PIONEER
ACADEMIC PUBLISHING LIMITED

Current Research in Medical Sciences
ISSN 2958-0390
www.pioneerpublisher.com/crms
Volume 3 Number 1 March 2024

Climate Change Impacts on Human Health

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doi:10.56397/CRMS.2024.03.01

Abstract

Our environment provides us with natural resources that are important for our survival and livelihoods. The Earth's species are dependent on the ecosystem service functions of our planet which is driven by climate stability. Health is a very important aspect and is most essential for life. Health is directly related to the nature of the environment, weather and climate. Changes in weather and climate have influenced the health of human populations in the past and caused several epidemics. Weather and climate can affect the distribution and survival of several arthropods, such as mosquitoes or mammals that are vectors for various diseases. Recently many people in Kerala and some parts of South India were affected by the West Nile virus which is attributed to the changing weather and vector borne influences. This fever is a mosquito-borne zoonotic disease and is caused by the flavivirus — West Nile Virus. The state of Kerala was on high alert as a seven year old boy from Mallapuram died in Kozikode due to the virus. In the same way, the water quality can be impacted giving rise to health problems. We are observing changes in the frequency and severity of weather and climate phenomena. This is seen as heavy rains, droughts, and also extreme cold or hot temperatures in different geographical regions. All this can lead to new climate-related health threats. Therefore, climate variability can pose threats to human health in several ways. The impacts of climate change are already being witnessed and will further increase in the coming decades. It may also lead to several emerging infectious diseases. Scientists study the exposure pathways in humans and animals for understanding the impacts of climate change on health. This involves conducting studies over time and in different locations, among different communities. In this research paper will discuss about the various impacts of climate change on human health.

Keywords: threats, diseases, impacts, epidemics and transmissions

Climate Change: Potential Health Impacts

A change in the global climate will affect the normal functioning of the earth's ecosystems. Some countries may experience extreme cold temperatures and people living in such areas would want warmer climates. Likewise certain areas may receive very hot temperatures and people would want milder temperatures. These changes in climate can lead to beneficial and/or adverse effects. The World Health Organization in its report on World Health in the year 2002 reported that climate change induced 2.4% of diarrhea, and 6% of malaria in the middle

income countries. The changes that may be witnessed initially may be some changes in the seasonality of some infectious diseases. This includes vector borne infections such as malaria, dengue, salmonellas is and so on that strike during the warmer periods. Further certain types of viral outbreaks are also common during high temperatures. Some individuals and plant and animal species may die due to sudden change in climate variability. Whereas some plant species are able to adapt themselves to harsh climatic conditions. Some other potential impacts of climate change include disturbed ecosystems that will affect food production, agrarian distress and social issues, land degradation, population displacements and rising sea levels.

Weather and Climate: Human Exposure

In order to understand the relationship between climate change and health we need to understand the health impacts of various meteorological exposures. These include weather, climate variability and climate change. Weather is defined as the constant change in the atmospheric conditions that occurs from minutes to weeks. Climate is generally referred to as the average state of the lower atmosphere, and related characteristics of the underlying land or water, with respect to a particular region/area, that's occurs over a period of several years. Climate variability is referred to as the variation about the average climate. This includes seasonal variations. It also includes the El Niño/ Southern Oscillation (ENSO) or the North Atlantic Oscillation that are large-scale regional cycles in atmospheric and ocean circulations. Climate change occurs over long time-scales. The most observed changes in the global climate have occurred due to natural reasons such as continental drift, astronomical cycles, variations in solar energy output and volcanic activities. But presently it is observed that human activities are responsible for bringing about global climate change.

The Planet's Natural Climate

The earth's climate is influenced by a set of interactions between the earth's sun, oceans, atmosphere, cry sphere, land surface and biosphere. The driving force for our planet's weather and climate comes from the sun. Due to uneven heating of the planet's surface there is greater convection flow in the atmosphere and oceans. This results in winds and ocean currents. The troposphere, stratosphere, mesosphere, thermosphere and exosphere are layers of our planet. Weather phenomena occur in the troposphere. The ozone in the stratosphere absorbs the high UV rays emitted from the sun. The earth receives energy from the sun, which warms the earth's surface. As this energy passes through the atmosphere, a certain percentage, approximately 30% gets scattered. Some part of this energy is reflected back into the atmosphere from the land and ocean surface. The rest approximately 70% remains to heat the earth. In order to establish a balance, the earth must radiate some energy back into the atmosphere.

As the earth is much cooler than the sun, it does not emit energy as visible light but emits through infrared or thermal radiation. However, certain gases in the atmosphere form a sort of blanket around the earth and absorb some of this energy. Without this blanket effect, our earth would be around 30°C colder than it normally is. These gases like carbon dioxide, methane, and nitrous oxide, along with water vapour, comprise less than one per cent of the atmosphere. They are called 'greenhouse gases' as the working principle is same as that which occurs in a greenhouse. This trapping of the radiation is responsible for the increased temperatures inside the greenhouse. This phenomenon is known as the green house effect and this process results in warming the air in the lower layers leading to global warming. This gas blanket has been in place ever since the formation of the earth. Together due to the natural green house effect, the earth's temperature is maintained to a present surface average of 33ºC.

Human Induced Greenhouse Gas Emissions

Since the industrial revolution human activities have been releasing more and more of these greenhouse gases into the atmosphere. This leads to the blanket becoming thicker and upsets the 'natural greenhouse effect'. The resulting enhanced greenhouse effect is more commonly referred to as global warming or climate change. The most important greenhouse gases are CO2, methane, chlorofluorocarbons and nitrous oxide. Scientists predict 1.5 - 4.5°C increase in temperatures by 2100. This may result in glaciers melting, sea levels rising, and redistribution of dry and wet regions. During the pre-industrial era, the amount of carbon dioxide remained constant but now it has increased from 250 ppm (in the year 1900) to

approximately 350 ppm presently more due to industrialization and urbanization. Economic activity, technology and population explosion are driving factors in enhancing global warming. Atmospheric CO2 levels have been increasing at an alarming rate since 1970. The industrial revolution around the 18th century has brought about a drastic change in the chemical composition of our atmosphere primarily due to the use of fossil fuels for energy production and transportation. Anthropogenic sources such as excessive fossil fuel burning, methane emissions from agricultural activities, manufacturing processes that use chlorofluorocarbons are increasing the greenhouse effect and thereby warming the planet. Research studies reveal that the atmospheric CO2 levels are expected to reach 450 ppm by the year 2040.

Environmental Impacts

In order to understand the relationship between climate change and health it is pertinent to understand some environmental impacts that can occur due to climate change. This is because these environmental impacts trigger health impacts in particular regions or areas. A rise in temperature would lead to the following consequences: Rapid loss of biodiversity and a decline in the earth's natural resources. There could be a change in the rainfall and monsoon patterns. There can be melting of ice caps and glaciers. Further, increasing temperatures would cause thermal expansion of the oceans and the sea level will rise. This will result in floods in the productive deltaic regions. Sea level rise can also result in the disappearance of many islands in the Caribbean, Pacific and the Indian oceans. Climate change can also cause disastrous effects on the different ecosystems. It can result in the disruption of marine ecosystems and cause flooding in the coastal wetlands. It could trigger frequent storms in many regions where storms were never experienced before. Such climate change induced floods can result in the spread of several infectious diseases. Finally, it can cause groundwater contamination and pose a threat to human health.

Need for Studying Climate Impacts on Health

Now that you have understood the environmental impacts and related human health threats due to climate change, let us analyze the need for studying such impacts. In this context, it is important how humans are exposed to the effect. Therefore, exposure is the most important factor for analyzing the impacts of climate change on human health. Weather and climate have to be studied over various spatial and temporal scales. The data regarding weather, disease, health status, land-use patterns, climate variability are all required for assessing the human health statistics in a particular region. Such studies can help address issues such as the spread of vector-borne diseases like chikungunya and dengue. Studies should incorporate the uncertainties that are inherent. Weather and Health: Anthropogenic Causes the London Smog of 1952: Case Study. This incident occurred in December 1952. During the cold month of December, most people in London burnt large amounts of coal for heating their homes. As a result, enormous emissions of smoke, soot, ash, sulphur oxides etc. were generated from the chimneys. On December 5th 1952, the temperature went down to -1 C and the humidity was around 80%. There was a thick fog and the air near the ground was moist. Usually, the air close to the ground is warmer than the air above it, and therefore rises but in this particular event, it resulted in the formation of a static layer of cooler air close to the ground, which Health is an atmospheric phenomenon called temperature inversion. The accumulation of smoke close to the ground was so much that the sunlight was totally cut off and the air stayed cool and static. An enormous amount of black soot, sticky particles of tar and gaseous sulphur dioxide were trapped in the fog which gave the fog a yellow-black colour. The water from the fog condensed around the soot particles. The sulphur dioxide reacted inside the foggy, sooty droplets forming sulphuric acid producing intense acid rain. Average smoke measurements taken at the National Gallery in London between the 4th and 8th December 1952 showed that the PM concentration was 56 times the level normally experienced and the sulphur dioxide level increased by 7 times (700 ppb). Around 4000 people died due to the smog causing pneumonia, bronchitis, tuberculosis, heart failure, asphyxiation, chest pains, inflammation of the lungs, damage to respiratory cells, permanent lung damage, respiratory ailments, susceptibility to cancers etc. The effects on vegetation were profound due to the resulting acidic rain. Following this disastrous event, London formulated the Clean air act, 1956 and all the traditional coal fires were converted to heaters fueled by gas, steam, hot water, oil,

smokeless coal and electricity.

Climate Change Effects on Human Health and Well-Being

Climate change has already affected human health. Major concerns are extreme weather events such as heat-waves, cold spells, floods and windstorms. Taking steps to tackle the root causes of climate change, understand the health co-benefits of action, invest in healthy environments, and advocate health-related developments is vital in order to reduce the burden of disease and promote population health. Evidence is growing that some weather events are likely to become more frequent, more widespread and/or more intense during the 21st century (IPCC, 2007). Human beings are presently exposed to climate change through changing weather patterns, changes in water, air, food quality, agriculture, livelihoods and infrastructure (Confalonieri et al., 2007). These direct and indirect exposures can result in a variety of health impacts, most of which are anticipated to be negative and will profoundly worsen if current accelerating trends continue unabated. Many health impacts resulting from extreme weather events can potentially be prevented through early warning systems and public health preparedness and response action. In recent years, many countries have experienced major heat-waves, floods and droughts that have led to deaths and human suffering, social disruption and a substantial burden to health systems. These changes will have a wider effect on the socioeconomic development, ecosystems, food production, water, agriculture and settlements (IPCC, 2007). Episodes of extreme temperature can affect health significantly, and they present a challenge for health systems.

Heat Exposure and Health Impacts

healthy human body has the internal temperature of about 37°C. A change in the temperature of more than 1°C occurs during periods of illness or environmental stress. The body's temperature also changes with the changing weather. The body knows to regulate the internal and external heat through its metabolic pathways. The average temperature of an adult is 97.8C. This may vary according to the activity we perform or during illness. The doctor records our temperature using a thermometer kept orally, rectally or under the arm. It is reported that the temperature recorded rectally is the most accurate. The hypothalamus in the human brain controls and regulates our temperature, balancing salt concentrations and body fluids and several other involuntary functions such as breathing, digestion, beating of our heart and so on. Transfer of heat from the body occurs through sweating, convection and radiation. When the temperature in the surrounding and body's skin temperature is the same approximately 35 to 37C, then no radiant heat loss or gain occurs. When the body gets hot the hypothalamus and nervous system direct the sweat glands to draw water from the dermis (innermost layer of skin), thereby causing an evaporative cooling on the skin's surface. Higher temperatures and heat cause heat stress in human beings and also animals. It has adverse effects on the population. Industrialization and urbanization especially in the developing world is giving way to increasing urban heat island effects. Our body's internal thermal regulatory mechanism "thermostat" helps to maintain a constant temperature by increasing the production of sweat and supplying more blood to the skin. This increases the rate of heat loss to balance the heat burden. In extreme hot conditions the rate of "heat gain" is more than the rate of "heat loss". As a result our body temperatures increase. This in turn can result in various health disorders. High heat exposures can result in exhaustion, fatigue, dehydration and heat stroke. In extreme cases and among the elderly or in children in can lead to sudden death. Heat stress has influences on our mental health. It can lead to mood swings, psychological disorders and disturbed sleep patterns. Extreme heat can also result in irritability and lack of concentration to do work. A report by the National Institute for Occupational Safety and Health (NIOSH; Ohio; 2013) concluded that women are less heat tolerant than men. This may be related to the cardiovascular activities, metabolism and body size. Heat stress can cause the following diseases. Heat edema: This results in swelling of the ankles. Heat rashes: These are small red spots that bring about a prickling sensation. It occurs due to the inflammation of the sweat glands. Heat cramps: This is caused as pain in the muscles due to salt imbalance. Heat exhaustion: This is caused due to excessive sweating. It can lead to excessive sweating, weakness, dizziness, eye disorders, intense thirst, nausea, headache, vomiting, diarrhea, muscle cramps,

breathlessness, palpitations, tingling and numbness of the hands and feet. Heat syncope: This is caused due to the insufficient flow of blood to the brain. It can result in dizziness and fainting. Heat stroke: This is due to extreme heat and is very serious. This occurs when the body temperatures are above 41°C. Higher temperatures can also lead to weakness, muscle cramps, dizziness, nausea, thirst and excessive sweating. Other important diseases caused due to heat include: Kidney diseases: High and extended periods of exposure to hot temperatures can cause major kidney diseases. Rhabdomyolysis results from heat stroke and has been linked to long-term renal disease. Kidney and urinary bladder infections are also more during hotter temperatures due to the body's impaired water regulating ability. Pollen allergies: The allergies due to pollen and other plants may be more in warm temperatures and summer. It can cause various skin ailments, asthma and nasal congestion in some cases. Cardiovascular diseases: Warmer temperatures spiral the rate of cardiovascular diseases and people are affected by stroke and dysrhythmia.

Extreme Weather Events

Changing climate can bring about extreme weather events. It is expected that the speed of hurricanes will increase by 11% by the end of the 21st century. The total rainfall is also expected to increase by 30% and above. Some regions may experience drought. Such unprecedented extreme weather events can result in flooding and water contamination, declining crop yields, destruction in natural resources and much more. They can have wide range of implications for human populations. Human health risks due to extreme weather events include the following:

a) Extreme weather and Food borne diseases: Climate change has resulted in significant crop destruction and reduced the availability and nutritional content of food. Extreme weather has caused farms to be infested with bugs and aphids. Farmers use unsustainable practices such as the application of synthetic pesticides which reduces the nutrition of crop yields. It is reported that aflatoxin is linked to global warming.

b) Extreme rainfall and diseases: 51% of water borne outbreaks occurs during extreme weather events. High rainfall leads to the spread infectious pathogens that contaminate drinking water reserves. Microorganisms and toxins that are spread through contaminated water can cause diseases such as typhoid, cholera, schistosomiasis, amoebic dysentry, giardiasis and other gastrointestinal problems. Viruses also spread during rainfall and make people ill. Floods can result in injury, death, infections, destruction of homes and displacement of people. Amoebic dysentery: This is also known as amoebiasis and is caused by the single-celled parasite Entamoeba histolytica. The protozoan parasites infest and destroy the cells of the colon causing bloody diarrhoea and liver abscesses. The disease mostly occurs after contamination of the water bodies and in areas with poor sanitation. With proper sanitation and water treatment the disease can be controlled. Cholera: It is an infectious disease caused by the bacterium Vibrio cholera that thrives in aquatic environments. It causes severe watery diarrhea, vomiting, fever, dehydration and also death. The infection spreads after the ingestion of contaminated water or food. Cholera is reported to be spreading in vulnerable regions of the world due to the increase in severe heat waves and more frequent and intense flooding. Haiti has experienced a surge in cholera outbreaks ever since the 2010 earthquake. Countries where there is a high population, poor water sanitation and crowded living conditions are mostly vulnerable. A team of investigators from the University of Maryland, USA observed that cholera is more during periods of excessive rainfall and higher air temperatures. During excessive rainfall, flooding can spread the bacteria to other regions resulting in fast-spreading epidemics. The researchers are also analyzing the climatological and hydrological cycles with NASA's Gravity Recovery and Climate Experiment (GRACE) satellites to identify environmental factors and correlate them with cholera outbreaks for prediction and warnings.

c) Extreme cold events and diseases: These are winter related diseases. Some regions are experiencing extreme chillness and cold which have increased due to climate variability. Extreme precipitation as snowfall can cause frostbite, asthma, rhinorrhea, pneumonia, influenza, norovirus, psoriasis, cold urticaria, carpel tunnel syndrome, tenosynovitis, myocardial infarction and heart diseases.

d) Cloud cover impacts, frontal passage and sunshine: Rapid changes in temperature cause

physiological changes in the human body. Rapid drops in temperature may affect blood pH, blood pressure, urination volume, and tissue permeability (Persinger, 1980). Outbreaks of epidemics may also be related to frontal passage. Donle (1975) observed sudden large influenza outbreaks in Germany, Norway, and Switzerland that occurred simultaneously with the influx of cold air over Northern and Western Europe (the passage of a surface wave is often followed by a rapid influx of cold air). The influenza outbreaks in Europe most frequently occurred in the cold months between January and March, when cold air masses most commonly intruded over the area. Studies have also reported the relationship of migraine attacks and rapid changes in barometric pressure. Cull (1981) observed fewer migraine attacks when the barometric pressure was low. This may be attributed to a decrease in sunshine during low-pressure intrusions, as solar radiation is a suspected triggering mechanism for migraine onset. The Canadian Climate Center study (1981) reported that migraines were most likely to occur on days with falling pressure, rising humidity, high winds, and rapid temperature fluctuations.

e) Effects of Humidity: Humidity also has an important impact on mortality as it influences the ability of the human body to cool itself by means of sweating or perspiration. The effects of low humidity occur in winter months and it induces stress on the naso-pharynx and trachea. Upper respiratory tract infections, bacterial and viral infections occur due to increase in the viscosity of the bronchial mucous and reduced immunity. In the same way high humidity also causes health impacts.

Infectious Diseases

Infectious diseases are spread due to climate and weather changes. The World Health Organization (WHO) predicts that vector-borne diseases will increase with climate change. Vectors are living organisms that can transmit infectious diseases among human beings and from animals to humans. Most of the vectors are bloodsucking insects, which ingest disease-producing microorganisms during a blood meal from an infected host (human or animal) and later inject it into a new host during their subsequent blood meal. Mosquitoes are the best known disease vector. Others include ticks, flies, sandflies, fleas, triatomine bugs and some freshwater aquatic snails. Historically, vector-borne diseases have been recorded in different countries in various climates. However, these diseases are steadily increasing as an indirect result of climate change. These diseases account for 17% of all infectious diseases and are highest in tropical and subtropical areas. Since 2014, major outbreaks of such diseases such as dengue, malaria, chikungunya and Zika have affected many populations in different countries. The distribution of such diseases is related to the demographic, environmental and social factors. Factors such as unplanned urbanization, changes in agricultural practices, and climate change can impact the transmission of pathogens. Further the growth of urban slums and improper solid waste management can put large populations at risk. Climate is known to be a major environmental driver influencing the epidemiology. Weather conditions affect the survival and reproduction rates of the vectors, their habitat suitability, distribution and abundance. Further climate change also impacts the development, reproduction and survival of the pathogens and viruses inside the vectors too. The Intergovernmental Panel on Climate Change (IPCC) lists vector-borne diseases among the consequences most likely to change due to global warming.

Vector Borne Viral Diseases

a) West Nile Virus: Geographically, the virus originated in Uganda in Africa since 1937. In the 1990's outbreaks were observed in Israel and Africa. Recently cases of West Nile viruses were reported in India in Kerala in 2019. Presently the virus is a vector-borne pathogen of global importance. With higher temperatures and humidity mosquitoes breed and reproduce more. They are vectors for transmitting the deadly West Nile virus fever. Culex quinquefasciatus is a vector and transmits the virus through biting. The Asian tiger mosquito — Aedes albopictus is also a vector for the West Nile virus. The symptoms include fever, headaches, body aches, fatigue, skin rash, vomiting and diarrhea. It can also cause encephalitis and meningitis. WNV originated in Uganda and is a widespread arthropodborne virus, an enveloped, single-strand RNA virus of the genus Flavivirus in the family of Flaviviridae. Prolonged warmer seasons and changing rainfall patterns are allowing these insects to survive longer. There are various factors that impact the transmission and distribution of the virus such as the interactions between pathogen, vector, vertebrate hosts and the environment. Also the

weather conditions have direct and indirect influences on vector competence (the ability to acquire, maintain and transmit the virus), on the vector population dynamic and on the virus replication rate within the mosquito. The importance of climatic factors (temperature, precipitation, relative humidity and winds) as drivers in WNV epidemiology is increasing under conditions of climate change.

b) Dengue Fever: Dengue fever affects millions of people globally every year. It is commonly observed in the Caribbean and tropical regions. Presently, the impact of climate change on dengue is increasing and is serious public health concern. It is observed the unseasonably wet and warm weather seasons and early monsoons have led to a number of dengue outbreaks in the Asia-Pacific region. There are many species in the ecological web that can keep the mosquitoes away. But the use of pesticides is wiping away these species thereby allowing mosquitoes to flourish. Climate change is directly linked to rising dengue cases every year. The Dengue viruses are transmitted by the Aedes mosquitoes, which are highly sensitive to environmental conditions. Higher temperatures reduce the time required for the virus replication and disseminate in the mosquito. This is known as the "extrinsic incubation period". It must occur before the virus can reach the salivary glands of the mosquitoes to be infected to humans. If the mosquito becomes infectious sooner due to warmer temperatures, it has a greater chance of infecting man before it dies. Dengue is endemic in more than 100 countries, including African, American, Asian, and Western Pacific countries with tropical climates.

c) Chikungunya: The changing weather and climate change has resulted in the resurgence of chikungunya. It is caused by the chikungunya virus (CHIKV) and is spread through the mosquitoes Aedes albopictus and Aedes aegypti. These mosquitoes mainly bite during the day time. The symptoms usually occur after ten to twelve days of exposure including fever, rash, severe myalgia, joint pain that stay for months together. It was first reported in Tanzania in 1952. The word chikungunya comes from the African Kimakonde language meaning "bent posture or to become contorted". Epidemics began in 2004 in 2004 and spread to the islands of the Indian Ocean. A million people were affected with the disease in 2005 in these islands. The medical communities started taking notice in 2005 when it affected 1.4 million people in India and in the French island of Réunion in the southwest Indian Ocean. It appears that the chikungunya reemergence depends on several factors — climate being an important one. With drought and heavy rainfall events disease vectors will spread quickly and vector-borne chikungunya prevalence is likely to increase, with the possibility of becoming endemic globally.

d) Zika Virus: Zika virus is a mosquito-borne flavivirus. It was first noticed in monkeys in Africa, Uganda in 1947. In 1952 in Uganda and the United Republic of Tanzania the disease was observed in humans. Very few cases have been reported from 1960–1980 that too in Asia and Africa. But in 2013 a large outbreak was reported in French Polynesia and other countries in the Pacific. Brazil reported a large outbreak in 2015. Presently a total of 86 countries and territories have reported Zika infection. The incubation period of Zika virus is 3–14 days. The people infected have fever, rash, conjunctivitis, muscle and joint pain, malaise, and headache. The infection lasts for 2–7 days. Severe storms and temperature rise are some environmental factors for the sudden resurgence of this disease.

e) Nipah Virus: It is a zoonotic virus that is transmitted from animals to human beings. The virus is found in the natural reservoir — bat species Pteropus. It was recently reported in many parts in India. It is generally transmitted through contaminated food or even directly between people. The people affected show headache, dizziness, respiratory distress, acute respiratory illness and encephalitis. The virus also affects livestock and economic loss among farmers. The World Health Organisation reports that there are direct linkages to climate change, deforestation and transmission of the virus. The loss of natural habitat of the bats and climate variability affect the food requirements of the bats. Nipah virus was first identified in 1998 in Malaysia. The areas that are affected the most are those that have abundant deforestation and the bats are getting to closer to human habitation which can be a cause for the transmission of the disease.

Vector Borne Protozoan Diseases

a) Malaria: Malaria annually claims more lives globally worldwide than any other disease. The vector-borne disease is transmitted by the female Anopheles mosquitoes. Plasmodium is a genus of the parasitic protozoans and are the

causative organisms causing malaria. Five species can cause malaria in human beings. They include P. vivax (most widespread form), P. ovale, P. falciparum (common form, most severe symptoms), P. malariae, and P. knowlesi. Plasmodium parasites multiply in the human liver after an infected mosquito bites and then it destroys the red blood cells. The symptoms of malaria are fever with shivering, headaches, seizures, vomiting, fatigue, pain. Malaria is reported to be the most sensitive to long-term climate change. The linkages between malaria and extreme climatic events are an important area of research and have long been studied. South India, Delhi and Punjab have experienced periodic malaria epidemics. Excessive rainfall and high humidity was reported to be the major environmental factor enhancing mosquito breeding and survival. Studies have brought out the relationship between climatic variables and biological parameters in malaria epidemics. The vector breeding, survival, mosquito biting rates, and parasite incubation rates are directly linked to climate variables. Therefore, climate change affects vector and parasite biology and disease transmission. The World Bank report estimates that by the year 2050, climate change will bring about a 50% higher probability of malaria in previously unexposed regions of South.

Tick and Flea-Borne Illness

In addition to mosquitoes, ticks are responsible for a number of vector-borne diseases. The Lyme disease is caused by ticks. With increasing temperatures and high levels of humidity a major increase in Lyme disease is observed in different parts worldwide. Bubonic plague occurred in the 14th century that wiped out 50% of the European population. It is also known as the "Black Death" and was an epidemic and killed 25 million people. The rodents are the vectors for plague and transmitted to fleas that bite them, which then infect humans. In the same way Tularemia caused by the bacterium Francisella tularensis is transmitted to humans through flea or tick bite. Epidemiologists have also reported the increase of flea-borne diseases. Fleas also live and flourish in warm, humid climates. Climate change and wildlife habitat destruction are some factors for tick and flea-borne disease transmissions.

Conclusion

Climate variability affects health and well being. Climate change and its associated diseases are presenting new risks. Climate change introduces new pests, pathogens and disease emergence. So climate change is a critical public health issue. Without a healthy ecosystem, drought and famine increase and diseases spread. Increase in drought and rainfall brings about extreme weather events and ecosystems change. When ecosystems change the vector habitats change and subsequently diseases spread. Therefore, it is important to address climate change and raise awareness of the close link between such change and diseases. Also socioeconomic factors such as land use change, population growth and urbanization, migration, and economic development will need to be factored into future risk assessments. We as individuals must help identify areas that are at greatest risk to climate change to help decision makers prioritize protective action plans. In this way we can support adaptation and mitigation of climate change to build healthier and sustainable communities.

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