Dengue Fever and Global Warming: An Epidemiological Analysis

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ABSTRACT

The article analyzes the connection between the rising number of cases of dengue fever and the warming of the planet’s atmosphere. We underline the significant role that Aedes mosquitoes play in the development of dengue fever by undertaking an in-depth examination of the factors that lead to the disease, how it is transmitted, and how it may be treated. Following that, the study explores the epidemiology of dengue fever and investigates the patterns and trends that the sickness demonstrates in different parts of the globe. We also evaluate the impact that a changing climate has had on the prevalence of dengue fever by relying on data from a wide variety of sources. Preventive measures to battle dengue fever, future patterns in dengue sickness, and the ramifications of those patterns are also discussed.

Keywords: Aedes aegypti, Climate change, Dengue Fever, Global warming.

1. INTRODUCTION

Dengue fever, an infectious illness spread by mosquitoes, is raising alarm bells throughout the globe. More than thirty times as many cases of dengue fever have been documented in the last fifty years, with most outbreaks happening in tropical areas with warm, rainy climate [1]. Climate change is a potential contributor to the rising incidence of dengue fever and its geographic extension, as it may make conditions more favorable for mosquito breeding and increase the spread of the disease. This is in addition to the increasing number of people and frequent national travel that speeds up the rising dengue fever transmission [2].

Most mosquito-borne infectious illnesses, including Zika and dengue fever, are very sensitive to changes in both ambient temperature and rainfall. There is a favorable relationship between normal ambient temperature and vector features including bite rate and extinct incubation rate, as shown by previous laboratory and field study [3]. Rainfall mostly affects the aquatic stage of vector-borne illness transmission. There is an increased risk of disease transmission after even mild rainfall, since more mosquitoes will spawn. However, excessive rainfall, with its flushing-out effect, may be disruptive to the vectors [3].

Based on the correlation between weather and disease spread, many studies have predicted how dengue fever would spread in a warmer world. Research suggests that disease transmission and vectorial capability may increase in the future [3]. Dengue fever has been on the rise, and its potential for rapid spread has grown as the disease has spread to new locations. Disease epidemic patterns, including epidemic magnitude and peak period, may shift under global warming due to the complex effect of climatic conditions on disease transmission. For instance, a prolonged environmental favorable time for the dengue fever vector in Europe was predicted to result in lengthier future dengue fever outbreaks. Dengue fever transmission forecasts may also vary from one place to another due to geographical heterogeneity. Dengue fever transmission in the future may act differently than it does now because tropical regions like South and Southeast Asia are predicted to remain in a more favorable state for dengue fever vectors in the future [4].

Dengue fever, a viral illness spread mostly by mosquitoes, is a major problem all over the world [5]. Concerns have been expressed concerning the role that climate change, and especially global warming, may be playing in the disease’s rising prevalence. Dengue fever’s interaction with environmental elements may be better understood if its etiology, transmission, and treatment are known, as well as the essential role played by Aedes mosquitoes in its spread (Fig. 1). The purpose of this article is to examine global dengue fever epidemiology patterns and determine whether or not an uptick in the disease is related to increasing temperatures.
2. Method

A wide variety of sources are used in this article including databases maintained by the World Health Organization (WHO), national health organizations, and peer-reviewed research publications. In order to collect information on the cause of dengue fever as well as its transmission and treatment, a systematic literature review is carried out. For the purpose of identifying worldwide trends in the incidence and geographical distribution of dengue fever, epidemiological data from a number of different locations are studied. In addition, research articles on climatic data and temperature records are reviewed in order to investigate the possible connection between rising global temperatures and an increase in the incidence of dengue disease.

Dengue predictions in the face of climate change were the subject of a recent literature assessment. The primary aim was to get familiarity with the work that has gone into developing a model for predicting dengue epidemics. From many academic databases, 42 publications were selected and examined to establish the current level of knowledge. The review’s findings suggest that a connection exists between global warming and the current epidemic of dengue fever. Patients’ age and gender may be important factors to consider when estimating dengue incidence, and the fact that this information is not easily accessible via application programming interface (API) is a limitation. Moreover, lack of patient data, missing information, and inadequate information were only a few of the problems faced during the literature review.

3. Dengue Fever Cause, Transmission, and Treatment

The climate has a significant role in the propagation of dengue fever. The spread of dengue virus and its vectors have been aided by climate change as well as worldwide commerce and transportation [16]. Over the course of the last several decades, not only has the number of dengue cases grown, but the disease has also expanded to new regions and become more explosive.

The dengue virus, which is a member of the Flaviviridae family of viruses, is the culprit behind dengue disease [11]. There are four unique serotypes of the virus, denoted by the numbers DEN-1, DEN-2, DEN-3, and DEN-4. Infection with a single serotype confers permanent immunity against that particular strain of the virus, but only temporary protection against the other serotypes [11]. The bites of infected female Aedes mosquitoes, notably Aedes aegypti and Aedes albopictus, are the primary means by which dengue disease is transferred from infected mosquitoes to people. When these mosquitoes feed on a person who is already infected with the virus, they too get infected with the virus. After being infected with the virus, the mosquito is able to pass it on to other people via its bites when it subsequently feeds on them [11].

Mosquitoes of the genus Aedes are often found in metropolitan and semi-urban regions, and they are most active during the day, particularly around dawn and sunset. Aedes mosquitoes are known to spread diseases such as Zika virus, malaria, and dengue virus [13]. Dengue fever is not passed on from one individual to another by direct contact; rather, the transmission of the virus from one human to another requires the presence of the Aedes mosquito.
which acts as a vector. On the other hand, transmission by blood products and vertical transmission (from an infected pregnant mother to her unborn child) have been observed in very unusual circumstances [13].

Dengue fever is not yet treatable with any particular antiviral medication. The majority of people who have dengue fever will recover on their own without the need for hospitalization [10]. The primary emphasis of treatment is on providing patients with supportive care in order to ease symptoms and avoid complications. It is normal practice to advise patients to get sufficient rest, drink plenty of water, and treat their discomfort with over-the-counter pain relievers such as acetaminophen [10].

In severe instances of dengue fever, hospitalization is absolutely necessary. This is especially true for patients who come with dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). Plasma leakage, severe bleeding, and organ failure are the defining characteristics of both DHF and DSS. In such circumstances, receiving fluid replacement treatment intravenously and carefully monitoring vital signs are necessary to manage the disease [10].

The prevention of dengue fever is one of the most important aspects of disease control. In locations where a dengue vaccine is available, preventative strategies include vaccination, the elimination of breeding grounds for mosquitoes, the use of insect repellents, the installation of screens and mosquito nets, community-based activities for mosquito control, and the use of mosquito repellents [9]. In order to lessen the toll that this mosquito-borne viral illness has on the general population’s health, it is necessary to use a comprehensive strategy for dengue prevention and control [9].

4. Epidemiology of Dengue Fever

The epidemiological picture of dengue fever across the world is complicated, and there are wide variances from one region to another [12]. To identify high-risk places and times of increasing dengue activity, we give a complete study of historical dengue data and trends. In addition, we investigate the role that variables such as population density, urbanization, and climatic variability have in the spread of the illness. Understanding the ways in which climatic elements interact with epidemicological dynamics, which may lead to shifts in the frequency of dengue fever cases, will get a lot of focus throughout this research project.

Dengue fever is a huge threat to public health on a worldwide scale, and its epidemiology is complicated. More than one hundred nations are known to be affected by the illness, most of which are located in tropical or subtropical climates [3]. Dengue fever has been a more widespread health problem over the last several decades, as shown by global trends. Dengue fever is a widespread disease that affects millions of individuals every year and is responsible for an estimated 390 million new infections yearly. Approximately 96 million of these instances are characterized by the presence of clinical disease [3].

Southeast Asia, the Pacific Islands, the Indian subcontinent, the Americas, and Africa are the most common regions in which dengue fever is found. Because Aedes mosquitoes are more prevalent in metropolitan settings with a higher people density, the illness is more prevalent in these settings [9]. Dengue fever is known to follow seasonal patterns, often reaching its peak during the wet season when mosquito numbers are at their highest. Because all four serotypes of dengue virus co-circulate in distinct places, the risk of severe dengue due to cross-immunity and antibody-dependent enhancement is significantly increased [6].

The influence of climate may be seen in the transmission dynamics of dengue fever, since climate elements such as temperature, precipitation, and humidity play a key part in this process. Warming of the planet as a whole and variations in the weather both have a role in the geographical spread of the illness. Outbreaks of dengue fever may put a burden on healthcare systems, especially when dealing with severe cases that require hospitalization and specialist treatment [8]. Dengue fever is difficult to manage since there is no antiviral therapy that is specific to the disease, and standard techniques of vector control only have a limited amount of success. Dengue control plans in endemic regions warrant crucial components such as integrated vector management, community participation, and active monitoring to be effective. Overall, the worldwide trends in dengue fever highlight how important it is to maintain efforts to monitor, prevent, and manage the illness, particularly in areas where the burden is greater [8].

In order to reduce the negative effects that dengue fever has on public health, it is necessary for international organizations, national governments, and local communities to work together in order to address the disease’s complicated epidemiology.

5. Global Warming and the Rise of Dengue Fever

The spread and incidence of vector-borne illnesses like dengue fever are increasingly influenced by global warming due to climate change [14]. Due to climate change, Aedes mosquitoes are expected to increase in population and spread over the globe as the breeding patterns and the spread of the diseases increases with climate change. To correlate climate change with the rise of dengue fever cases, we provide a comprehensive examination of temperature records and their association with cases of dengue fever.

Human-caused climate change, including global warming, is now recognized as a major contributor to the worldwide spread of dengue disease [14]. The dengue virus is responsible for dengue fever, which is spread by the bites of infected female Aedes mosquitoes (especially Aedes aegypti). The connection between rising temperatures and dengue disease is intricate. Several crucial components all play a role in the enhanced transmission and spread of the illness when temperatures rise owing to climate change (Fig. 2). The spread of Aedes mosquitoes is a major consequence of climate change [15]. The mosquito population increases and flourishes as the temperature rises. This has led to an increase in the likelihood of dengue fever transmission in previously non-endemic locations, since these vectors are now able to thrive in environments that were previously unsuited for them. Aedes mosquitoes change
their behavior and activity levels as the temperature rises [15]. The incubation time for the virus inside a mosquito’s body may be shortened by warmer temperatures. This decrease in the incubation period makes human transmission of the virus during mosquito feeding more likely.

Another effect of global warming is a longer transmission season. Due to their increased activity and longevity at higher temperatures, Aedes mosquitoes may now spread the dengue virus for much longer into the year. In areas where dengue fever was formerly seasonal, this causes an increase in cases. Humans’ outdoor habits and their likelihood of being bitten by mosquitoes are both influenced by climate change [16]. The spread of dengue fever may be exacerbated by the creation of mosquito breeding grounds during and after extreme weather events, which is typically linked to global warming [7].

As cities expand and alter due to human activity and climate, they provide breeding grounds for the Aedes mosquito. Aedes mosquitoes, which may spread dengue disease, thrive in human settlements due to feeding patterns of the mosquitoes. Dengue fever may spread quickly due to international travel. People with the virus may spread it to other areas, giving those places dengue disease for the first time [7].

Vulnerable groups, such as those living in poverty and without access to sufficient healthcare and sanitation, are disproportionately impacted by global warming and the growth of dengue fever. The health and economic effects of dengue fever epidemics might be more difficult to manage for these communities [7]. There ought to be a rigorous and all-encompassing effort to combat the spread of dengue disease in such communities. Promoting climate-resilient public health policies and boosting monitoring and early warning systems are all part of this strategy. The spread of dengue disease could be reduced, and at-risk people may be protected if the international community works together to reduce emissions of greenhouse gases. Urgent action is needed to protect public health and well-being in the face of changing climatic circumstances due to the interaction between global warming and dengue disease [7].

6. Future Trends in Dengue Fever

Future trends in dengue fever and the possible influence on world health are estimated based on how global warming is predicted to influence dengue disease to new areas. Dengue fever’s trajectory in the future paints a nuanced and shifting picture for world health. Epidemiologists anticipate that climate change, urbanization, and international travel will each play a role in shaping the disease’s future distribution. As such, dengue fever is expected to continue its upward trajectory [12].

Dengue fever is spread mostly by Aedes mosquitoes, and as global temperatures increase, their ideal habitat will certainly spread. Dengue fever may spread to previously undisturbed areas and cause an increase in the number of cases [12]. As cities expand and human populations increase, Aedes mosquito populations boom. The danger of dengue fever epidemics rises as more people move to urban areas, and this is especially true in overcrowded regions with poor waste management and sanitation. The fast spread of dengue fever is a direct result of the rise in international travel. Dengue fever may be spread to areas where it had not previously been seen because infected people might transport the virus to new areas. This transcontinental transmission may cause epidemics in previously unaffected regions [17].

Multiple dengue virus serotypes in circulation at the same time makes illness prevention and control more difficult. There is an elevated risk of severe dengue infections in those who have been infected with one serotype and then subsequently infected with a second serotype [17]. Dengue fever transmission patterns might be affected by climate change and harsh weather. The peak transmission times in areas prone to seasonal outbreaks may move, allowing the disease to spread throughout the year, shifting it from seasonal to an on-going infection. The use of conventional pesticides to combat vectors is hindered by the prevalence of insecticide-resistant vectors. Due to the potential for insecticide-resistant Aedes mosquitoes, new and long-term strategies for vector control are needed [17]. Dengue fever
has a devastating effect on such vulnerable population as young individuals, older adults, and individuals with compromised immune systems. The illness may also be more devastating to underprivileged populations because of socioeconomic gaps.

In order to identify epidemics and begin actions as soon as possible, reliable monitoring and early warning systems are required [11]. To lessen the effect of severe dengue cases, better diagnosis and case management are essential. It’s possible that ongoing attempts to create better dengue vaccinations will play a crucial role in preventing and controlling the illness. The prevalence of dengue fever may be decreased if safe and effective vaccinations are made available to the public. Dengue fever is expected to continue to rise, which will place a strain on public health systems throughout the globe. To overcome these obstacles, a concerted and coordinated effort that incorporate climate-resilient tactics, cutting-edge vector control approaches, and enhanced healthcare measures is needed. To protect world health and lessen the severity of this mosquito-borne illness, preventative and control measures for dengue fever are essential.

7. CONCLUSION

This research provides a strong support for the hypothesis that rising temperatures are linked to an increase in dengue disease. The spread of dengue disease to new locations is becoming more likely as temperatures increase. Improved monitoring, vector control, new-enhanced vaccine, and climate-conscious policymaking are all urgently required. Protecting public health and reducing the future impact of mosquito-borne illness requires close attention to the connection between climate change and dengue fever. The ability to predict the future of dengue fever in the context of climate change may aid governments and public health experts in taking prompt and preventive measures to protect people from dengue in the future. In conclusion, climate change is causing a worrying scenario that is impacting numerous areas. Dengue fever has long been a source of worry. As a result, a dengue surveillance system that incorporates monitoring of weather patterns may be of considerable assistance to the health sector in enabling it to take preventative actions in a timely fashion.

REFERENCES


