

A SYSTEMATIC REVIEW OF RELATED LITERATURE ON DENGUE DISEASE

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ABSTRACT

The burden of dengue continuously wreak havoc all over the world. This literature review synthesizes key findings from various studies on epidemiology and key drivers influencing the increasing burden of dengue using PRISMA methodology for systematic literature review. At the regional level, Southeast Asia, South Africa, and the Western Pacific have the highest dengue burdens, with a notable increase in cases observed in the Western Pacific between 2013 and 2019. Environmental factors such as temperature, rainfall, and humidity play a crucial role in dengue transmission, with urbanization and population growth further exacerbating the spread of the disease. The review also highlights the correlation between climate change and the expansion of dengue-suitable areas, with urbanization expected to be the primary driver by 2050.

1. INTRODUCTION

“Dengue is the most prevalent mosquito-borne disease” apart from malaria. Dengue is transmitted by infected by female Aedes mosquitoes to humans through bites (Guo et al., 2017; Guzman & Harris, 2015; Subido & Aniversario, 2022). Mosquito-borne diseases remain a health challenge that continues to pose a significant threat to global public health. Mosquito-borne diseases include dengue, malaria, chikungunya, Zika, yellow fever, and West Nile virus. These diseases have a widespread impact on communities around the world, particularly in tropical and subtropical countries where mosquitos thrive. Dengue has the highest global incidence and have been significantly increasing since the early 2000 (WHO, 2023). An estimated 3.9 billion people are in danger of being infected with dengue in more than 132 countries, of which approximately 96 million are symptomatic with 40,000 annual fatalities (WHO, 2024).

Over the years, dengue infections have exhibited a rising trend in incidence and geographic spread, influenced by factors such as urbanization, climate change, and inadequate vector control measures (Du, Jing, Liu, & Liu, 2021; Kesetyaningsih, Andarini, Sudarto, & Pramoedyo, 2018; Xavier, Honório, Pessanha, & Peiter, 2021). This review aims to systematically analyze the literature on dengue infections, focusing on trends in epidemiology and the key drivers influencing the increasing burden of the disease.

2. METHODOLOGY

Protocol and Guidelines

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & Group, 2010). This review protocol was designed to ensure transparency and reproducibility.

Eligibility Criteria

Inclusion

Studies included in this literature review were published between 2000 and 2024 particularly articles focusing on the epidemiology and key drivers of dengue infections. Journals are peer-reviewed articles in English.

Exclusion

Studies not directly related to dengue infections and non-peer-reviewed articles, conference abstracts, and opinion pieces.

Information Sources

The review utilized PubMed and Google Scholar in accessing journal articles. Additional articles were identified through reference lists of included studies.

Search Strategy

The search strategy combined Medical Subject Headings (MeSH) terms and keywords related to dengue infections. The following search string was adapted for each database: “Dengue” OR “Dengue Fever” OR “Dengue Virus” AND “Epidemiology” OR “Incidence” OR “Geographic Spread” OR “Risk Factors.”

Data Extraction

Data were extracted using a standard form, including details on authorship, publication year, study design, geographic location, and key findings.

Study Selection

The initial search yielded 3, 214 articles. After removing duplicates, 2,765 articles were screened by title and abstract. Of these, 187 full articles were assessed for eligibility, and 13 studies were included in the final review.

3. RESULTS

The table presents the articles reviewed in this study particularly focusing on dengue epidemiology, trends, and the drivers influencing the increasing burden of the disease.

Table 1. Summary of Studies under this review

Author	Study Design	Geographic Location	Findings
Shepard et al. (2013)	Economic burden and epidemiology assessment study.	Southeast Asia	The annual economic burden of dengue in Southeast Asia was estimated at \$950 million (USD). The study estimated around 2.9 million symptomatic dengue cases annually in the region, of which only 6% were reported to surveillance systems, highlighting significant underreporting.
Salda et al. (2005)	Molecular epidemiological study	Philippines	The study identified a genotype shift in dengue virus serotype 2 (DENV-2) in the Philippines, indicating local evolution and the emergence of a new genotype.
Togami et al. (2023)	Epidemiological analysis using regional surveillance data	Western Pacific Region	Approximately 70% of dengue cases estimated to have been in Asia based on the 20-year period data ending in 2019. Dengue cases in the Western Pacific Region has increased to about 144% from 2013-2019. The reported case fatality ratio ranged from 0.19% in 2014 and 0.30% in 2019.
Du et al. (2021)	Retrospective Analysis	Global, with regional analysis	The number of global dengue episodes increased by 85.47%, from 30.67 million in 1990 to 56.88 million in 2019. The global ASR rose by 1.70% annually from 1990 to 2011, then declined by 0.41% per year from 2011 to 2019. Despite the global decline in ASR after 2011, regions such as Oceania (EAPC 11.01), East Asia (EAPC 4.84), and Southeast Asia (EAPC 0.38) experienced increasing ASRs during this period. Middle and high-middle SDI regions also saw rising ASRs from 2011 to 2019. In low and low-middle SDI regions, the dengue incidence rate was higher among individuals over 65 years old compared to other age groups. Additionally, the proportion of dengue episodes in individuals over 70 increased in most GBD regions in 2019 compared to 1990 or 2011.
L'Azou et al. (2016)	Epidemiological Analysis using data from placebo groups in vaccine efficacy trials	Southeast Asia and Latin America	The incidence of Dengue Hemorrhagic fever is less than 0.3 episodes per 100 person-years in each cohort. In age groups 9-12 years and 13-16 years, the burden of dengue was higher in Asia than in Latin America.
Messina et al. (2014)	Retrospective mapping and analysis	Global	The four stereotypes of dengue – DENV1-4 have expanded their geographic ranges significantly since 1943, with notable increases in regions of Africa, the Americas, and Asia. The co-circulation of multiple DENV types within the same regions has become more common, leading to hyperendemicity, which is associated with higher risk

			of severe dengue outbreaks.
Yang et al. (2021)	Comprehensive analysis of the global, regional, and national burden of dengue from 1990 to 2019.	Global	By 2019, the 15-19 age group has the largest portion of deaths and disability-adjusted life years (DALYs). South-East Asia and South Africa reported the highest number of dengue cases, deaths, and DALYs. The study found a notable positive correlation between dengue burden and factors such as global land-ocean temperature index and air passenger travel metrics, indicating that climate change and increased human mobility contribute to the rising dengue burden.
Abdalgader et al. (2024)	A modelling framework was utilized to assess the spatiotemporal dynamic of dengue transmissions.	Mainland China	Climatic conditions are a key driver to rapid dengue transmission. Local human movement significantly contributes to the spread of dengue within regions. Imported cases play a crucial role in initiating dengue outbreaks, increasing the disease incidence rate by 34.6%.
Kesetyaningsih et al. (2018)	Ecological Study	Sleman District, Yogyakarta, Indonesia.	Dengue cases exhibited a clustered spatial pattern across all sub-districts of Yogyakarta in Indonesia. The study found out positive correlation between land cover (percentage of built-up area) and dengue incidence indicating higher dengue cases in areas with more built-up land. Conversely, elevation showed a negative correlation with dengue incidence, suggesting fewer cases in higher-altitude areas. Climatic factors such as humidity and rainfall significantly affected dengue incidence, with contributions ranging from 13.5% to 27.4%. Temperature did not have a significant effect on dengue incidence across the studied sub-districts. In areas with sporadic dengue cases, no climate parameters showed a significant effect.
Xavier et al. (2021)	Time Series Analysis	Rio de Janeiro, Brazil	The study concluded that temperature and rainfall are significant determinants of dengue incidence, as they directly influence the population density of Aedes aegypti, the primary mosquito vector for dengue.
Messina et al. (2019)	Predictive modeling Study	Global Analysis	The study estimated that by 2050, the population living in dengue-suitable areas is projected to increase to 60%, primarily due to urbanization and climate change. Urban growth is expected to play a more substantial role than climate change in expanding dengue suitability, emphasizing the need for targeted vector control in rapidly urbanizing regions.
Subido Aniversario (2022)	Correlation and wavelet coherence analysis	Philippines	The study found strong correlation between precipitation and dengue incidence, indicating that an increased rainfall is associated with a rise in dengue cases. Additionally, the study found a positive correlation between temperature and dengue incidence; however, this correlation was less pronounced compared to precipitation. Furthermore, a seasonal pattern was observed citing that dengue cases

			predominantly occurred during the rainy season (June to November) suggesting that the wet climate during these months creates favorable conditions for mosquito breeding dengue transmission.
Struchiner et al. (2015)	Retrospective Analysis examining the factors contributing to the rise in dengue incidence over a 40-year period.	Singapore	The study found that population growth was the most significant factor, contributing to an 86% increase in dengue incidence over the study period. Mean and minimum annual temperatures together accounted for a 14% increase in dengue cases.

4. DISCUSSION

This literature review presents a range that explore the epidemiology, burden, environmental factors, and determinants of dengue across all regions. Dengue incidence varies across regions, with Southeast Asia, South Africa, and Western Pacific Region showing the highest burdens. The study by Togami et al. (2023) indicates a notable increase in dengue cases in the Western Pacific Region from 2013-2019, with a small increase in fatality ratios. Additionally, Du et al. (2021) report a rise in age-standardized rates in regions like Oceania, East Asia, and Southeast Asia, signaling an upward trend in disease incidence, despite a global decline post-2011.

Environmental and climatic factors plays a significant role in driving the incidence of dengue as emphasized by Kesetyaningsih et al. (2018), Struchiner et al. (2015), and Xavier et al. (2021). Temperature, rainfall, and humidity were found to be key determinants. Specifically, rainfall is associated with a higher dengue incidence due to its effect on mosquito breeding, as observed by Subido and Aniversario (2022) in the Philippines. In areas like Yogyakarta, Indonesia, built-up land and climatic factors were found to influence dengue clusters, with temperature having a lesser impact. This suggests the need for targeted interventions based on local environmental conditions.

Urbanization, linked to both climate change and population growth, is another significant factor affecting dengue spread. Studies by Messina et al. (2019) and Struchiner et al. (2015) indicate that urbanization contributes more to the expansion of dengue-suitable areas than climate change alone. With population growth, especially in rapidly urbanizing regions, the vector's habitats expand, leading to higher transmission rates.

Several studies highlight the significant economic and health impacts of dengue. For example, Shepard et al. (2013) report an annual economic burden of \$950 million USD in Southeast Asia, driven by both direct and indirect costs. Additionally, the underreporting of cases (only 6% of symptomatic cases reported) suggests a need for better surveillance systems in the region. On a global scale, Du et al. (2021) point out the growing number of dengue episodes, which increased by 85.47% between 1990 and 2019, reflecting the increasing public health burden. Yang et al. (2021) further support this by showing a positive correlation between dengue burden and climate change, suggesting the potential for higher future impacts.

Molecular studies, such as the one by Salda et al. (2005), reveal important insights into the evolution of the dengue virus. The shift in genotype of DENV-2 in the Philippines indicates that the virus is evolving locally, potentially affecting vaccine efficacy and control strategies. The global spread and co-circulation of multiple dengue virus serotypes, highlighted by Messina et al. (2014), are associated with more severe outbreaks, emphasizing the importance of continuous surveillance and strain monitoring.

Given the growing dengue burden, studies like those by (L'Azou et al., 2016) and Messina et al. (2019) suggest that a combination of climate adaptation, vector control, and vaccination efforts will be necessary to mitigate future risks. The increased population living in dengue-suitable areas by 2050 will require urgent public health strategies, especially in urbanized regions where the disease burden is likely to rise.

5. CONCLUSION

In summary, this review of literature and studies underscore the complexity of dengue transmission, which is influenced by multiple factors, including climate, population dynamics, virus evolution, and surveillance gaps. A multidisciplinary approach involving surveillance, climate adaptation, and public health measures is essential to control dengue's growing burden.

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