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AN OVERVIEW ON CHANGING CLIMATE AND IMPACT ON VECTOR-BORNE DISEASES IN INDIA

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ABSTRACT

The climate change is happening due to naturally occurring green house gases include water vapors, CO_2 O_3, CH_4, CFC and nitrogen oxides which together create a natural green house effect. It is all due to human activities are causing green house gas levels in the atmosphere to increase and thus causing in global temperature to rise led to climate change and is likely to big threat to distribution of several vector-borne diseases, including malaria and dengue etc. India is endemic for six major vector-borne diseases (VBD) namely malaria, dengue, chikungunya, filariasis, Japanese encephalitis and visceral leishmaniasis. Over the years, there has been reduction in the incidence of almost all the diseases except chikungunya which has re-emerged since 2005. The upcoming issue of climate change has surfaced as a new threat and challenge for ongoing efforts to contain vector-borne diseases. There is greater awareness about the potential impacts of climate change on VBDs in India. Studies undertaken in India on malaria in the context of climate change impact reveal that transmission windows in Punjab, Haryana, Jammu and Kashmir and north-eastern states are likely to extend temporally by 2-3 months and in Orissa, Andhra Pradesh and Tamil Nadu there may be reduction in transmission windows. It was found that Orissa, West Bengal and southern parts of Assam will still remain malarious and transmission windows will open up in Himachal Pradesh and north-eastern states etc. Impact of climate change on dengue also reveals increase in transmission with 2 °C rise in temperature in northern India. Re-emergence of kala-azar in northern parts of India and reappearance of chikungunya mainly in southern states of India. As a big threat in India have also been highlighted, as reported by Dhiman et al., 2010.

KEYWORDS : Climate Change, Malaria, Dengue, Chikungunya, Filariasis, Japanese Encephalitis and Visceral Leishmaniasis.

INTRODUCTION

Climate has always been changing and the change is natural. Earth has witnessed ice ages in past which are better examples of change in climate. The climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007).

The earth's climate has always been in a state of change (1-3). For nearly three centuries it has been in a warming phase. This was preceded by a cold period, the Little Ice Age, which was itself preceded by a warmer phase known as the Medieval Warm Period, or Little Climatic Optimum. Such changes are entirely natural, but there is evidence that in recent years a portion of the current warming may be attributable to human activities, particularly the burning of fossil fuels (4-6). The potential impact of this global warming on human health is a major subject of debate (7-10). Many of the diseases that currently occur in the tropics are mosquito borne (11). It is commonly assumed that their distribution is determined by climate and that warmer global temperatures will increase their incidence and geographic range (12-14).

Greenhouse gas emissions have brought us global warming, melting glaciers, rising sea levels, air pollution, ocean acidification, disrupted marine and wildlife biodiversity, groundwater contamination, soil depletion and a host of other adverse effects that stem from other technological innovations that were conceptualized without considering the consequences. All these effects are intertwined as a result of gas emissions that accumulated in the atmosphere. It eventually penetrated the ozone layer found in the Earth's stratosphere.

National Action Plan on Climate Change (www.pmindia.nic.in)

- Provision of enhanced public health care service
- Assessment of increased burden of disease due to climate change
- Providing high-resolution weather and climate data to study the regional pattern of disease
- Development of a high-resolution health impact model at the state level
- GIS mapping of access routes to health facilities in areas prone to climatic extremes
- Prioritization of geographic areas based on epidemiological data and the extent of vulnerability to adverse impacts of climate change
- Ecological study of air pollutants and pollen (as the triggers of asthma and respiratory disease) and how they are affected by climate change
- Studies on the response of disease vectors to climate change
- Enhanced provision of primary, secondary and tertiary health care facilities and implementation of public health measures, including vector control, sanitation and clean drinking water supply.

Major Vector Diseases in India

The major vector borne diseases in India are reported as Malaria, Dengue, Chikungunya, Japanese Encephalitis, Kala-aazar and Filariasis as described in Table 1.

Malaria is endemic in most of the districts of India. The factors based on temperature and regional humidity showed reduced intensity but increase in months of transmission.

Accumulated rainfall from May to August could predict malaria cases in September to December.

Sustainable development variables may some time reduce the adverse impacts on the system to climate change alone, while, it may some times also aggravate these impacts if the development variables are not managed well.

Well crafted and well managed developmental policies could result in enhanced resilience of communities and systems and lower health impacts due to climate change (Garg et al., 2009).

For the disease dengue spread climatically almost whole country is suitable, water availability, temperature and life style are major determinants.

The temperature thresholds (°C) for pathogens and vectors of major vector borne diseases are shown in table 2.

Since transmission dynamic of VBDs is affected by agricultural practices, deforestation, urbanization, socio-economic conditions and intervention measures which may viewed as plausible guidelines and not with certainty.

Vector-Borne Diseases (VBDs) are climate-sensitive as the pathogen has to complete some part of its development in insect/arthropod vectors like mosquitoes, sand flies, ticks, etc. Since these vectors are cold-blooded creatures, their developmental stages of life cycle and the development of parasite in their body (extrinsic incubation period) are affected by climatic conditions like temperature, rainfall, relative humidity, wind velocity etc. Recently, climate change has emerged as a new threat which is likely to affect spatial and temporal distribution of malaria and other VBDs.

Table 1. Major Vector Borne Diseases in India (2010).

Diseases	Cases/annum	Deaths
Malaria	1.59 million	1023
Filariasis	600 million (total burden)	-
Kala-azar	28941	105
Dengue	28292	110
Chikungunya	59535 (23.26 % confirmed)*	-
Japanese Encephalitis	5149	677

As reported by Dhiman et al., 2010

Table 2. Temperature thresholds (°C) for pathogens and vectors of major vector borne diseases Malaria and Dengue.

Disease	Pathogens	Minimum Temp	Maximum Temp	Vector	Minimum temp for vector
Malaria	Plasmodium falciparum	16-19 C	33-39	Anopheles	8-10 (Biological activity)
	Plasmodium vivax	14.5-15 C	33-39	Anopheles	8-10 (Biological activity)
Dengue	Dengue Virus	11.9	Not known	Aedes	6-10

As reported by Dhiman et al., 2010

Table 3. Projected Impacts of Climate Change (Source IPCC, 2007).

Malaria-Global	>220-400 m additional pop at risk with A2 scenario by 2020 to 2080; reduced if > 3 consecutive months are considered.
Malaria-Africa	16-28 % increase in person-months of exposure (including 5-7 % increase in altitudinal by 2020-2080) limited latitudinal expansion.
Malaria-Zimbabwe	Highlands become more suitable for transmission with 1.4 to 4.5 °C increase.
Malaria-Britain	Increase in risk of local malaria transmission 8-15 % with 1-2.5 °C average T raises by 2050. Indigenous transmission unlikely.
Malaria-Portugal	Increase in no of days suitable for survival of malaria vector. Risk is very low if no vector.

Table 4. Projected impacts of climate change.

Malaria-Australia	Receptive zone expands southward by 2050. Absolute risk of reintroduction very low.
Malaria-India	Projected shift to southwest and northern states. TWs widen in northern and western studies; shorten in southern states by 2050.
Dengue-Global	Global population at risk 3.5 billion with CC; 5-6 billion with population growth and CC (Baseline 1.5 billion).
Dengue-New Zealand	Potential risk of outbreaks in more regions.
Dengue-Australia	Climate suitability increase southwards with 1.8 to 2.8 °C increase.

Asia spans tropical and temperate regions. *Plasmodium falciparum* and *P. vivax* malaria, dengue fever, dengue haemorrhagic fever, and schistosomiasis are endemic in parts of tropical Asia. In the past 100 years, mean surface temperatures have increased by 0.3–0.8 C across the continent and are projected to rise by 0.4–4.5 C by 2070 (15). An increase in temperature, rainfall and humidity in some months in the Northwest Frontier Province of Pakistan has been associated with an increase in the incidence of *P. falciparum* malaria (16). In north-east Punjab, malaria epidemics increase fivefold in the year following an El Nin˜o event, while in Sri Lanka the risk of malaria epidemics increases fourfold during an El Nin˜o year. In Punjab, epidemics are associated with above-normal precipitation, and in Sri Lanka, with below-normal precipitation (17). According to WHO, many countries in Asia experienced unusually high levels of dengue and/or dengue haemorrhagic fever in 1998, the activity being higher than in any other year. Changes in weather patterns, such as El Nin˜o events, may be major contributing factors (18), since laboratory experiments have demonstrated that the incubation period of dengue 2 virus could be reduced from 12 days at 30 C to 7 days at 32–35 C in *Aedes aegypti* (19). Dengue fever has been reported in several small island states in the Pacific where rainfall and local temperatures correlate with the southern oscillation index, a component of the El Nin˜o–Southern Oscillation phenomenon. Furthermore, a positive correlation was found between the index and dengue fever in 10 out of 14 such island states (20).

Impacts of Climate Change on Health

Climate change refers to change in temperature, pattern of rainfall and rise in level of sea which results in weather related mortality due to heat strokes, skin diseases eye diseases floods, storms leading to deaths, injuries, psychological distress. The infectious diseases includes vector borne diseases, changed incidence of diarrheal diseases. Alerted productivity and associated pest and diseases include malnutrition, hunger, impared child growth and development. Air quality respiratory illnesses include asthma and respiratory diseases.

In addition to the existing drivers of vector-borne diseases, such as seasonal weather variation, socioeconomic status, vector control programmes, environmental changes and drug resistance, climate change and variability are highly likely to influence current vector-borne disease epidemiology. The effects are likely to be expressed in many ways, from short-term epidemics to long-term gradual changes in disease trends. There is some epidemiological evidence to support this view. However, the contribution of all the factors affecting disease transmission and clinical outcomes needs to be taken into account (multivariate analysis). Currently there are few if any published data that provide such information, partly because the science of climate and health is not well developed. The fraction of changes in vector-borne diseases attributable to climate change is therefore still unknown. This is a serious obstacle to evidence-based health policy change.

Although the impacts of climate variability on vector-borne diseases are relatively easy to detect, the same cannot be said of climate change because of the slow rate of change. Furthermore, it is possible that human populations may adapt to climate change thus minimizing the impacts. Climate change has far reaching consequences that go beyond health and touch on all life-support systems. It is therefore a factor that should be rated high among those that affect human health and survival (Table 3 and 4).

CONCLUSION

Refined assessments using min/max, diurnal/nigh temp and outdoor/indoor temperature are required. Dengue and Chikungunya are resurging fast. Need understanding the relationship between climate and diseases and impact assessment. Leishmaniais, JE and leptospirosis also need to be evaluated in the context of climate change. Plenty of scope for research in disease epidiomeology in relation to environmental factors.

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