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Highlights

- Dengue virus (DENV) is the fastest-growing mosquito-borne disease worldwide.
- In 2024, 14.1 million dengue cases were reported worldwide
- Globally, 9404 dengue-related deaths were recorded with a CFR of 0.07%.
- Dengue fatalities were 4.91 times higher in the Southern vs. Northern Hemisphere
- We urge adding DENV to WHO's R&D priority list to tackle this growing threat

Global Dengue Epidemic Worsens with Record 14 Million Cases and 9,000 Deaths Reported in 2024

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Abstract

Dengue, caused by the dengue virus (DENV), is the fastest-growing mosquito-borne disease worldwide. We utilised monthly data on dengue cases and deaths reported through the World Health Organisation's (WHO) global surveillance system for the period of 1st January to 31st December 2024. We then performed a generalised linear regression model to understand country-level determinants of dengue-related mortality. In 2024, 14.1 million dengue cases were reported globally, surpassing the historic milestone of 7 million observed in 2023. This figure represents a twofold increase compared to 2023 and a 12-fold rise compared to 2014 (*n*=1,206,644). In 2024, 9,508 dengue-related deaths were recorded, resulting in a global case-fatality rate of 0.07%. In the regression analysis, countries in the Southern hemisphere (incidence rate ratio [IRR]: 5.95, 95% CI: 4.19–8.46), and aged population (IRR 1.04, CI: 1.01-1.07), and mean annual temperature (IRR 1.21, CI: 1.16-1.26) were significantly associated with higher dengue-related mortality per million population. The ongoing dengue outbreak underscores the urgent need for global investment in DENV research, vaccine development, vector control, and therapeutic strategies. We urge the inclusion of DENV in the WHO's Research and Development Priority Disease list to address this growing global health threat.

Background

Dengue virus (DENV) is currently the world's fastest-spreading mosquito-borne disease [1]. In 2023, the world witnessed its first landmark of 6.5 million cases and 7000 deaths due to DENV [2]. The record of cases and deaths by DENV is continuing to increase, with new records continuing to emerge each year since 2021. Since 2021, indigenous dengue cases have been recorded in mainland Europe and the USA, highlighting the growing risk of autochthonous dengue transmission in these regions [2]. DENV is a member of the Flaviviridae family transmitted by *Aedes aegypti* and *Aedes albopictus*, mosquitoes of the genus *Aedes*.

Several factors likely contributing to the global increase in dengue cases, including globalisation, rapid urbanisation, and climate change [1]. In 1950, approximately 31 million passengers travelled by air; however, in the post-COVID-19 period, nearly 4.5 billion passengers are traveling globally each year [1]. The rapid urbanisation worldwide since the 1980s has created ideal breeding sites for *Aedes* mosquitoes. These sites often evolve through the accumulation of stagnant water in commonly discarded or neglected items such as plant pots, plastic containers, and unused car tires, creating ideal environments for mosquito larvae development and thereby increasing dengue transmission risk [3]. Warmer temperatures enable mosquitoes to grow and spread more rapidly, bite humans more frequently, and shorten the extrinsic incubation period of the virus [4]. Additionally, changes in rainfall patterns have extended vector seasons. The impact of dengue are disproportionately severe in developing countries and among urban populations in penurious or neglected areas, where limited access to healthcare and vector control exacerbates disease burden. In recent years, *A. albopictus* has spread to every continent except Antarctica. While the exact number of countries where *A. albopictus* is endemic remains uncertain, the mosquito has been identified in at least 20 European countries [5]. The spread and adaptability of *A. albopictus* is an increasing concern for dengue and other arboviruses, including Zika and chikungunya viruses.

A primary infection with any serotype of DENV can lead to severe dengue, however, individuals infected for the second time with a different dengue serotype are more likely to develop severe secondary dengue infection [6,7] . In addition, previous studies have demonstrated that individuals - suffering from chronic diseases, such as diabetes, obesity, and hypertension, are at greater risk of progressing to severe disease with dengue not exempted [8]. In this study, we hypothesised that countries with higher urbanisation rates and population density, poor air quality index, higher temperatures, and rainfall might experience a higher burden of dengue cases while those with a higher prevalence of co-morbidities (diabetes, hypertension, obesity, and elderly population) might experience a higher fatality rate [9]. To explore these hypotheses, this article examines the global burden of dengue cases and fatalities in 2024 by analysing their distribution and identifying factors influencing dengue-related mortality.

Data sources, study design, and Statistical analysis

We collected and analysed data from daily reports of new dengue cases and deaths, monthly reported cases and deaths, and cases and deaths per million inhabitants worldwide from the WHO Global Dengue Surveillance system from 1st January 2014 to 31st December 2024 [10]. We also explored the nation-level factors affecting dengue-related cases and deaths per million population. WHO's database included dengue-related data from a total of 105 countries where at least one dengue case was detected in 2024 **(Table S1).**

We considered cases and deaths per million population as the outcome variable, while predictor variables included population density, the percentage of the population aged 65 years or older, the percentage of the urban population, the prevalence of obesity, diabetes and hypertension, and environmental factors such as average temperature, total rainfall and Air Quality Index (AQI). These data were gathered from the World Bank, other United Nations sources, and 'Our World in Data' [11–17].

We performed summary statistics for dengue cases and deaths and calculated the incidence by continent and for the northern and southern hemispheres, using monthly and yearly data. A generalised linear regression model with Poisson distribution was employed to identify independent predictors of dengue cases and deaths, while reporting the incidence rate ratio (IRR) and 95% Confidence Interval (CI). The

IRR represents the multiplicative change in the incidence rate of dengue (cases per million population) associated with a one-unit increase in the explanatory variable, while controlling for other covariates in the model. For example, for the aged population, the IRR of 1.04 indicates the deaths per million population increased by 4% with a 1% increase in the proportion of the population aged 65 years and over in the country. Statistical analyses were performed using R Version 3.5.2.2 [18]

Global dengue cases and deaths in 2024

Between 1 January and 31 December 2024, a staggering 14,127,435 dengue cases were recorded worldwide ,the highest-ever recorded number of dengue cases since the global dengue recording system was introduced in 2010. This figure is more than double to the previous record of 6.8 million reported by the WHO in 2023. Compared to the cases recorded in 2014 (*n*=1,206,644), global dengue fever increased 12-fold in 2024 **(Figure S1)**. The year 2024 recorded 9,508 deaths, the highest number since the recording system was introduced by the WHO that same year, resulting in a case-fatality rate of 0.07%. The death toll in 2024 was 15 times higher compared to the deaths recorded in 2014 (*n*=683) **(Figure S2)**. The WHO database includes updated historical data dating back to 2014; however, the dataset appears to be incomplete up to 2022.

Dengue seasonality varied in the Southern and Northern hemispheres due to the variation in weather patterns in the two opposite hemispheres. The highest number of cases in the Northern Hemisphere occurred in October, with 410,619 cases **(Figure S1)**. In the Southern Hemisphere, the highest number of cases was recorded in March, with 2,664,539 (2.66 cases per million). In tropical areas, the cases ranged from 0.23 to 2.52 per million, while in subtropical areas, the cases were notably lower, ranging from 0.04 to 0.26 per million **(Figure S3)**.

In South America, Brazil reported the highest burden of dengue, with 10,267,077 cases (47,904 cases per million population) and 6,264 dengue-related deaths, resulting in the highest death rate per million (29.23

deaths/M), followed closely by French Guiana (26.90 deaths/M) **(Figure S2)**. In Europe, 213 cases in Italy, 85 cases in France, and 10 cases in Spain were reported in 2024. In Africa, although the overall case numbers were lower, Niger recorded a notably high case-fatality rate (CFR) of 20.69% (12 deaths out of 58 cases) **(Table S1)**.

At the continental level, South America reported the highest dengue burden, with 11,921,180 cases and 7,413 deaths. North America followed, reporting 1,143,046 cases and 935 deaths, with a relatively low CFR of 0.08%. In Asia, 884,402 cases and 1,008 deaths were recorded, with a CFR of 0.11%. Although Africa reported fewer total cases and deaths, it showed the second highest CFR at 0.09%, after Asia **(Table 1 and Figure S3)**.

In the generalized linear regression, several factors were associated with the increased case and death rate. Countries located in the Southern Hemisphere (IRR: 2.08, 95% CI: 1.96–2.20), a high mean annual temperature (IRR: 1.21, 95% CI: 1.21–1.22), and high rainfall (IRR: 1.01, 95% CI: 1.01–1.02) showed a significant association with higher dengue cases per million compared to countries in the Northern Hemisphere, with lower mean annual temperatures, and lower rainfall, respectively. For dengue-related deaths per million population, countries in the Southern Hemisphere (IRR: 1.21, 95% CI: 5.95, 95% CI: 4.19–8.46), annual mean temperature (IRR, 95% CI: 1.16-1.26) were significantly associated with higher mortality rates compared to countries in the Northern Hemisphere and lower mean annual temperature **(Table 2).**

Global Dengue Surge: Rising Cases, Regional Disparities, and Data Gaps

The unprecedented global burden of dengue in 2024 highlights the alarming growth trajectory of this mosquito-borne disease. With over 14.1 million reported cases worldwide, dengue has exceeded the historic milestone of 7 million cases reported in 2023 [2]. This twofold increase within a year and a staggering 12-fold rise since 2014 highlight the escalating public health crisis. The significant mortality toll of over 9,500 deaths, with South America alone accounting for nearly 70% of these fatalities, emphasises the disproportionate regional impact of dengue. Such figures reveal the pressing need to address the multifactorial challenges driving the outbreak, including climate change, urbanisation, and resource disparities in healthcare and vector control measures. Dengue patients in the Southern Hemisphere experienced five times higher deaths compared to their northern counterparts, primarily because of higher recorded deaths in Brazil and other South American countries [2,19]. To explore this further, we conducted an additional analysis comparing tropical and subtropical regions, which provided a more accurate geographic differentiation of dengue burden **(Fig S3).**

Countries with a higher aged population had a higher death rate due to DENV. Our findings confirm previous studies that have shown a higher fatality rate of severe dengue in older people [19]. The reasons behind that are not well established, but older individuals also have multiple co-morbidities, which may independently increase the risk of severe disease. Furthermore, older populations are also excluded from recent novel vaccine campaigns in South America due to a lack of robust clinical trials conducted with this population group [20]. A study including 1705 fatal cases showed that each additional 10-year age increment was associated with a 30% increase in CFR [21]. However, in endemic regions, children are disproportionately affected compared to adults, with a relatively higher incidence of dengue haemorrhagic fever (DHF) observed among them [22].

Our analysis shows a remarkable increase in dengue cases and deaths and underscores the critical importance of robust global data-sharing mechanisms. Surveillance systems such as the WHO's global dengue surveillance could be pivotal in identifying trends, tracking outbreaks, and informing timely interventions [23]. Comprehensive, real-time data collection enables accurate analysis of determinants such as temperature, population density, and urbanization, as demonstrated in this study. However, gaps in reporting persist, with a current delay of nearly two months on the WHO dashboard.

The COVID-19 pandemic highlighted the importance of real-time data sharing, a practice that must be replicated for other diseases, including dengue. Countries not currently reporting dengue cases to the

WHO platform, including European countries, should be encouraged and supported to participate in this global effort to enhance data transparency and collaboration. Addressing these challenges through investments in digital health infrastructure, standardised reporting protocols, and international collaboration is essential to improving the global response to dengue. Transparent and accessible data sharing will be vital for forecasting outbreaks, tailoring interventions, and evaluating the effectiveness of existing control measures.

Prioritizing Dengue: Urgent Global Action for Research, Innovation & Control

Given the escalating global health threat posed by dengue, we advocate that WHO should include the DENV in its ‘Prioritising diseases for research and development (R&D) in emergency contexts’ list [24]. This designation would catalyse investment in critical areas such as vaccine development, therapeutic innovations, and enhanced vector control strategies. Notable progress in dengue vaccine development is underway in Brazil, led by the Butantan Institute, though broad regional and global access may still take time. The lack of a universally accessible and effective dengue vaccine leaves millions vulnerable to severe disease outcomes [25]. Furthermore, this study highlights how climate and demographic factors exacerbate dengue-related mortality, underlining the need for tailored, multidisciplinary approaches to vector control and dengue prevention . Prioritising DENV on the global R&D agenda would ensure coordinated efforts to address the growing burden of dengue and prevent future outbreaks of this magnitude. Including dengue as a priority disease is not just a scientific necessity but also a moral imperative to protect global health and reduce the inequities associated with this preventable disease.

Dengue prevention is heavily reliant on vector control and elimination strategies [26]. While vector control remains essential in managing mosquito-borne diseases, its limited success has raised concerns about whether additional alternative approaches should be prioritized for controlling dengue and other arboviruses [26]. Greater emphasis must be placed on developing effective vaccines, novel therapeutics, improved patient management strategies, and early detection systems for secondary and severe dengue cases including the warning signs recommended by WHO’s 2009 Guidelines such as abdominal pain, persistent vomiting, mucosal bleeding, lethargy, clinical fluid accumulation in the lungs and abdomen, and rapid decline in platelet count [25,27]. A coordinated global priority-setting effort is urgently required to tackle dengue more effectively, with the WHO taking a leading role in these initiatives [28]. The inclusion of dengue on the WHO priority disease list would facilitate action and drive investment and innovation in research and public health interventions. Dengue was previously identified as an important disease by the WHO's nominated expert member for listing Priority Diseases, such as in 2017 [29]. Strengthening international collaboration and resource allocation is critical to address the rising global dengue burden.

There are significant disparities in national dengue reporting capacities. Brazil provides a strong example, with dengue designated a notifiable disease since 1961 and electronic reporting via the Notifiable Diseases Information System (SINAN) implemented since 1993[20]. The country's surveillance infrastructure is robust, featuring mandatory case reporting, broad diagnostic capacity, and active monitoring at both national and local levels[20] . This facilitates more comprehensive case detection than in many countries where underreporting is common due to weaker health systems and infrastructures. Furthermore, as primary dengue infection is often mild, healthcare-seeking behaviour, particularly in low- and middle-income countries, can further limit case detection, as individuals may only present when severely ill [30].

Future dengue research should prioritise understanding the drivers behind the twofold increase in cases between 2023 and 2024. Key areas include the effects of climate anomalies such as El Niño on mosquito distribution, the impact of rapid urbanisation and land use changes, the role of co-circulating serotypes in transmission dynamics, and viral evolution influencing disease severity and spread [31]. Further priorities include identifying barriers to timely diagnosis and reporting in high-burden regions, evaluating scalable innovations in vector control and surveillance, and optimising vaccine deployment strategies across diverse settings [31]. These research directions closely align with the WHO agenda and are vital for guiding targeted interventions and strengthening global dengue preparedness.

Limitations:

We collected data from the WHO's global dengue surveillance platform, which is a relatively new platform . Additionally, the WHO relies on dengue reports from various countries, each of which may use different definitions for dengue cases and dengue-related deaths. Reporting gaps could potentially exist largely due to a lack of surveillance resources and tools in poorer, dengue-stricken regions across the globe. WHO surveillance data are collected monthly and reflect variability in reporting practices among countries. For instance, some nations report data weekly or biweekly, and retrospective revisions, including negative values, are common due to ongoing data cleaning. As the WHO notes, data availability varies significantly across regions. In Europe, case counts are limited to *locally acquired infections* only, given the high proportion of imported cases from endemic areas [23]. This distinction can contribute to an underestimation of the actual dengue burden in the region. In the African region, data are currently limited to outbreak-affected countries, and other nations will be included as data become available. These nuances underscore broader challenges in surveillance, where both underreporting and definitional differences can affect accurate global comparisons. Cross-country variations necessitate caution in interpreting and generalising the data. We identified factors associated with national-level dengue cases, deaths, and CFR, but these findings should not be interpreted at the individual level, nor should the associations be considered causal. However, due to the absence of detailed age-specific variables in the available data, we were unable to analyse or present severity and fatality by age group.

Conclusion

In 2024, dengue cases (>14 million) and deaths (>9,000) reached record highs. Urgent focus is needed on vaccine development, novel therapies, improved patient management, vector control, and early detection of secondary and severe dengue cases. Prioritising dengue in the WHO's research agenda, alongside global collaboration and investment as well as standardisation of data, is crucial for providing meaningful comparison across countries, and a timely and coordinated public health response in reducing its burden and preventing future outbreaks

Declarations of competing interest

The authors declare no conflict of interest.

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Author´s Contribution Statement

Conceptualization: NH, Data curation: MNH, writing original draft: NH, MNH, JO, Writing, review, and editing: MA, MNH, JO, MB, SK, DP, PP

Ethics statement

There is no identifiable individual-level data, and ethical approval is not required.

Data availability

Dengue data was obtained from the WHO Global Dengue Surveillance system, with additional information sourced from the World Bank, various United Nations agencies, and 'Our World in Data.'

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Table titles

Table 1: Comparison of the dengue cases, deaths, and case fatality ratio (CFR) of dengue in 2024 by continent. Data was collected from WHO's global dengue surveillance system. (https://worldhealthorg.shinyapps.io/dengue_global/)

Table 2: Country-level factors associated with dengue cases, deaths, and case–fatality rate, with national-level explanatory variables using a multiple linear regression model between 1 January 2024 and 31 December 2024. Data were collected from the WHO's global dengue surveillance system (https://worldhealthorg.shinyapps.io/dengue_global/)

Tables

Table 1: Comparing the dengue cases, deaths, and case fatality ratio (CFR) of dengue in 2024 by continent. Dengue-related data were collected from the WHO's global dengue surveillance system. (https://worldhealthorg.shinyapps.io/dengue_global/). Data from a total of 105 countries were included in the analysis.

Continents	**Cases**	**Deaths**	**Cases/M**	**Deaths/M**	**CFR (%)[a]**
Africa	168,851	152	85,882.02	15.96	0.09
Antarctica	0	0	--	--	--
Asia	884,402	1,008	23,009.60	15.78	0.11
Europe	308	0	5.12	0.00	0.00
North America	1,143,046	935	203,246.70	61.24	0.08
Oceania	9,648	0	19,863.54	0.00	0.00
South America	11,921,180	7,413	240,857.36	118.48	0.06
Total/ average	**14,127,435**	**9,508**	**5,455.85**	**4.81**	**0.07**

Cases/M: cases per million people; Deaths/M: deaths per million people; CFR: case fatality ratio.

[a] The total number of cases and deaths is presented, with the case fatality rate (CFR) calculated as total deaths divided by total cases, expressed as a percentage. The averages are provided for Cases/M and Deaths/M.

Table 2: Country-level factors associated with dengue cases, deaths, and case–fatality rate, with national-level explanatory variables using a multiple linear regression model between 1 January 2024 and 31 December 2024. Dengue-related data were collected from the WHO's global dengue surveillance system (https://worldhealthorg.shinyapps.io/dengue_global/). Data from a total of 105 countries were included in the model.

Country-level factors	**Cases/M**		**Deaths/M**		**CFR (%)**	
	IRR (95% CI)	*p*-value	IRR (95% CI)	*p*-value	IRR (95% CI)	*p*-value
Aged 65 and above (%)	1.04 (1.04 - 1.05)	*<0.001*	1.04 (1.01 - 1.07)	*0.005*	1.18 (0.95 – 1.52)	*0.147*
Urban population (%)	1.01 (1.01 - 1.02)	*<0.001*	1.01 (0.99 - 1.01)	*0.810*	1.06 (0.99 – 1.15)	*0.104*
Population density	1.01 (1.01 - 1.02)	*<0.001*	1.01 (0.99 - 1.01)	*0.082*	1.01 (0.99 - 1.01)	*0.630*
Obesity (%)	1.01 (1.01 - 1.02)	*<0.001*	1.02 (0.99 - 1.05)	*0.217*	0.83 (0.69 – 0.98)	*0.039*
Average annual temperature	1.21 (1.21 - 1.22)	*<0.001*	1.21 (1.16 - 1.26)	*<0.001*	1.06 (0.90 - 1.46)	*0.562*
Total Rainfall	1.01 (1.01 - 1.02)	*<0.001*	1.01 (1.01 - 1.02)	*<0.001*	1.01 (0.99 - 1.01)	*0.532*
Air Quality Index	1.01 (1.01 - 1.02)	*<0.001*	1.01 (1.01 - 1.02)	*0.007*	1.01 (0.98 – 1.04)	*0.484*
Hemisphere (Southern)	2.08 (1.96 – 2.20)	*<0.001*	5.95 (4.19 – 8.46)	*<0.001*	0.13 (0.01 – 1.79)	*0.199*

CI: confidence interval; IRR: incidence risk ratio; Cases/M: cases per million people; Deaths/M: deaths per million people.

Conflict of Interest:

The authors declare no conflict of interest.