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Dengue Fever in Fiji:Epidemiological Insights and Strategic Control Approaches

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Abstract

The incidence of dengue has grown dramatically around the world in recent decades, with cases reported to WHO increasing from 505 430 cases in 2000 to 5.2 million in 2019. A vast majority of cases are asymptomatic or mild and self-managed, and hence the actual numbers of dengue cases are under-reported. Many cases are also misdiagnosed as other febrile illnesses . Dengue fever is most common in tropical and subtropical regions of the world and is arguably one of the most devastating diseases in countries like Fiji. This paper attempts to evaluate the disease, focusing on the Fijian case in the last 15 years, explaining the degenerative processes of the disease, and present-day approaches to controlling the disease, as well as newer methods of diagnosis and therapies. The intended outcome is to broaden knowledge and enhance approaches to address one of the most persistent health risks in one of the highly affected regions of the globe.

Keywords: Dengue fever, climate change, public health, impact, early interventions. Fijian Islands

INTRODUCTION

Dengue fever corresponds to the clinical picture induced by any one of the four antigenically distinct serotypes of the dengue virus which causes great suffering to mankind and burdened for the health services especially in the tropical countries especially where there are conducive environments for Aedes Mosquitoes breeding (Guzman et al., u20162010). Over the last 15 years, there have been observed increasing levels of dengue cases in Fiji due to climate changes and urbanization which creates favorable conditions for mosquito breeding and distribution (Reed et al., 1997). Extreme weather conditions in Fiji affect air, marine, and road transportation. Transmission of diseases carried by vectors and water, mental health issues related to severe heat, direct injuries, and personal losses (such as property damage) The physical effects of climate change, including rising sea levels, temperature increases, increased CO2 levels, and more frequent extreme weather events, are harming the health of coral reefs and triggering coral bleaching.

Severe weather conditions, such heat waves and floods, can also hasten the spread of diseases carried by vectors of pathogens, like fleas, ticks, and mosquitoes [4,13]. Warmer temperatures accelerate the metabolism of pathogens and vectors, allowing for faster reproduction and dissemination, although irregular rainfall patterns could make more appropriate places for breeding [17, 18]. These patterns could lengthen the tropical and subtropical regions' transmission season and raise the possibility that invading vector species and infectious illnesses will establish themselves in temperate climates by improving the conditions for the vectors' proliferation [19], a trend that The present study will assessed the epidemiology

of dengue in Fiji for the years ranging 2007 to 2018, review the strategies currently in place to manage the disease and make interventions.

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OBJECTIVE:

The objective of this research is to assess the epidemiology, burden, and management of dengue fever in Fiji in order to provide a thorough understanding of the disease's dissemination and extent. In specifically, the study looks at the factors that contribute to dengue transmission, evaluates the efficacy of the current control measures, and identifies areas where health policies and practices should be improved.

Methodology:

A study on a sample of recent case studies and projects focusing on vector-transmitted diseases in the Pacific region, with an emphasis on mosquito-borne diseases, was conducted due to the dearth of research specifically aiming at investigating diseases transmitted by vectors, more specifically mosquito-borne diseases in the Pacific region in the context of climate change. This focus is due to the fact that, in comparison to other communicable diseases, these illnesses are not as well documented in the Pacific region. Three primary components made up the study were:

1. a review of the literature on case studies and studies that particularly address the relationship between vector-borne illnesses and climate change in the Pacific area;
2. the listing of instances of current outbreaks carried by mosquitoes and public health initiatives in the Pacific area, as examples;
3. a description of their nature, including the primary causes of the outbreak, the project's objectives, the primary obstacles they face, and the consequences for public health outbreak management and containment.

A narrative literature review was conducted to find references, and PubMed and Google Scholar searches were restricted to English-language studies published in the last 15 years. The terms "Zika," "Dengue," "Chikungunya," "Pacific," "Pacific Islands," "Aedes mosquito," and "Vector" were among those used.Google Search was used to find ECDC or WHO in order to add further analytical and summary reports from specialized foreign and national organizations.

A thorough assessment of the literature was done, concentrating on the research that has already been done on the prevalence, effects, and prevention methods of dengue fever in tropical areas, with a particular focus on Fiji (Guzman et al., 2016; Reed et al., 1997). This review assisted in setting the scene and pointing out areas where the body of research was lacking. A narrative literature review was conducted to find references, and PubMed and Google Scholar searches were restricted to English-language studies published in the last 15 years. The terms "Zika," "Dengue," "Chikungunya," "Pacific," "Pacific Islands,"

"Aedes mosquito," and "Vector" were among those used.Google Search was used to find ECDC or WHO in order to add further analytical and summary reports from specialized foreign and national organizations Data Collection Hospital reports, pertinent databases, and public health records were the sources of information on dengue fever cases in Fiji from 2007 to 2018. In order to comprehend recent patterns and possible contributing factors, current statistics on dengue incidence, vector populations, and climate data were also collected.

Data Analysis

The gathered data was analyzed using statistical techniques, which revealed trends and relationships between dengue incidence and elements including urbanization, climatic change, and the existence of mosquito vectors. Dengue incidence rates were compared before and after the deployment of current control strategies in order to assess their efficacy.

Results and Discussion:

A total of 42 publications and reports were found and examined. In addition to their evident connection to the Pacific, the papers were chosen based on a thematic relevance criterion; studies that addressed diseases spread by mosquitoes in other regions were not taken into consideration. The text makes reference to the works that were judged sufficient and appropriate to be used for this paper.

First and foremost, the literature review has demonstrated that the following diseases can be mentioned among the numerous vector-borne illnesses in the Pacific, including those spread by mosquitoes: dengue fever, chikungunya fever, Zika, lymphatic filariasis, Japanese encephalitis, Murray Valley encephalitis.

Globally speaking, tropical areas are where these diseases are most prevalent because of the warm, humid weather that makes it easy for mosquito species that carry the disease, such as Aedes, Culex, and Anopheles, to breed and survive. The Aedes mosquito, specifically in the Pacific region, is a recognized carrier of many viruses, including the dengue (DENV), and chikungunya (CHIKV) viruses.

Mosquito development and life cycles, as well as the viruses they transmit, are strongly reliant on regional ecosystems. Aedes mosquitoes are cold-blooded insects that need water sources for reproduction and development as well as particular temperature ranges to survive [22]. The high temperatures, extended periods of precipitation, and high air humidity seen in tropical and subtropical climates provide an ideal setting for mosquito survival, development, and reproduction [23]. For instance, unpredictable rainfall patterns might have a beneficial or negative impact on the establishment of outbreaks carried by mosquitoes. Elevated precipitation and floods could potentially augment the vector breeding grounds and environments for mosquito larvae.

Raising the ambient temperature also facilitates mosquito larvae development and speeds up their maturity.

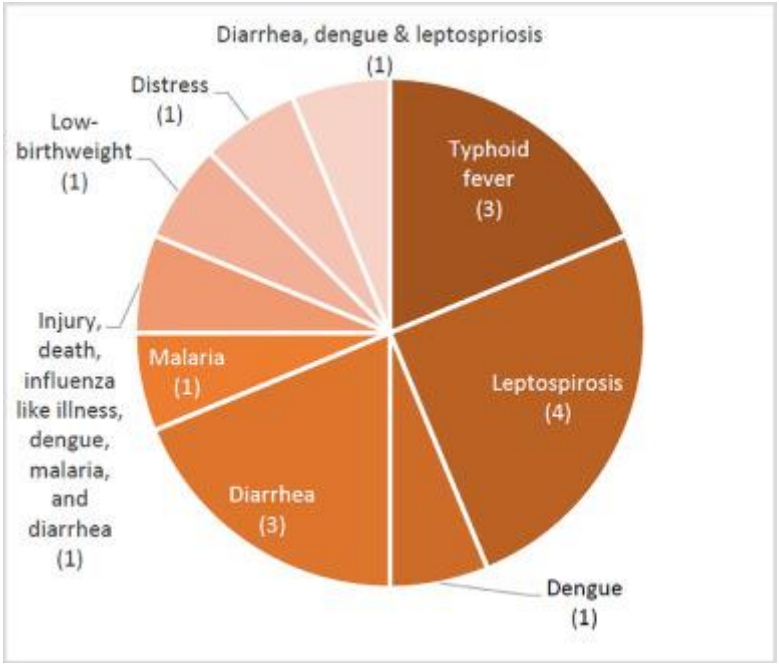
Furthermore, adult female mosquitoes feed more frequently on blood, which increases the possibility that they will spread pathogenic pathogens [25]. Furthermore, as the temperature of the surrounding environment rises, there is a reduction in the extrinsic incubation period due to the enhanced viral replication within the mosquitos. Therefore, higher humidity levels and warmer temperatures, particularly during the rainy season, encourage the growth of tropical mosquitoes and the incidence of Aedes-borne outbreaks as well as continuous viral circulation between host and vector populations [26, 27].

The Pacific Region's Mosquito-Borne Diseases: An Overview of DENV:

Aedes mosquitoes have been found to be the primary disease vector species in the Pacific region. In the

In the past, dengue epidemics were mostly caused by a single DENV serotype; however, more recent studies have shown that different dengue virus serotypes (types one through four) as well as recently discovered Aedes-borne Zika and chikungunya transmission are co-circulating [28]. Since the 1960s, reports of regular DENV epidemics have come from the Pacific region. DENV has since developed both epidemic and endemic circulation.

As the climate changes further, Dengue fever that is susceptible to the temperature is growing. The frequency and intensity of Dengue outbreaks in the Pacific area have risen dramatically in recent years [28], necessitating a deeper comprehension of how climate change is.



Since the industrial revolution, average global temperatures have already increased by more than 1°C, with significantly more warming seen over continental land masses. Our findings demonstrate how these modifications have probably already increased the likelihood that Ae. aegypti, if introduced, will be able to finish its life cycle in regions with enough precipitation and human hosts available. Without a closer look at how climate change supports mosquito development or establishment risk, investigations into recent trends in viral disease emergence linked to this vector species—such as the six-fold increase in dengue incidence from 1990 to 201363, the establishment and spread of Zika virus in the Americas64, and recent outbreaks of yellow fever in Angola, the Democratic Republic of the Congo, and Brazil65—

would be incomplete.

DENV in Fiji have modest clinical presentations despite their potential for epidemics. These symptoms are frequently ignored [37]. Till now in Fiji Dengue fever have mild presentations, which include fever, rash, and malaise are flu-like symptoms that can lead to a mistake when laboratory testing. Most people recover completely, although occasionally an infection can serious health issues include encephalitis, neurological conditions, newborn deformities (ZIKV), severe and persistent arthralgia (CHIKV), or hemorrhagic symptoms (DENV), which can lead to hospital admission or potentially catastrophic outcomes.

Key findings:

Only low-level DENV transmission in Fiji from 2013 to 2017 could be confirmed by recent research, suggesting that the Fijian population has adequate herd immunity [42, 43]. The warm, wet season of November to June is when the transmission season is most likely to occur. Following rainfall events, highly populated areas in Fiji record the highest levels of DENV. Furthermore, since 1960, there have been suitable temperature conditions for DENV year-round transmission, particularly in Fiji's major urban areas in the South-East and North-West of Viti Levu, according to meteorological records.

The Wolbachia Method for Vector and Transmission Control in the Pacific Region

Recent findings state that DENV outbreaks have been remarkably active globally in 2019 [45]. As previously mentioned, lengthened transmission seasons due to climatic change and increased international mobility may make these trends more plausible, while invasive vector species and recently discovered viruses may infest and settle in previously unaffected but more favorable places [46].

Therefore, addressing the health risks associated with mosquito-borne diseases is crucial to the effort to increase climate resilience.

Novel entomological approaches to cut off transmission routes for DENV disease are gaining increasing attention in the field of public health because most prevention strategies rely primarily on personal protective behavior, which frequently requires behavioral modification and significant population awareness. Aedes aegypti's level of viral transmission was significantly reduced when disease-carrying mosquito populations were controlled by preventing virus replication in Aedes mosquitoes [48]. Scientists are working on pilot programs around the Pacific region to reduce the danger of (re-)emerging epidemics, based on encouraging findings from laboratory and field trials. It is possible to significantly lower the vector competence for DENV by inducing infection in Aedes aegypti using strains of Wolbachia bacteria and preventing virus reproduction inside the mosquito.

The Pacific region's Wolbachia approach

Goal: The World Mosquito Program seeks to eradicate diseases like as DENV, with a particular emphasis on the Pacific region. by obstructing the pathways via which mosquito-borne illnesses are transmitted. When larvae are infected with Over time, the wild mosquito population and its vector capabilities will decline due to a specific strain of the bacteria Wolbachia (wMel), which will also aid in mosquito suppression and lower virus levels of transmission.

Methods: Currently, the World Mosquito Program uses the Wolbachia method in Kiribati, Fiji, Vanuatu, and Sri Lanka. In lab settings, a particular strain of Wolbachia, initially isolated from the related Aedes species Aedes reversi, infects mosquito larvae. Following infection, male mosquitoes containing Wolbachia are released into specified areas where they will breed with wild mosquitoes and multiply.

Findings: Wolbachia transmission was found to occur both vertically, inside mosquito eggs, and horizontally, from infected male mosquitoes to wild female mosquitoes. Consequently, two effects were evident: Firstly, viruses including DENV, ZIKV, and CHIKV are less likely to replicate when Wolbachia strains are present in the mosquito. Secondly, there's a chance that mosquito eggs won't hatch, which could limit mosquito numbers. This approach has been successfully used in Guangzhou, China, where researchers used the Wolbachia technology to almost completely eradicate Aedes albopictus mosquitoes from two islands, with encouraging long-term results: Research conducted in the inner suburbs of Cairns has previously demonstrated that the Wolbachia strain can persist in mosquito populations for over eight years [49].

Three primary tendencies are indicated by the data and evidence gathered:
First of all, given that it raises the dangers and makes it easier for MBD outbreaks to spread, the environment plays a crucial role in the transmission of vector-borne illnesses. The ongoing alterations in the local and global climates, as well as non-climatic variables like due to the Pacific region's brittle health infrastructure and inadequate surveillance methods highly susceptible to MBDs resurfacing.
Second, due to many factors including the following, the Pacific region is particularly well-suited to persistent mosquito-borne viral (co-)circulation. extremely favorable weather conditions, particularly high temperatures paired with prolonged rainy spells, which help mosquitoes proliferate and spread as vectors because of their biology, which is highly dependent on temperature and moisture, and the viruses they host;
Thirdly, although though the relationships between climate variability, climate change, and the spread of MBDs have been extensively researched, there is still more to be done to integrate the results of these studies into public health prevention strategies. considering options for future climate change adaptation, which are significant for Pacific countries [51].

Conclusion:
This article has outlined the primary connections between climate change and health as well as how it affects Pacific Island countries. It also discussed the instances given by mosquito-borne illnesses like Dengue fever. Also given were the main conclusions of the study on the prevalence of Dengue virus diseases in Fiji and its relationship to climate change. The development of diseases carried by mosquitoes is one of the many concerns that climate change is posing to the island nations in the Pacific region. It is clear from this that, in addition to gaining a greater understanding of how climate change may affect the transmission of vectors, a deeper comprehension of the many effects of climate change on human health is required.
and there are insufficient early warning systems, which could direct appropriate adaptation steps. These are thought to be necessary to better equip Pacific nations like Fiji Island nationto handle the numerous problems posed by climate change.
In Fiji, dengue fever continues to pose a serious threat to public health, especially in areas where the environment encourages the growth of Aedes aegypti and Aedes albopictus. The results highlight the significance of seasonal and region-specific approaches in managing and containing dengue outbreaks. Given that they report the highest number of cases, the Western and Central divisions need to concentrate their efforts on vector management, public health campaigns, and strengthening the healthcare system. Future studies ought to concentrate on the efficiency of cutting-edge vector management techniques as

well as the long-term effects of climate change on dengue transmission.

Recommendations:

The findings lead to the following recommendations being put forth:

1. **Improving Community Involvement**: Involve communities in vector control initiatives by utilizing education and awareness campaigns to highlight the significance of removing breeding habitats and implementing preventative measures.
2. **Increasing the Use of Innovative Tools**: To supplement conventional vector control techniques, increase the use of novel tools like GPS-enabled monitoring apps and biological control techniques like Wolbachia-infected mosquitoes.
3. **Strengthening Healthcare Systems**: To guarantee prompt diagnosis and treatment of dengue fever, enhance the healthcare system, especially in rural regions. This entails ensuring that diagnostic resources and tools are easily accessible as well as training healthcare personnel on the most recent treatment regimens.
4. **Organizing Frequent Awareness Campaigns**: Hold frequent public health campaigns to inform the public about preventive measures, early symptom recognition, and the need of seeking medical attention as soon as possible. These efforts should be carried out especially before and during peak transmission periods.
5. **Monitoring and Surveillance:** To track dengue incidence, vector populations, and the efficacy of control measures, improve monitoring and surveillance systems. In order to stop outbreaks, real-time data gathering and analysis can assist in promptly locating and addressing newly emerging hotspots.
6. **Policy Development**: Create and implement public health regulations that assist community involvement, environmental management, and sustainable vector control. To achieve a comprehensive strategy to dengue prevention and control, policies should support coordination between several sectors, such as health, the environment, and education.

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Conflicts of Interest: The authors declare no conflict of interest.

References

1. Waggoner, J.J., et al., Viremia and Clinical Presentation in Nicaraguan Patients Infected Wi1. Waggoner, J.J., et al., Viremia and Clinical Presentation in Nicaraguan Patients Infected With Zika Virus, Chikungunya Virus, and Dengue Virus. Clinical Infectious Diseases, 2016. 63(12): p. 1584-1590.

2. Bhatt, S., et al., The global distribution and burden of dengue. *Nature*, 2013. 496(7446): p. 504–507.
3. Brady, O.J., et al., Refining the global spatial limits of dengue virus transmission by evidence-based consensus. *PLOS Neglected Tropical Diseases*, 2012. 6(8): p. e1760.
4. Shi, Z. Impact of Climate Change on the Global Environment and Associated Human Health. OALib **2018**, 5, 1–6. [CrossRef]
5. Mimura, N. Small Islands. In Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working GROUP II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change; Parry, M., Parry, M., Canziani, O., Palutikof, J., Van der Linden, P., Hanson, C., Eds.; Cambridge University Press: Cambridge, UK, 2007.
6. McIver, L.; Kim, R.;Woodward, A.; Hales, S.; Spickett, J.; Katscherian, D.; Hashizume, M.; Honda, Y.; Kim, H.; Iddings, S.; et al. Health Impacts of Climate Change in Pacific Island Countries: A Regional Assessment of Vulnerabilities and Adaptation Priorities. Environ. Health Perspect. **2015**, 124, 1707–1714. [CrossRef] [PubMed]
7. Chowdhury, M.R.; Chu, P.S.; Zhao, X.; Schroeder, T.A.; Marra, J.J. Sea level extremes in the U.S.-A_liated Pacific Islands—A coastal hazard scenario to aid in decision analyses. J. Coast. Conserv. **2010**, 14, 53–62. [CrossRef]
8. Campbell, J.; Warrick, O. Climate Change and Migration Issues in the Pacific; United Nations Economic and Social Commission for Asia and the Pacific: Bangok, Thailand, 2014.
9. ADB Pacific Risks, Vulnerabilities, and Key Impacts of Climate Change and Natural Disasters. Available online: https://www.adb.org/sites/default/files/linked-documents/E-Pacific-Risks-Vulnerabilities-Climate-Change.pdf (accessed on 18 September 2019).
10. Maynard, J.; Gove, J.; Tracey, D.; Johnson, J.; Lecky, J.; Conklin, E.; van Hooidonk, R.; Donovan, M.; Hospital, J.; Kleiber, D.; et al. Coral Reefs: Vulnerability to Climate Change in West Hawai ˇi; PIFSC Special Publication: Hawaii, HI, USA, 2019.
11. Lindegren, M.; Checkley, D.M.; Koslow, J.A.; Goericke, R.; Ohman, M.D. Climate-mediated changes in marine ecosystem regulation during El Niño. Glob. Chang. Biol. **2018**, 24, 796–809. [CrossRef]
12. WHO. Climate change and health: Key facts. Available online: https://www.who.int/news-room/fact-sheets/ detail/climate-change-and-health (accessed on 18 September 2019).
13. Crimmins, A.; Balbus, J.; Gamble, J.; Beard, C.; Bell, J.; Dodgen, D.; Eisen, R.; Fann, N.; Hawkins,M.; Herring, S.; et al. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment; US Global Change Research Programme: Washington, DC, USA, 2016.
14. NASA 2018 Fourth Warmest Year in Continued Warming Trend, According to NASA, NOAA. Available online: https://climate.nasa.gov/news/2841/2018-fourth-warmest-year-in-continued-warmingtrend- according-to-nasa-noaa/ (accessed on 18 September 2019).
15. Helmholtz Zentrum Muenchen Auswirkungen des Klimawandels. Available online: https://www.allergieinformationsdienst.de/immunsystem-allergie/risikofaktoren/auswirkungen-desklimawandels. html (accessed on 18 September 2019).
16. Asad, H.; Carpenter, D.O. E_ects of climate change on the spread of Zika Virus: A public health threat. Rev. Environ. Health **2018**, 33, 31–42. [CrossRef]
17. Chang, A.Y.; Fuller, D.O.; Carrasquillo, O.; Beier, J.C. Social justice, climate change, and dengue. Health Hum. Rights **2014**, 16, 93–104.

18. Leal Filho, W.; Bönecke, J.; Spielmann, H.; Azeiteiro, U.M.; Alves, F.; Lopes de Carvalho, M.; Nagy, G.J. Climate change and health: An analysis of causal relations on the spread of vector-borne diseases in Brazil. J. Clean. Prod. **2017**. [CrossRef]
19. WHO. Human Health and Climate Change in Pacific Island Countries; World Health Organization: Geneva, Switzerland, 2015.
20. Musso, D.; Rodriguez-Morales, A.J.; Levi, J.E.; Cao-Lormeau, V.M.; Gubler, D.J. Unexpected outbreaks of arbovirus infections: Lessons learned from the Pacific and tropical America. Lancet Infect. Dis. **2018**, 18, e355–e361. [CrossRef]
21. Wu, X.; Lu, Y.; Zhou, S.; Chen, L.; Xu, B. Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. Environ. Int. **2016**, 86, 14–23. [CrossRef]
22. Gomes, A.F.; Nobre, A.A.; Cruz, O.G. Temporal analysis of the relationship between dengue and meteorological variables in the city of Rio de Janeiro, Brazil, 2001–2009. Cad. Sa*ú*de P*ú*blica **2012**, 28, 2189–2197. [CrossRef] [PubMed]
23. Paz, S.; Semenza, J.C. El Niño and climate change—Contributing factors in the dispersal of Zika virus in the
24. Campbell-Lendrum, D., Manga, L., Bagayoko, M. & Sommerfeld, J. Climate change and vector-borne diseases: what are the implications for public health research and policy? *Philos. Trans. R. Soc. B Biol. Sci.* **370**, 20130552 (2015).
25. Kilpatrick, A. M. & Randolph, S. E. Drivers, dynamics, and control of emerging vector-borne zoonotic diseases. *Lancet* **380**, 1946–1955 (2012).
26. Hales, S., De Wet, N., Maindonald, J. & Woodward, A. Potential effect of population and climate changes on global distribution of dengue fever: an empirical model. *Lancet* **360**, 830–834 (2002)