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Global Landmark: 2023 Marks the Worst Year for Dengue Cases with Millions Infected and Thousands of Deaths Reported

--Manuscript Draft--

Manuscript Number:	
Article Type:	Short Communication
Keywords:	Dengue outbreak; dengue surveillance; dengue vaccine; climate change
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Abstract:	Objectives: In 2023, the world experienced the worst dengue virus (DENV) outbreak on record. This study aims to identify global regions and continents with a high burden of Dengue in 2023. Design: We collected data on the number of DENV cases and deaths reported by various countries to the WHO and WHO regional offices to identify regions with a high burden. We estimated cases per million population and case-fatality ratio among the confirmed cases reported by each country. Results: Overall, in 2023 globally, 6.5 million cases and >6800 deaths attributed to DENV were recorded, marking a historic milestone. Two distinct hotspots of dengue virus circulation emerged: the South American and the South and Southeast Asian regions. South America reported 3,924,992, the highest number of cases and 1,946 deaths, resulting in a case fatality ratio (CFR) of 0.05. In Asia, 1,622,405 cases and 3,637 deaths were reported, with a CFR of 0.22. Conclusions: The increased cases and mortality highlight the urgent need for a comprehensive global approach aimed at DENV infection control, including vaccine development, vector control, public health initiatives, and improved clinical management.
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July 10, 2024

Dr. Eskild Petersen MD, Editor-in-chief

IJID Regions

Subject: Article (Short Communications) on the global burden of dengue cases and deaths in 2023

Dear Dr Eskild Petersen,

Please find our manuscript as a commentary entitled "Global Landmark: 2023 Marks the Worst Year for Dengue with Millions Infected and Thousands of Deaths Reported" submitted to 'IJID Regions' for your consideration review and publish in the journal.

The year 2023 marks the historic milestone of 6 million cases and more than 6000 deaths caused by dengue virus infection. Countries in the temperate regions including the USA, France, Spain, and Italy also recorded dengue cases in 2023. There were two obvious hotspots of dengue cases: South America and Asia (South Asia and Southeast Asia). As we approach the summer and the rainy season, countries in the Northern Hemisphere are bracing for another potentially record-breaking year of DENV in 2024, eliciting both anticipation and surprise among observers. In the first half of 2024, laboratory-confirmed dengue cases surged to nearly 4.7 million, with over 5,366 deaths reported globally.

We estimated the continent-wide mortality rate per thousand population which revealed the highest number of cases from South America (3,924,992) with the highest number of deaths in Asia (3,637). Globally, there were 56,672.26 cases and 28.45 deaths per million population. The highest number of cases and deaths per million population was reported in North America, with 258,252.27 cases and 90.30 deaths, respectively. While these are just numbers, the figures are significant and concerning thus impacting millions of individuals each year. We argue that urgent global initiatives be taken to address the global spreading of the dengue virus to early detect cases, and save lives through comprehensive public health measures that include a successful vaccine shortly.

We are looking forward to hearing from you.

Best regards,

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Global Landmark: 2023 Marks the Worst Year for Dengue Cases with Millions Infected and Thousands of Deaths Reported

Conflict of Interest:

The authors declare that there is no conflict of interest.

Highlights

- The world is experiencing the largest dengue outbreak ever
- In 2023 the first global landmark of 6.5 million cases and >6800 deaths touched
- South America reported the highest number of dengue cases (3.9M)
- Asia had the highest case-fatality ratio (0.22)
- Brazil reported the highest cases (3.1 M) and Bangladesh highest number of deaths (1705)

Global Landmark: 2023 Marks the Worst Year for Dengue Cases with Millions Infected and Thousands of Deaths Reported

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Abstract

Objectives: In 2023, the world experienced the worst dengue virus (DENV) outbreak on record. This study aims to identify global regions and continents with a high burden of Dengue in 2023.

Design: We collected data on the number of DENV cases and deaths reported by various countries to the WHO and WHO regional offices to identify regions with a high burden. We estimated cases per million population and case-fatality ratio among the confirmed cases reported by each country.

Results: Overall, in 2023 globally, 6.5 million cases and >6800 deaths attributed to DENV were recorded, marking a historic milestone. Two distinct hotspots of dengue virus circulation emerged: the South American and the South and Southeast Asian regions. South America reported 3,924,992, the highest number of cases and 1,946 deaths, resulting in a case fatality ratio (CFR) of 0.05. In Asia, 1,622,405 cases and 3,637 deaths were reported, with a CFR of 0.22.

Conclusions: The increased cases and mortality highlight the urgent need for a comprehensive global approach aimed at DENV infection control, including vaccine development, vector control, public health initiatives, and improved clinical management.

Keywords: Dengue outbreak, dengue surveillance, dengue vaccine, climate change

The article:

Dengue fever, a mosquito-borne illness, is caused by four distinct serotypes of the dengue virus within the Flaviviridae family. Transmission to humans occurs through the bites of *Aedes aegypti (L.)* and *Aedes albopictus* (Skuse) mosquitoes. Currently, Dengue Virus (DENV) is endemic in over 125 countries, with reported cases to the World Health Organization (WHO) escalating annually. While the majority of infections (>80%) exhibit no or mild symptoms leading to lifelong immunity against the specific serotype, reinfection with different serotypes, termed as secondary dengue infection poses a significant risk of severe dengue, culminating in fatal outcomes [1].

We collected data on dengue cases and deaths from multiple sources: including WHO's global dengue surveillance dashboard [2], WHO Eastern Mediterranean Region, WHO European Region [3], WHO Region of Africa, WHO Region of the Americas, WHO South-East Asia Region [4], and WHO Western Pacific Region. We used the national data to accumulate cases by country, continent, and globally. We estimated the cases per million population by countries and continents. The case-fatality rate of dengue was estimated by dividing the number of deaths by the number of confirmed cases reported by each country.

Globally, a total of 6.43 million cases and 6,892 deaths were recorded in 2023 with 56,672 cases and 28.45 deaths per million population [2]. Continent-wise, the highest number of cases were reported from South America (3,924992 cases) with the highest number of deaths in Asia (3,637 deaths). The highest number of cases and deaths per million population was reported in North America, with 258,252.27 cases and 90.30 deaths, respectively **(Table 1)**.

Two distinct hotspots of dengue virus circulation emerged: the South American and the South and Southeast Asian regions **(Table 1)**. The top five countries with cases of DENV infections in 2023 were Brazil (3,088,723), Vietnam (369,000), Bangladesh (321,179), Mexico (277,963), and Peru (274,227). Brazil reported the highest number of cases (3,088,723) while Bangladesh reported the highest number of deaths (1,705) [2,5]. Additionally, three European countries reported locally transmitted dengue cases in 2023: Italy (82 cases), France (43 cases), and Spain (3 cases), while the United States documented a record 156 locally transmitted cases of DENV [6] (**Fig 1 and Table S2**).

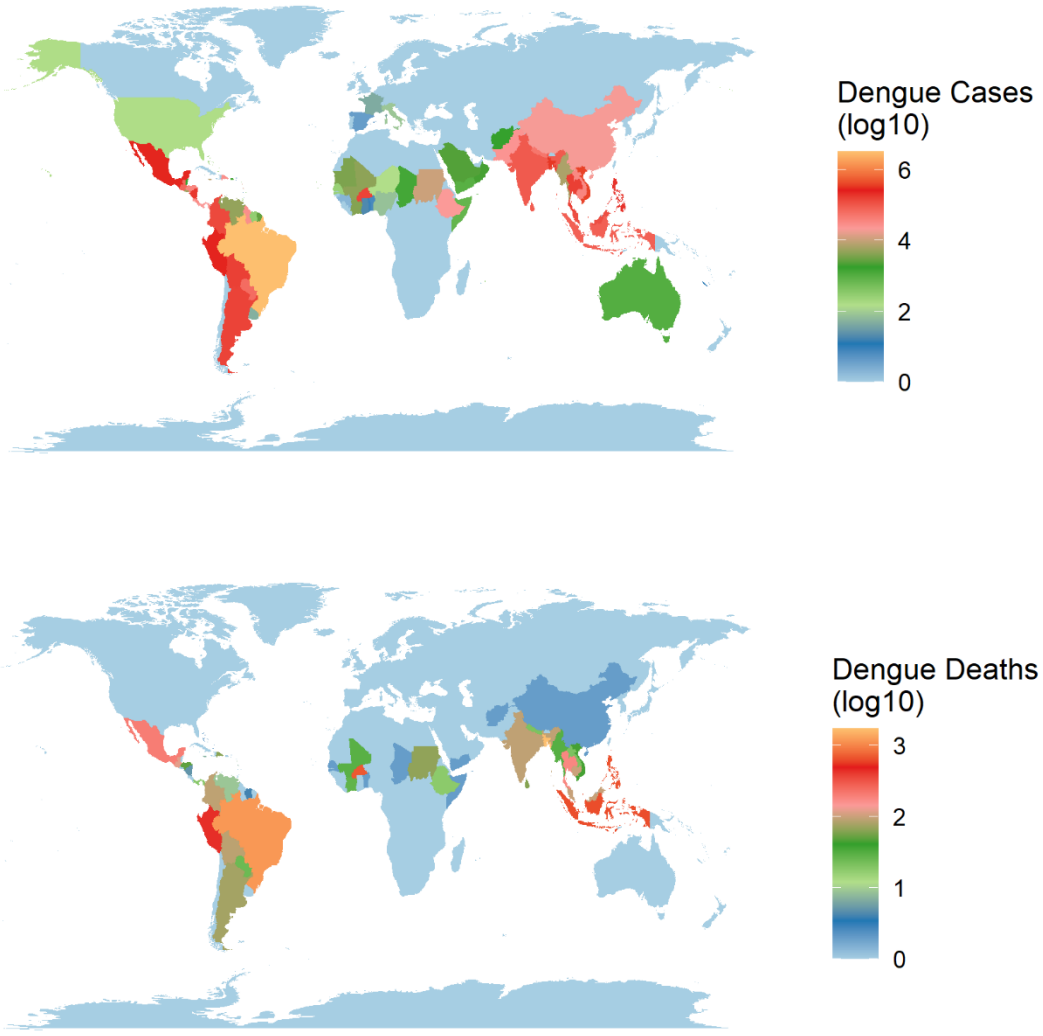

Fig 1: Number of dengue cases and deaths per million population by country in 2023. Source of the data: WHO global monitoring of dengue [2]

In the first half of 2024, laboratory-confirmed dengue cases surged to nearly 4.7 million, with over 5,366 deaths reported globally [2]. As we approach summer and rainy season, countries in the Northern Hemisphere are bracing for another potentially record-breaking year of DENV, eliciting both anticipation and surprise among observers.

WHO described several drivers for the largest-ever DENV outbreak in 2023 [1]. The impacts of the 2023 El Niño phenomenon and climate change, resulting in rising temperatures, heavy rainfall, and high humidity; fragile health systems strained by the COVID-19 pandemic; and political and financial instabilities in countries experiencing complex humanitarian crises and significant population movements [1]. The changes in rainfall seasonality and the introduction of heterogeneous serotypes contributed to the largest-ever outbreak in Bangladesh [7]. Brazil reported the highest-ever number of DENV cases in 2023 reported by any other country in the world which was probably linked to climate change and co-circulation of all four serotypes in the country [1].

Dengue is a major global health issue, impacting millions of individuals each year presenting significant public health challenges. The incidence of dengue is increasingly being reported in rural areas, broadening its geographical and demographic reach. Dengue infection can vary from mild to severe dengue fever, with fatality rates potentially exceeding 1% [8]. The case fatality ratio (CFR) of primary DENV infection is generally low with an estimated value of 0.01-0.1%, but the CFR could reach up to 1-4% for secondary or tertiary DENV infection [8]. The direct costs of dengue, including hospitalization, outpatient visits, and supportive care are substantial. The indirect costs such as loss of productivity, long-term disability, and economic losses due to disease outbreaks are also very high. Furthermore, the disease places a heavy burden on healthcare systems, resulting in significant economic and social strain.

There were discrepancies between our collected data (6.43 million cases and 6,892 deaths), while the WHO's reported totals (6.5 million cases and over 7,300 dengue-related deaths) on their official

webpage [1]. We searched the data on WHO's Global Dengue Surveillance dashboard [2]and found no inconsistencies with our findings. However, the differences could have been attributed to variations in case definitions used by different countries. The reported number of cases is likely a significant underestimation of the actual number, as many cases are asymptomatic and do not seek hospital or clinic testing [1]. A study in India found the actual number of cases to be 282 times higher than the reported cases [9]. In Africa, there are fewer reports on dengue and other arboviruses, possibly due to the high burden of malaria, which exhausts most resources [10]. Nevertheless, the findings show that the number of cases and deaths is significant and concerning.

Dengue and other *Aedes*-borne diseases are a critical global health challenge, that demands coordinated efforts from multiple sectors. The adaptability of mosquitoes to various breeding sites, including urban environments, and their resistance to insecticides continue to hinder vector control efforts. And while the development of dengue vaccines, such as Dengvaxia and TAK-003 marks significant progress, there are still concerns regarding their efficacy and safety across different age groups and serotypes. Therefore, vaccination strategies must be carefully tailored to specific epidemiological contexts. To address the burden of dengue, it is essential to enhance surveillance, improve clinical management, advance research on vaccines and treatments, and implement effective vector control strategies. International collaboration and sustained investment in public health infrastructure are critical in mitigating the impact of dengue and protecting vulnerable populations worldwide [11].

Table 1: Number of dengue cases and deaths per million population by continents in 2023

Continent	Cases	Deaths	Cases/Million	Deaths/Million
Africa	194032	832	9088.38	33.63
Antarctica	0	0	0.00	0.00
Asia	1622405	3637	34416.06	36.03
Europe	128	0	2.12	0.00
North America	692109	477	258252.27	90.30
Oceania	1032	0	69.41	0.00
South America	3924992	1946	94877.55	39.18
Total/average	**6434698**	**6892**	**56,672.26**	**28.45**

Acknowledgments

We acknowledge the WHO and the regional office of WHO for sharing dengue cases and death data on a portal accessible by the public.

Financial Support

There was no funding for this study.

Conflicts of interest

The authors declare no conflict of interest.

Ethics statement

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

Author´s Contributions

Conceptualization: NH, Data curation: MNH, writing original draft: NH, Supervision: MA, Writing, review, and editing: NH, MNH, JO, MA

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Appendix Table S1

Table S1: Worldwide dengue cases and deaths in 2023. Sources: ECDC, WHO Africa and WHO [2]

Country	WHO Region	Continents	Cases	Deaths	Cases/Million	Deaths/Million
Afghanistan	WHO Eastern Mediterranean Region	Asia	1700	1	40.25	0.02
Oman	WHO Eastern Mediterranean Region	Asia	2016	0	434.07	0.00
Pakistan	WHO Eastern Mediterranean Region	Asia	24352	0	101.26	0.00
Saudi Arabia	WHO Eastern Mediterranean Region	Asia	2259	0	61.14	0.00
Somalia	WHO Eastern Mediterranean Region	Africa	755	1	41.61	0.06
Sudan	WHO Eastern Mediterranean Region	Africa	10412	66	216.43	1.37
Yemen	WHO Eastern Mediterranean Region	Asia	951	1	27.61	0.03
France	WHO European Region	Europe	43	0	0.66	0.00
Italy	WHO European Region	Europe	82	0	1.39	0.00
Spain	WHO European Region	Europe	3	0	0.06	0.00
Benin	WHO Region of Africa	Africa	6	1	0.44	0.07
Burkina Faso	WHO Region of Africa	Africa	146878	688	6316.93	29.59
Cape Verde	WHO Region of Africa	Africa	410	0	684.84	0.00
Chad	WHO Region of Africa	Africa	1342	1	73.42	0.05
Ethiopia	WHO Region of Africa	Africa	21469	17	169.68	0.13
Ghana	WHO Region of Africa	Africa	18	0	0.53	0.00
Guinea	WHO Region of Africa	Africa	1	0	0.07	0.00
Ivory Coast	WHO Region of Africa	Africa	3922	27	135.84	0.94
Mali	WHO Region of Africa	Africa	4427	29	190.05	1.24
Mauritania	WHO Region of Africa	Africa	3582	0	736.58	0.00
Mauritius	WHO Region of Africa	Africa	265	0	203.76	0.00
Niger	WHO Region of Africa	Africa	148	0	5.44	0.00
Nigeria	WHO Region of Africa	Africa	72	0	0.32	0.00

Sao Tome and Principe	WHO Region of Africa	Africa	69	0	297.60	0.00
Senegal	WHO Region of Africa	Africa	248	1	13.96	0.06
Togo	WHO Region of Africa	Africa	8	1	0.88	0.11
Anguilla	WHO Region of the Americas	North America	1	0	62.90	0.00
Antigua	WHO Region of the Americas	North America	254	0	2693.59	0.00
Argentina	WHO Region of the Americas	South America	146876	75	3208.73	1.64
Aruba	WHO Region of the Americas	South America	22	0	207.01	0.00
Bahamas	WHO Region of the Americas	North America	243	1	588.92	2.42
Barbados	WHO Region of the Americas	North America	771	0	2734.09	0.00
Belize	WHO Region of the Americas	North America	1688	0	4108.81	0.00
Bermuda	WHO Region of the Americas	North America	1	0	15.61	0.00
Bolivia	WHO Region of the Americas	South America	156774	88	12654.73	7.10
Brazil	WHO Region of the Americas	South America	3088723	1184	14271.73	5.47
Cayman Islands	WHO Region of the Americas	North America	42	0	605.97	0.00
Colombia	WHO Region of the Americas	South America	131784	90	2530.16	1.73
Costa Rica	WHO Region of the Americas	North America	30649	0	5880.27	0.00
Dominica	WHO Region of the Americas	North America	419	0	5736.58	0.00
Dominican Republic	WHO Region of the Americas	North America	27972	62	2468.20	5.47
Ecuador	WHO Region of the Americas	South America	27838	33	1530.36	1.81
El Salvador	WHO Region of the Americas	North America	5788	0	909.36	0.00
French Guiana	WHO Region of the Americas	South America	2684	0	8598.29	0.00
Grenada	WHO Region of the Americas	North America	628	1	4976.90	7.92
Guadeloupe	WHO Region of the Americas	North America	11751	7	29686.31	17.68
Guatemala	WHO Region of the Americas	North America	72358	119	3999.44	6.58
Guyana	WHO Region of the Americas	South America	27709	0	34047.48	0.00
Honduras	WHO Region of the Americas	North America	34050	49	3214.14	4.63
Jamaica	WHO Region of the Americas	North America	8180	6	2895.02	2.12
Martinique	WHO Region of the Americas	North America	13239	6	36075.44	16.35
Mexico	WHO Region of the Americas	North America	277963	203	2163.88	1.58

Montserrat	WHO Region of the Americas	North America	6	0	1367.99	0.00
Nicaragua	WHO Region of the Americas	North America	181096	4	25700.83	0.57
Panama	WHO Region of the Americas	North America	20924	18	4682.99	4.03
Paraguay	WHO Region of the Americas	South America	63216	24	9213.11	3.50
Peru	WHO Region of the Americas	South America	274227	441	7982.69	12.84
Puerto Rico	WHO Region of the Americas	North America	1242	0	380.94	0.00
Saint Barthelemy	WHO Region of the Americas	North America	737	0	67036.57	0.00
Saint Kitts	WHO Region of the Americas	North America	286	1	5988.90	20.94
Saint Lucia	WHO Region of the Americas	North America	60	0	332.87	0.00
Saint Martin	WHO Region of the Americas	North America	1272	0	39654.58	0.00
Saint Vincent	WHO Region of the Americas	North America	17	0	163.94	0.00
Sint Maarten	WHO Region of the Americas	North America	1	0	22.61	0.00
Suriname	WHO Region of the Americas	South America	282	3	452.48	4.81
Trinidad	WHO Region of the Americas	North America	126	0	82.09	0.00
Turks and Caicos Islands	WHO Region of the Americas	North America	182	0	3951.20	0.00
Uruguay	WHO Region of the Americas	South America	48	0	14.02	0.00
USA	WHO Region of the Americas	North America	156	0	0.46	0.00
Venezuela	WHO Region of the Americas	South America	4809	8	166.76	0.28
Virgin Islands	WHO Region of the Americas	North America	7	0	70.89	0.00
Bangladesh	WHO South-East Asia Region	Asia	321179	1705	1857.02	9.86
India	WHO South-East Asia Region	Asia	94198	91	65.94	0.06
Maldives	WHO South-East Asia Region	Asia	3417	0	6558.28	0.00
Nepal	WHO South-East Asia Region	Asia	51243	20	1658.53	0.65
Sri Lanka	WHO South-East Asia Region	Asia	89799	61	4101.61	2.79
Thailand	WHO South-East Asia Region	Asia	159219	179	2217.50	2.49
Australia	WHO Western Pacific Region	Oceania	1023	0	38.69	0.00
Cambodia	WHO Western Pacific Region	Asia	35390	99	2088.54	5.84
China	WHO Western Pacific Region	Asia	19627	1	13.77	0.00
Indonesia	WHO Western Pacific Region	Asia	83302	633	300.15	2.28

Laos	WHO Western Pacific Region	Asia	32109	20	4206.17	2.62
Malaysia	WHO Western Pacific Region	Asia	120418	96	3509.86	2.80
Myanmar	WHO Western Pacific Region	Asia	6685	30	122.49	0.55
New Caledonia	WHO Western Pacific Region	Oceania	9	0	30.72	0.00
Philippines	WHO Western Pacific Region	Asia	195603	657	1667.01	5.60
Singapore	WHO Western Pacific Region	Asia	9938	0	1652.28	0.00
Vietnam	WHO Western Pacific Region	Asia	369000	43	3732.59	0.43