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Research Article

Epidemiological Trends of Dengue in Nainital District: Effect of Source Reduction Interventions (2023–2024)

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I N F O

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A B S T R A C T

The present study deals with comparative epidemiological and entomological trends over the past two years (2023&2024) in Nainital district of Uttarakhand. In 2023, a total of 830 dengue cases were recorded, whereas in 2024 a of total 60 cases were recorded. In terms of the monthly variation in 2023, the dengue cases were started from the month of June (1), and the highest number of cases were recorded in the month of September (320), and the last case was recorded in the month of December (1), whereas in 2024 the dengue cases started in the month of September (10), followed by October (31) and November (19). The comparison reveals that the number of dengue cases was highly significant change ($P > 0.05$) over two years (2023 & 2024). In terms of age-and gender-specific distribution of dengue cases, the incidence rate in males was higher and the predominant age group was 21-30 years. The entomological survey was conducted from May to December in each year. The monthly variation of all the entomological indices, i.e. House Index (HI), Container Index (CI) and Breteau Index (BI), was higher in 2023 as compared to 2024 due to enhanced source reduction efforts and increased community participation.

Keywords: Dengue, Aedes, Entomological Indices, Source Reduction, Community Participation

Introduction

A mosquito-borne viral infection, 'Dengue' poses a significant public health challenge globally, particularly in tropical and subtropical regions (WHO, 2012).[1] The global incidence of dengue has risen substantially in recent decades, increasing eightfold over the last two decades alone. From 505430 cases in 2000, it rose to over 2.4 million cases in 2010 and shot up to 5.2 million in 2019. Reported deaths between the years 2000–2015 rose over four times from 960 to 4032. Dengue is predominantly transmitted by Aedes aegypti and Aedes albopictus mosquitoes.[2,3] These mosquitoes are day biters and well adapted to human habitats, having a preference for human blood.[4] A crowded urban environment, where adequate water supply is mostly compromised, offers innumerable breeding sites to the vectors. Rapid urbanisation in the last forty years has thus provided the ideal ecological conditions for large populations of Aedes aegypti to thrive. The vector lives in intimate association with large and crowded human populations in tropical urban areas, conditions ideal for dengue epidemic transmission.[5] Dengue transmission is perennial in endemic tropical areas. However, in most countries there is a distinct seasonal pattern. The environment and climate variables such as temperature, humidity and, rainfallsignificantly influence the transmission of dengue infection.[6] Rainfall increases the number of breeding sources, thus increasing the density of Aedes mosquitoes. Further, the lifespan of mosquitoes and their biting activity increases at optimal temperatures, thereby increasing the number of infected mosquitoes and the risk of dengue transmission.[7,8] The climatic conditions and geographic characteristics of Nainital, including its moderate to high rainfall and dense vegetation, create a conducive environment for the proliferation of Aedes mosquitoes, the primary vectors of the dengue virus. The interplay of these ecological factors with socio-economic elements, such as population density and public health infrastructure, influences the epidemiological dynamics of dengue in the region. This study presented the epidemiological trend of dengue in the Nainital district over the past two years and demonstrated a decline in the number of cases after the involvement of manpower in source reduction.

Material and methods

Study Area

In Uttarakhand, the district of Nainital lies in the Kumaun division, located approximately in between 80º14' and 78º80' east longitude and 29º00' and 29º05' north latitude. On the northern side lie the Himalayan ranges, while on the southern side lie the plains, making the resultant climate of the district an enjoyable one. The total geographical area is 3422 Km. Geographically the district is divided into 2 zones, viz. Hilly and Bhabar. The foothill area of the district is known as Bhabhar. The present study was conducted in the Bhabar area of Nainital district because most of the dengue cases are recorded from these areas every year. There are 3 blocks that fall in the Bhabar area of Nainital district (Haldwani, Ramnagar and Kotabagh) and some areas of the Bhimtal block, which is prone to dengue cases.

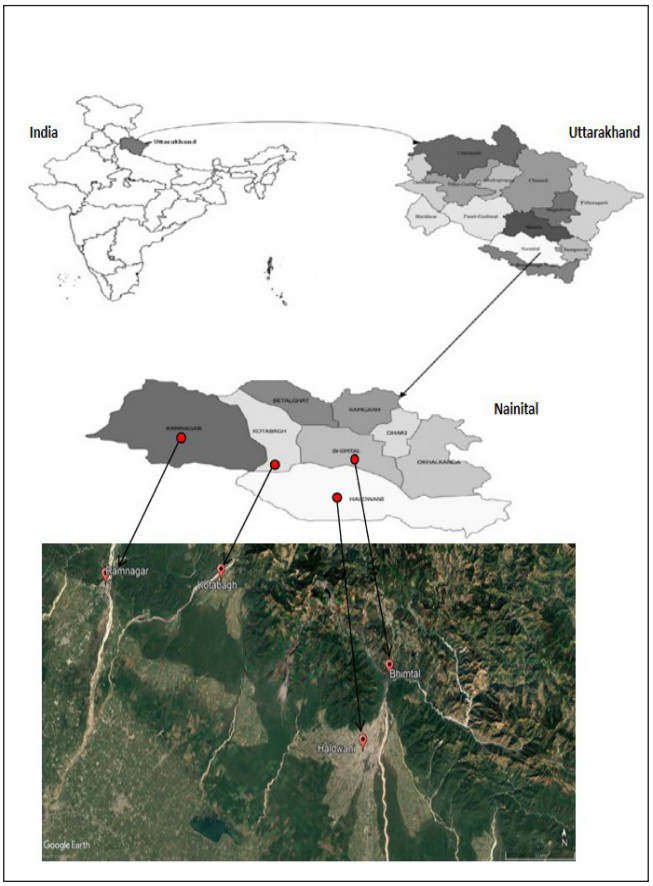

Figure 1.Presents a pictorial representation of the study area with hot spots of Nainital district

Epidemiological data collection

The epidemiological data for the present study was collected from all health facilities and the Government Medical College of Nainital district. Only the serologically confirmed dengue cases, diagnosed using enzyme-linked immunosorbent assay in 2023 & 2024 by different sentinel laboratories of all health facilities and the Government Medical College of Nainital district, were included. In the analysis, all the duplicate entries and patients with a travel history of travel within 10 preceding days of the onset of illness from other districts or states where dengue also occurred were classified as imported and were not included in the analysis.

Entomological Surveillance

The rainy season begins each year in late May, and most rainfall occurs in July, moderate in August to September and gradually decreases in October. November to December

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was dry or with very low rain in Nainital district. A door-to-door entomological survey was conducted from May to December in 2023 & 2024 by the DMO Team (VBD Consultant, Malaria Inspector, Health workers) and ASHA's in addition, a new component, i.e., Volunteer, was added in 2024. In the Bhabar area of Nainital (Haldwani, Ramnagar, Kotabagh and some areas of Bhimtal), due to the lack of water facilities in every house, water is stored in containers, and coolers are used during the summer days. All these sources are considered potential breeding sites for Aedes mosquitoes. All water-holding containers were examined, viz., discarded tyre, cooler, fridge, junk materials, cement tank, clay pots and plastic container, etc. following the standard procedure outlined by the World Health Organisation (WHO) for entomological techniques.[9] In these areas, a survey was conducted for all potential breeding sites in pre-monsoon (May-June), monsoon (July-September) and post-monsoon months (October-December) in 2023 & 2024.

Statistical Analysis

Analysis of data was done by using Microsoft Excel, where descriptive statistics, correlation matrices and regression models were applied using built-in formulas and the Data Analysis Toolpak add-in. The entomological data was analysed with the help of different entomological indices, viz. House Index (HI), Container Index (CI), and Breteau Index (BI).

Container Index (CI)- i.e., the percentage of water-holding containers infested with larvae or pupae.

(CI = Number of Aedes larvae positive containers x 100 / Number of containers with water inspected)

House Index (HI)- i.e., the percentage of houses infested with larvae and/or pupae.

(HI = Number of houses positive for Aedes larvae x 100 / Number of houses inspected)

Breteau Index (BI)- i.e., the number of positive containers per 100 houses inspected.

(BI = Number of positive containers x 100 / Number of houses inspected)

Results

The present study showed the comparison of the number of dengue cases over the last two years (2023 and 2024) in Nainital district. In 2023, a total of 830 dengue cases were recorded, whereas in 2024 a total 60 cases were recorded. In terms of the monthly variation in 2023, the first case of dengue was recorded in the month of June (1) followed by July (10), August (95), September (320), October (336), November (67) and December (1), whereas in 2024 the dengue cases started in the month of September (10), October (31) and November (19) (Fig. 2). The comparison of the number of dengue cases in 2023 and 2024 with the Chi-square test reveals that there was a highly significant change (P>0.05).

In terms of age and gender-specific distribution of dengue cases, the incidence rate in males higher than in the females (Fig.3). Dengue cases were predominant in the age group of 21-30 years (fig.4).

The entomological survey was conducted from May to December in each year. To determine the availability or presence of Aedes larvae, we used different entomological indices, i.e., House Index (HI), Container Index (CI) and Breteau Index (BI). In 2023, the monthly variation of all entomological indices is higher than the monthly variation of entomological indices in 2024 (Fig. 5). The trend analysis of the house positivity rate was also higher in 2023; in terms of monthly variation of the house positivity rate, it was nil in the month of May and June, 1.04% in July, 1.79% in August, 0.51% in September, 0.45% in October, 0.35% in November and 0.11% in December. In 2024 the monthly variation of the house positivity rate was nil in the month of May and June, 0.14% in July, 0.34% in August, 0.52% in September, 0.44% in October, 0.14% in November and 0.06% in December (Fig. 6). All entomological indices and house positivity rates clearly showed the low availability or presence of Aedes larvae in 2024 from the month of May to December as compared to 2023.

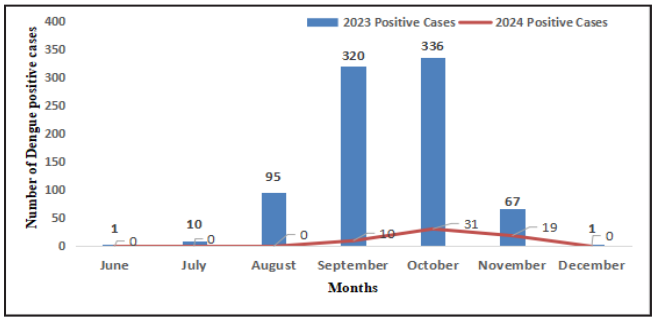

Figure 2.Monthly variation of dengue cases in Nainital District (2023 & 2024)

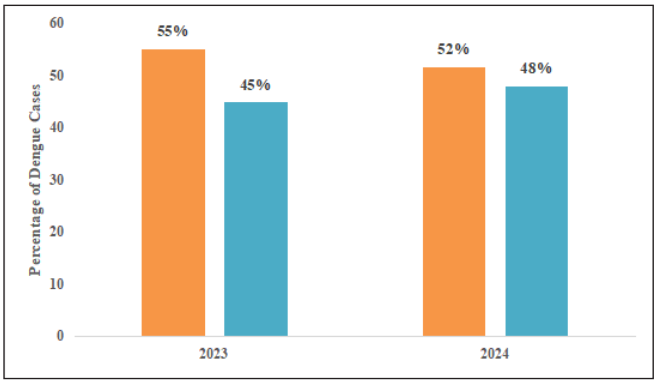

Figure 3.Gender-specific distribution of dengue cases in Nainital district (2023 & 2024)

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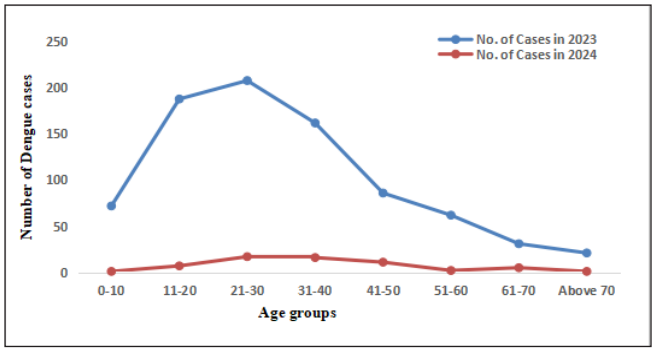

Figure 4.Distribution of dengue cases according to age groups in Nainital district (2023 & 2024)

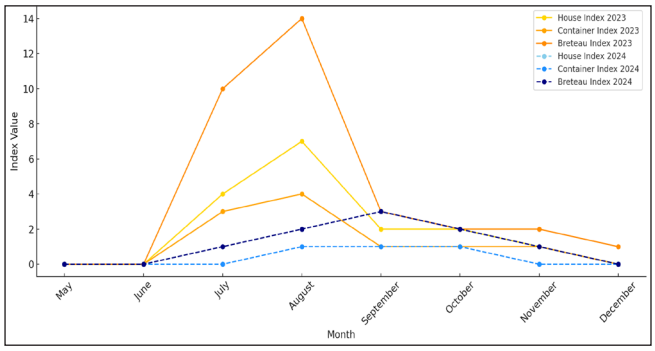

Figure 5.Comparison of entomological indices in 2023 & 2024

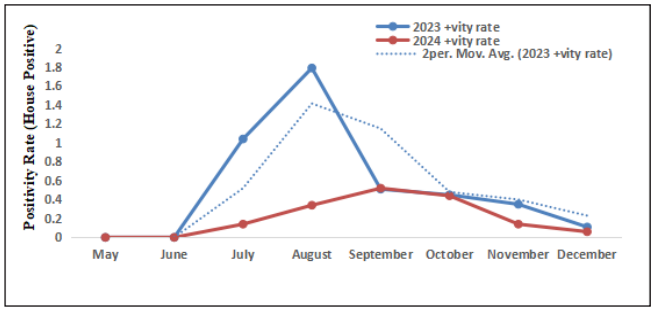

Figure 6.Trend Analysis for Positivity Rate (House Positives) in Nainital District (2023 & 2024)

Discussion

The present study showed the epidemiological pattern of dengue cases over a two year-period in Nainital district. This study highlights the significant difference in entomological indices with dengue cases between the years 2023 and 2024. The pattern of rainfall and its influence on dengue transmission have been widely documented. During monsoon season the peak rainfall in July and August creates optimal breeding conditions for Aedes mosquitoes. In this study dengue cases in 2023 followed this pattern closely, with the highest number of cases recorded during and post-monsoon months. However, in 2024, the late emergence of dengue cases during post-monsoon period, suggests the effective early intervention, which controlled the large mosquito population.

A key component of this study is the entomological surveillance conducted from May to December in both years. The entomological indices, i.e., House Index (HI), Container Index (CI), and Breteau Index (BI), are accepted widely for the prediction of dengue outbreaks.[10] A study done by Arunachalam et al. (2010) indicated that HI greater than 1% and BI over 5% are considered thresholds for rising epidemic risk.[11] The House Index (HI) in 2023 crossed these thresholds during the peak of dengue-arising months, whereas in 2024 all indices remained below danger level at all. Hence, the hypothesis that vector control measures in 2024 were more effective in limiting mosquito proliferation is verified by this study as well. Aedes mosquito is the primary vector of dengue, needs clean stagnant water to breed and thrives in domestic environments, and source reduction is a major component to break the life cycle of mosquitos in the larval stage. This is corroborated by research from Brazil, where consistent entomological monitoring was linked to timely responses and decreased dengue transmission.[12] Similarly, research from Thailand demonstrated that school-and community-based interventions could lead to measurable reductions in larval indices and disease incidence.[13] In India a study conducted in Tamil Nadu showed that community participation significantly improved the outcomes of dengue vector control measures.[14]

In terms of age and gender-wise distribution of dengue cases, the highest incidences are among males, with predominance in the 21-30 years age group. It was found that the trend is not unique to Nainital and has been reported across multiple studies. For instance, a study in Delhi found that young adults in the 21-30 age group, particularly males, are more frequently affected because of their outdoor activity and occupational exposures.[15] An observation supported by similar studies from Malaysia and Sri Lanka.[16,17] These gender disparities in dengue cases might also be attributed to behavioural and occupational differences and hence emphasises the need for targeted awareness campaigns.

Conclusion

The findings of this study support the critical role of integrated vector management in dengue control. The drastic reduction in dengue cases and entomological indices in 2024 as compared to 2023 can be largely due to enhanced source reduction efforts and increased community participation through the inclusion of volunteers by the state government of Uttarakhand, working with Accredited Social Health Activists (ASHA) and the District Malaria Officer team. These results fit well with global evidence and demonstrate that sustainable dengue control is achievable through proactive community engagement timely.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: None

References

1. Arunachalam N, Tana S, Espino FE, Kittayapong P, Abeyewickrem W, Wai KT, Tyagi BK, Kroeger A, Sommerfeld J, Petzold M. Eco-bio-social determinants of dengue vector breeding: a multicountry study in urban and periurban Asia. Bulletin of the world Health Organization. 2010 Mar;88(3):173-84. [Google Scholar] [Pubmed]
2. Anker M, Arima Y. Male–female differences in the number of reported incident dengue fever cases in six Asian countries. Western Pacific surveillance and response journal: WPSAR. 2011 Jun 30;2(2):17.[Google Scholar] [Pubmed]
3. Arunachalam N, Tyagi BK, Samuel M, Krishnamoorthi R, Manavalan R, Tewari SC, Ashokkumar V, Kroeger A, Sommerfeld J, Petzold M. Community-based control of Aedes aegypti by adoption of eco-health methods in Chennai City, India. Pathogens and global health. 2012 Dec 1;106(8):488-96. [Google Scholar] [Pubmed]
4. Das B, Ghosal S, Mohanty S. Aedes: What Do We Know about Them and What Can They Transmit?. InVectors and vector-borne zoonotic diseases 2018 Nov 5. IntechOpen. [Google Scholar]
5. Gupta E, Dar L, Kapoor G, Broor S. The changing epidemiology of dengue in Delhi, India. Virology journal. 2006 Dec;3:1-5. [Google Scholar] [Pubmed]
6. Gubler DJ. Dengue, urbanization and globalization: the unholy trinity of the 21st century. Tropical medicine and health. 2011;39(4SUPPLEMENT):S3-11. [Google Scholar] [Pubmed]
7. Medeiros LC, Castilho CA, Braga C, de Souza WV, Regis L, Monteiro AM. Modeling the dynamic transmission of dengue fever: investigating disease persistence. PLOS neglected tropical diseases. 2011 Jan 11;5(1):e942. [Google Scholar] [Pubmed]
8. World Health Organization. Newsroom Factsheet. Geneva: WHO; 2021 May 19.https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue.
9. Ponlawat A, Harrington LC. Blood feeding patterns of Aedes aegypti and Aedes albopictus in Thailand. Journal of medical entomology. 2005 Sep 1;42(5):844-9. [Google Scholar] [Pubmed]
10. Polwiang S. The seasonal reproduction number of dengue fever: impacts of climate on transmission. PeerJ. 2015 Jul 9;3:e1069. [Google Scholar] [Pubmed]
11. Ratanawong P, Kittayapong P, Olanratmanee P, Wilder-Smith A, Byass P, Tozan Y, Dambach P, Quiñonez CA, Louis VR. Spatial variations in dengue transmission in schools in Thailand. PLoS One. 2016 Sep 26;11(9):e0161895. [Google Scholar] [Pubmed]
12. Tissera HA, Jayamanne BD, Raut R, Janaki SM, Tozan Y, Samaraweera PC, Liyanage P, Ghouse A, Rodrigo C, de Silva AM, Fernando SD. Severe dengue epidemic, Sri Lanka, 2017. Emerging infectious diseases. 2020 Apr;26(4):682. [Google Scholar] [Pubmed]
13. World Health Organization. Manual on practical entomology in malaria. (No Title). 1975. [Google Scholar]
14. Wu PC, Lay JG, Guo HR, Lin CY, Lung SC, Su HJ. Higher temperature and urbanization affect the spatial patterns of dengue fever transmission in subtropical Taiwan. Science of the total Environment. 2009 Mar 15;407(7):2224-33. [Google Scholar] [Pubmed]
15. World Health Organization, Special Programme for Research, Training in Tropical Diseases, World Health Organization. Department of Control of Neglected Tropical Diseases, World Health Organization. Epidemic, Pandemic Alert. Dengue: guidelines for diagnosis, treatment, prevention and control. World Health Organization; 2009. [Google Scholar] [Pubmed]
16. World Health Organization. Global strategy for dengue prevention and control 2012-2020. InGlobal strategy for dengue prevention and control 2012-2020 2012. [Google Scholar]
17. Yang HM, Macoris ML, Galvani KC, Andrighetti MT, Wanderley DM. Assessing the effects of temperature on dengue transmission. Epidemiology & Infection. 2009 Aug;137(8):1179-87. [Google Scholar] [Pubmed]

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