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Letter to the Editor

Mapping hotspots and cluster analysis of the current dengue outbreak in Bangladesh

Dear Editor,

Dengue, an arthropod-borne viral infection transmitted primarily by the *Aedes aegypti* mosquito, has emerged as a critical global health challenge, affecting millions of people around the world. While sporadic cases of the dengue virus have been observed in Bangladesh since 1964, the country entered a new phase with the emergence of endemicity after the pivotal outbreak in 2000 [1]. The year 2019 marked a significant milestone, recorded an alarming surge in dengue cases, reached a staggering count of 101,354. However, the subsequent enforcement of lockdown measures during the COVID-19 pandemic in 2020 and 2021 induced a remarkable reduction in cases, dwindling to 1405 and 28,429 cases, respectively [2]. The resurgence of dengue in 2022 manifested as another formidable outbreak, amassing 62,382 cases and resulting in 281 fatalities. Regrettably, the ongoing year, 2023, has shattered previous records, with 1187 reported deaths and an unprecedented escalation to 207964 cases by mid-October [3]. This distressing upsurge continues to underscore the significance of comprehending the complex dynamics of dengue transmission.

In recent decades, Geographic Information Systems (GIS) technology has played a key role in assessing the disease's outbreak, identifying the transmitted area, and visualizing the spatial and temporal analysis to support outbreak-control initiatives [4,5]. In line with this, the current study has been investigated the spatial distribution of dengue cases within Bangladesh. The application of hotspot and cluster analysis was employed to decipher the spatial distribution of the ongoing dengue outbreak in Bangladesh. By identifying high-risk zones, this research aims to offer valuable insights for tailored intervention strategies that can effectively curb dengue transmission. Notably, this endeavor represents a pioneering initiative in unraveling the complex spatial patterns underpinning the ongoing dengue outbreak in Bangladesh.

Fig. 1A presents the monthly distribution (January–October 2023) of confirmed dengue cases and associated fatalities in Bangladesh. The graph illustrates a relatively lower incidence of cases from January through May. However, there was a consistent upsurge from June to September and declined in October. This surge reached its peak in September and declined in October by following 79,598 and 5230 reported cases and 193 and 397 recorded deaths. Notably, the trend indicates fluctuation for both case and death numbers during this period.

The study used Getis-Ord GI* statistics to show dengue disease patterns, including areas of high prevalence (hot spots) and lower prevalence (cold spots) of positive dengue cases and associated deaths. This analysis suggests that the North-West and North-East part of Bangladesh had no hot and cold spot zones of dengue outbreak except during September and October months. However, the districts of Southwestern region including Bagerhat, Pirojpur, Jhalokati, Patuakhali, Barguna, the Eastern Hill regions including Cox's Bazar and Bandarban, and part of the Central region (Shariatpur) had hotspot of dengue cases within a 95%–99 % confidence interval. In May and June, hotspot locations shifted to the Central region, including Dhaka city and neighboring districts such as Gazipur, Narayanganj, Narsingdi, Manikganj, Faridpur, Shariatpur, Madaripur, indicating a change in the outbreak dynamics. From July to October, hotspot distribution changes again. Along with Dhaka district, some parts of the Southwestern region including Pirojpur, Jhalokati, Patuakhali, Barguna, and Lakshmipur showed intensified dengue transmission. This highlights the evolving outbreak nature, with different zones becoming active at different times of the year (Fig. 1B). Regarding death, the hotspot (at a confidence level of 95 %–99 %) has consistently manifested within the districts of the Eastern Hilly region, encompassing Chattogram and Rangamati, persisted until May. On the other hand, the central region, which encompasses the capital city, Dhaka, consistently exhibited hotspots (at a confidence level of 90 %–99 %) from May to October (Fig. 1B).

The Anselin local Moran's I analysis yielded vital insights on dengue transmission. Regarding cases, the North-East and North-West parts showed an L-L cluster, signifying low-value concentration. Conversely, the Chattogram district had an H-L outlier, denoting high value amid low values till January to April. The southern region showed an H–H cluster and L-H outlier except May–June; from May to October, the central part had an H–H cluster and L-H outlier. Shifting to mortality, the Eastern Hilly region consistently displayed a complex pattern with H-L, L-H, and L-L clusters, underscoring death dynamics. In contrast, the western part sporadically showed an H-L outlier in June–July; the central part has an H-L outlier till June and L-H outlier in July–August (Fig. 1C).

In conclusion, our study examined the dynamics of the dengue outbreak in Bangladesh, revealing a significant spread across distinct regions. The Central part, Southern areas, and Eastern Hilly regions emerged as focal points of concern. Particularly noteworthy is the heightened fatality rate observed in the Central part and the Eastern Hilly area throughout the study period. We believe the findings hold the potential to guide prioritization efforts, helping authorities target interventions where they are needed most. By pinpointing dengue hotspots, we inform resource allocation, planning, and policy implementation to curb transmission. Our study thus serves as a valuable tool in the fight against dengue in Bangladesh, contributing to a more informed and efficient approach to public health management.

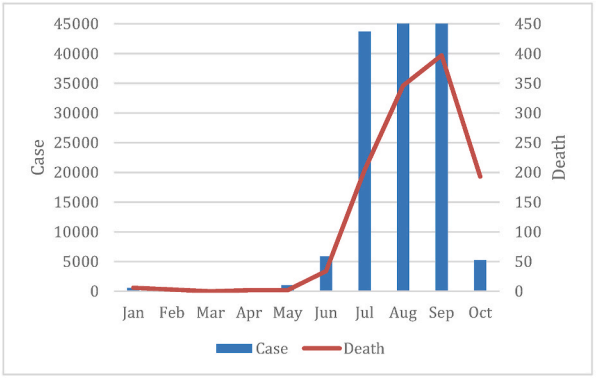
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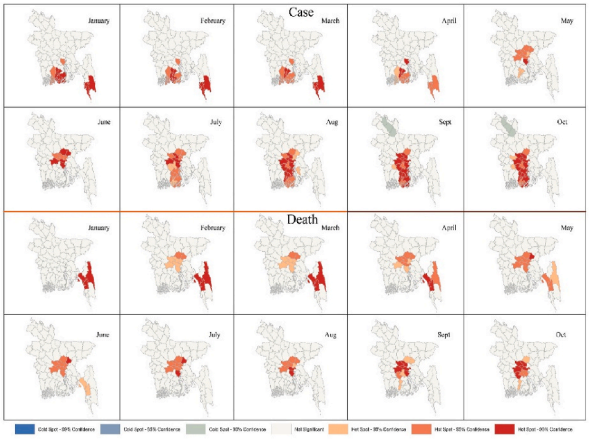
Declaration of competing interest

The authors declare no conflict of interest.

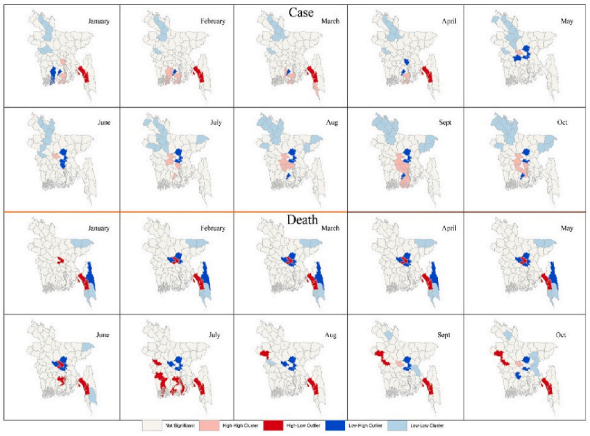
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A



B



C

Fig. 1. Spatial-temporal distribution of dengue distribution in Bangladesh during 2023. **A.** Monthly (January–October 2023) dengue cases and deaths distribution in Bangladesh, **B.** District-wise hotspot of cumulative monthly dengue cases and deaths per 10,000 populations, **C.** District-wise cluster analysis of cumulative monthly dengue cases and deaths per 10,000 populations.

References

[1] Sharmin S, Glass K, Viennet E, Harley D. Geostatistical mapping of the seasonal spread of under-reported dengue cases in Bangladesh. PLoS Neglected Trop Dis 2018;12. https://doi.org/10.1371/journal.pntd.0006947.

[2] Haider N, Hasan MN, Khalil I, Tonge D, Hegde S, Chowdhury MAB, et al. The 2022 dengue outbreak in Bangladesh: hypotheses for the late resurgence of cases and fatalities. J Med Entomol 2023. https://doi.org/10.1093/jme/tjad057.

[3] DGHS. Dengue Press Releases 2023. https://old.dghs.gov.bd/index.php/bd/home/5200-daily-dengue-status-report. [Accessed 18 August 2023].

[4] Faridah L, Mindra IGN, Putra RE, Fauziah N, Agustian D, Natalia YA, et al. Spatial and temporal analysis of hospitalized dengue patients in Bandung: demographics and risk. Trop Med Health 2021;49. https://doi.org/10.1186/s41182-021-00329-9.

[5] Patwary MM, Hossan J, Billah SM, Kabir MP, Rodriguez-Morales AJ. Mapping spatio-temporal distribution of monkeypox disease incidence: a global hotspot analysis. New Microbes New Infect 2023;53. https://doi.org/10.1016/j.nmni.2023.101150.

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