics generated by the natural imbalance is being thoroughly investigated by different groups in different countries. It is simultaneously interesting and scary to know that the disruption of temperature within the nature; i.e., the climate change accounts for the increase in the number and extent of the emerging and re-emerging diseases. Involvement of the health professionals with the environmental scientists and the microbiologists would be fruitful to develop the preventive strategies against these diseases caused by the climate change and the global warming. Genetic analyses of the disease causing bacteria and viruses would further aid to develop clinical counters to improve the mass public health.

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Conflict of Interest

Authors have declared that they have no conflict of interest.

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