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Exploring Dengue Transmission Trends, Public Health Challenges, and Intervention Efficacy Among Adolescents in Dhaka City: An Observational Study

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Abstract

Background: Dengue fever remains a major public health threat in Dhaka City, Bangladesh, with adolescents (15–22 years) particularly vulnerable due to high mobility and environmental exposure. This observational retrospective study analyzes fourteen years of dengue trends (2010–2023), comparing them with the August–October 2023 outbreak, which recorded the highest dengue burden in over a decade. The study evaluates disease severity, hospitalization rates, and the effectiveness of targeted public health interventions. **Methods:** A retrospective hospital-based study was conducted using laboratory-confirmed dengue cases from eight major hospitals in Dhaka City, ensuring adherence to ethical research standards. Comparative analysis between intervention and control regions assessed the impact of vector control programs, awareness campaigns, and healthcare accessibility. Cohen's d was used to quantify effect sizes, and statistical analyses were performed using SPSS and R software. **Results:** Dengue cases peaked in September 2023, with a monthly average of 1,250 cases (SD = 300). The overall adolescent prevalence was 15%, with hospitalization rates 15% higher in females than males. Intervention areas showed a 20% reduction in hospital admissions, with a Cohen's d effect size of 0.6, indicating a moderate impact of public health measures. Lower-income communities faced a 30% higher infection rate, emphasizing disparities in healthcare access and preventive resources. **Discussion**: Findings reveal that adolescents remain a high-risk group due to urban exposure, limited preventive behaviors, and delayed healthcare access. Comparisons between 2010–2023 and August–October 2023 highlight worsening disease severity, driven by urbanization, climate factors, and inadequate mosquito control. Strengthening real-time surveillance, improving drainage infrastructure, and expanding school-based awareness campaigns is crucial for sustainable dengue control. **Conclusion:** Targeted public health interventions significantly reduce dengue transmission, but socioeconomic inequalities and urban environmental factors remain major challenges. Sustained vector control, improved urban planning, and enhanced healthcare accessibility are essential for long-term dengue prevention and outbreak preparedness in Dhaka City.

Keywords: Dengue, Transmission, Adolescents, Vector Control, Disease Surveillance, Bangladesh

Introduction

Dengue fever is a mosquito-borne viral disease that has become a major public health challenge in Dhaka City, Bangladesh, particularly affecting adolescents aged 15-22 years (Bonna et al., 2023a). The disease is caused by the Dengue virus (DENV), a member of the Flavivirus genus, and is transmitted primarily by Aedes aegypti and Aedes albopictus mosquitoes (Zende et al., 2024). Over the past decade, dengue outbreaks in Bangladesh have become more frequent and severe, with Dhaka consistently experiencing the highest number of cases nationwide (Sharif et al., 2024). The city's rapid urbanization, high population density, poor drainage infrastructure, and

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inconsistent mosquito control measures have contributed to the rising burden of dengue, particularly during the monsoon season from August to October, when heavy rainfall and high humidity create ideal breeding conditions for mosquitoes (Hossain, Sorif et al., 2023). Despite various government-led and community-based interventions, dengue cases in Dhaka have continued to rise, with 2023 marking the highest recorded outbreak in the past decade, leading to an unprecedented strain on the healthcare system (Kayesh et al., 2023a).

Dengue virus transmission occurs when a female Aedes mosquito bites an infected individual, acquires the virus, and later transmits it to a new host through subsequent bites. After entering the mosquito's midgut, the virus undergoes replication and spreads to the salivary glands, making the mosquito infectious after an extrinsic incubation period of 8-12 days (Rahim et al., 2023). Once infected, the mosquito remains a lifelong carrier, transmitting the virus each time it bites a susceptible person. The Aedes mosquitoes thrive in urban environments, breeding in stagnant water collected in discarded tires, clogged drains, poorly maintained water storage containers, and other artificial water sources. In humans, the virus has an intrinsic incubation period of 3 to 14 days, after which symptoms appear, ranging from mild fever and headaches to severe complications such as internal bleeding, plasma leakage, and multi-organ failure (Habiba, 2023). Dengue progresses through three phases: the febrile phase, characterized by high fever, muscle pain, and skin rash; the critical phase, where vascular leakage and hemorrhagic symptoms may develop; and the recovery phase, during which fatigue and weakness may persist. In some cases, dengue escalates to Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS), leading to severe complications and fatalities, particularly among individuals previously exposed to a different Dengue virus serotype due to antibody-dependent enhancement (ADE) (Zende et al., 2024). Dhaka's rapid urbanization, high population density, and insufficient vector control measures have contributed to the persistence of dengue outbreaks, making disease containment increasingly challenging. During the monsoon season, waterlogging and inadequate waste management further exacerbate mosquito proliferation, making vector control efforts increasingly challenging. The high adaptability of Aedes mosquitoes to urban environments, combined with climate variability and poor infrastructure, has allowed dengue to establish itself as a year-round public health threat in Dhaka, with peaks occurring during the monsoon months (Reza et al., 2024). This study explores how transmission patterns have evolved over time and assesses whether current public health interventions have effectively reduced dengue incidence and severity among adolescents.

While numerous studies have examined dengue epidemiology and climate influences on outbreaks, there has been limited research on how dengue disproportionately affects adolescents in highly urbanized settings like Dhaka City. Adolescents are among the most vulnerable groups due to frequent outdoor exposure, high mobility, and lower adherence to personal protective measures such as using mosquito repellents or wearing protective clothing. Additionally, educational institutions, dormitories, and informal settlements serve as high-risk environments for disease transmission, with poor sanitation and water storage practices contributing to increased exposure (Shafique et al., 2024). Despite public health efforts to control dengue through mosquito control programs and awareness campaigns, the disease continues to cause significant morbidity and hospitalization rates among adolescents, highlighting the need for more targeted intervention strategies (Kayesh et al., 2023b).

The rapid expansion of Dhaka City has further intensified the spread of dengue, as unregulated urbanization has led to inadequate drainage, improper waste disposal, and an increase in artificial water-holding containers that serve as mosquito breeding sites (Rahaman et al., 2023). Lower-income areas, where mosquito control efforts are often inconsistent, continue to experience higher infection rates and more severe cases, largely due to delayed access to healthcare and lack of preventive measures. In contrast, regions with structured mosquito control interventions, such as fogging, larvicidal treatments, and organized awareness campaigns, have reported a decline in hospital admissions(Samsudin et al., 2024). This study examines these differences by comparing dengue prevalence and hospitalization rates in districts with active dengue prevention programs versus those with limited or ineffective control measures, helping to determine which public health efforts have been most impactful in reducing the burden of dengue among adolescents.

Understanding the factors influencing dengue severity, the role of urbanization in disease spread, and the effectiveness of public health interventions is essential for developing more targeted and sustainable prevention strategies. This research will help inform future dengue control policies, resource allocation, and healthcare preparedness efforts, particularly in high-risk urban populations like Dhaka City. Given the rising number of dengue cases and the increasing severity of outbreaks, there is an urgent need for integrated vector management strategies, improved urban planning, and strengthened healthcare infrastructure to curb dengue transmission and reduce the disease burden among vulnerable adolescent populations(Oduoye et al., 2023a). This study provides evidence-based recommendations that can contribute to more effective dengue prevention and control strategies, not only in Dhaka but in other urban centers facing similar public health challenges.

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Despite extensive research on dengue transmission and public health interventions, there remains a significant gap in understanding the specific impact of dengue on adolescents in urban settings like Dhaka City. This demographic is particularly vulnerable due to frequent outdoor exposure, high mobility, and residence in densely populated areas, factors that increase their risk of mosquito bites and subsequent infection. While previous studies have extensively examined the role of Aedes aegypti mosquitoes in dengue transmission, the effects of urbanization, and the challenges posed by socio-economic disparities and inadequate waste management (Malavige et al., 2023) (Viennet et al., 2016), they have not sufficiently addressed how these factors specifically influence dengue severity and hospitalization trends among adolescents. Additionally, much of the existing research in Dhaka has focused on overall dengue incidence and broad-scale epidemiological patterns but has not provided a detailed analysis of disease severity within different demographic groups, particularly adolescents who are disproportionately affected due to their behavioral and environmental exposure.

Furthermore, while public health interventions such as vector control programs, awareness campaigns, and healthcare accessibility initiatives have been implemented in Dhaka, their effectiveness in reducing dengue burden specifically among adolescents remains underexplored (Hossain, Md Jubayer et al., 2024). Existing studies often assess these interventions at a population-wide level, without considering how adolescent-targeted strategies—such as school-based awareness programs or community engagement initiatives—impact dengue transmission rates, hospitalization, and recovery outcomes. Moreover, few studies have conducted hospital-based analyses focusing on adolescent patients, making it difficult to determine how age-related physiological and behavioral factors influence disease severity and treatment outcomes (Lachyan et al., 2023).

In addition to gaps in intervention research, prior studies in Dhaka have not comprehensively explored how secondary infections, immunity variations, and coexisting health conditions affect dengue severity among adolescents. The relationship between nutritional status, immune response, and recovery duration in young patients remains inadequately studied, limiting the ability to develop targeted prevention and treatment approaches (Tejo et al., 2024). Some global studies have suggested that gut microbial dysbiosis—an imbalance in the gut microbiota—may influence immune responses (Hasan, Md Rakibul and Yusuf, 2023) and disease severity in dengue infections, potentially affecting viral replication, inflammatory responses, and recovery time(Shi et al., 2023). However, despite its possible implications for disease progression, this area remains largely unexplored in Dhaka-specific research, with limited studies investigating how variations in gut microbiota among dengue patients might contribute to differences in symptom severity, hospitalization rates, and overall recovery outcomes. Furthermore, while dengue infection is associated with high morbidity and extended recovery periods, its effects extend beyond physical symptoms, often leading to mental health challenges such as stress, anxiety, and emotional distress, particularly among adolescents (Shih et al., 2024) (Hasan, Md Rakibul, 2024). Despite the potential psychological burden caused by prolonged illness, missed academic activities, and hospitalization-related trauma, local research has not adequately explored how dengue affects the mental well-being of young patients or the need for psychological support during and after recovery (Islam, 2024a).

This study seeks to address critical gaps in dengue research by analyzing the severity of dengue cases among adolescents during the peak monsoon season of 2023 and comparing these findings with long-term dengue transmission trends from 2010 to 2023. By utilizing hospital admission records from eight major healthcare institutions in Dhaka, this research provides a clinically validated assessment of disease burden, demographic risk factors, and intervention effectiveness. Unlike survey-based studies that may introduce self-reporting biases, this approach ensures accurate documentation of laboratory-confirmed dengue cases and hospitalization trends, allowing for a data-driven analysis of dengue's impact on adolescents. Additionally, this study evaluates the effectiveness of vector control programs, public awareness campaigns, and healthcare accessibility in mitigating dengue transmission and severity, offering valuable insights into which strategies have been most successful and where improvements are needed. Our study seeks to bridge these critical gaps by focusing specifically on the incidence, severity, and hospitalization trends of dengue among adolescents aged 15-22 in Dhaka City. By utilizing hospital-based data from eight major healthcare institutions, we provide a clinically validated assessment of disease burden rather than relying on self-reported surveys, which are prone to inaccuracies. Additionally, this study evaluates the effectiveness of adolescent-specific public health interventions, determining whether existing mosquito control strategies, educational programs, and healthcare access improvements have successfully reduced dengue incidence and severity among young populations. Unlike previous research that focuses primarily on epidemiological trends, this study takes a multidimensional approach by incorporating disease severity assessments, intervention evaluations, and an analysis of risk factors specific to adolescents. By doing so, it provides evidence-based recommendations for developing targeted, more effective public health policies to mitigate the impact of dengue in urban environments like Dhaka City (Assis et al., 2024).

This study aims to evaluate the prevalence, severity, and hospitalization patterns of dengue among adolescents (15-22 years) in Dhaka City during the monsoon season from August to October 2023, while also analyzing long-

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term dengue trends from 2010 to 2023. The objectives include assessing the effectiveness of targeted public health interventions, identifying key factors influencing disease severity and hospitalization rates, and examining the impact of urbanization and socio-economic disparities on dengue transmission. By utilizing hospital records from eight major healthcare institutions, this study aims to provide evidence-based insights to strengthen dengue prevention and control strategies for high-risk urban populations.

Methods

This study employed a retrospective hospital-based observational design to analyze the prevalence, demographic characteristics, and public health intervention impacts on dengue cases among adolescents in Dhaka City, Bangladesh. The study focused on hospital records from August to October 2023, the peak dengue transmission period, as these months experience heavy rainfall, water stagnation, and increased mosquito breeding, significantly contributing to the spread of the disease. The retrospective nature of the study ensured an accurate, data-driven approach by utilizing documented medical records rather than relying on self-reported cases.

Study Setting and Population

The study was conducted in Dhaka City, the capital of Bangladesh, which has experienced a significant rise in dengue cases in recent years due to its dense urban population, inadequate drainage systems, and high mosquito breeding activity. Dhaka is particularly vulnerable to dengue outbreaks, making it a critical location for epidemiological research to understand disease burden and intervention effectiveness. The study focused on adolescents aged 15 to 22 years, a demographic that is highly susceptible to dengue infection due to frequent outdoor activities, limited use of personal protective measures, and higher exposure to mosquito-infested environments. This age group is also important from a public health perspective because illness-related disruptions can significantly impact education, productivity, and mental well-being (Wahiduzzaman et al., 2024).

Data were collected from hospital records of eight major healthcare institutions in Dhaka that serve as key treatment centers for dengue patients. These hospitals were selected based on their high patient load, geographical distribution, and accessibility to diverse socio-economic groups across the city. The hospitals included: National Institute of Neurosciences & Hospital (NINS), Dhaka Medical College Hospital (DMCH), Mitford Hospital (Sir Salimullah Medical College), Shaheed Suhrawardy Medical College Hospital, Mirpur Islami Bank Hospital, Mirpur General Hospital, Anwar Khan Modern Medical College Hospital, and Ibn-Sina Medical College Hospital, Dhaka, Bangladesh. Both indoor (admitted patients) and outdoor (outpatient department) cases were included in the dataset to provide a comprehensive representation of dengue burden. This approach captured not only severe cases requiring hospitalization but also milder cases that received outpatient care, offering a more accurate assessment of disease prevalence within the adolescent population.

Sampling Frame and Sampling Strategy

The sampling frame comprised all laboratory-confirmed dengue cases among adolescents (15-22 years old) who sought treatment in the eight selected hospitals from August to October 2023. Only cases with definitive laboratory confirmation (NS1 antigen test, IgM/IgG ELISA, or RT-PCR) were included, ensuring that all data were clinically validated. Cases with uncertain diagnoses, incomplete records, or missing demographic information were excluded to maintain data accuracy.

A purposive sampling strategy was used, as the study aimed to analyze all confirmed cases recorded in hospital databases during the study period. Unlike population-based studies that use randomized sampling, this approach ensured comprehensive inclusion of dengue-affected adolescents seeking hospital care, reflecting real-world disease burden and healthcare utilization trends.

Data Collection Method

Data were extracted from electronic and paper-based hospital records available in the selected institutions. The dataset included patient demographics (age, gender, and residential area), date of admission and discharge, diagnostic confirmation of dengue, hospitalization details, disease severity classification (mild, moderate, or severe), and treatment outcomes. Additionally, hospital records provided geographical distribution insights, allowing the study to assess dengue incidence across different hospital catchment areas in Dhaka.

To evaluate the impact of public health interventions, hospital admission trends were analyzed in regions with structured dengue prevention measures, such as mosquito control programs and community awareness campaigns,

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compared to regions with minimal interventions. This comparative assessment allowed for a data-driven evaluation of public health response effectiveness.

Data Analysis

The extracted hospital data were analyzed using SPSS and R statistical software to identify dengue prevalence trends, demographic risk factors, and intervention outcomes. Descriptive statistical measures, including mean, median, standard deviation, and frequency distributions, were used to summarize the data.

Analysis of hospital admissions revealed an average of 1,250 dengue cases per month, with the highest peak in September (1,800 cases). Gender-specific analysis showed that 16% of cases were male and 14% were female, suggesting a slightly higher risk of infection among males. Comparative analysis was conducted to assess the effectiveness of public health interventions. Findings indicated that regions with structured mosquito control and awareness campaigns experienced a 20% reduction in hospital admissions compared to areas with limited intervention. Furthermore, community-based educational programs led to a 25% improvement in knowledge, attitude, and practice (KAP) scores related to dengue prevention.

Results

This study aimed to assess the severity of dengue cases among adolescents aged 15-22 years during the peak monsoon season (August to October 2023) and compare these findings with dengue trends observed from 2010 to 2023. By analyzing hospital records from eight major hospitals in Dhaka City, this study provides a comprehensive understanding of how dengue burden has evolved over time, focusing on prevalence, hospitalization rates, demographic variations, and the impact of public health interventions.

The analysis of the dengue epidemic's impact on Dhaka City's young population, particularly those aged 15-22 years, spanning from 2010 to November 2023, reveals critical insights into the dynamics of this public health challenge (Oduoye et al., 2023b). Through an in-depth examination of various factors, including socioeconomic conditions, demographic variations, and climatic influences, the study offers a comprehensive understanding of the Knowledge, Attitude, and Practices (KAP) related to Dengue Fever (DF) among this demographic.

Dengue Prevalence and Demographic Trends (2010-2023)

Analysis of hospital admission records revealed that dengue cases have consistently surged during the monsoon months over the last 14 years, with a significant spike in 2023, recording the highest number of confirmed cases and fatalities. The data showed that male adolescents had a slightly higher prevalence of dengue than females, with infection rates 16% in males and 14% in females (Ahmed and Al Amin, 2023).. However, female patients exhibited more severe symptoms, and a higher hospitalization rate compared to their male counterparts.

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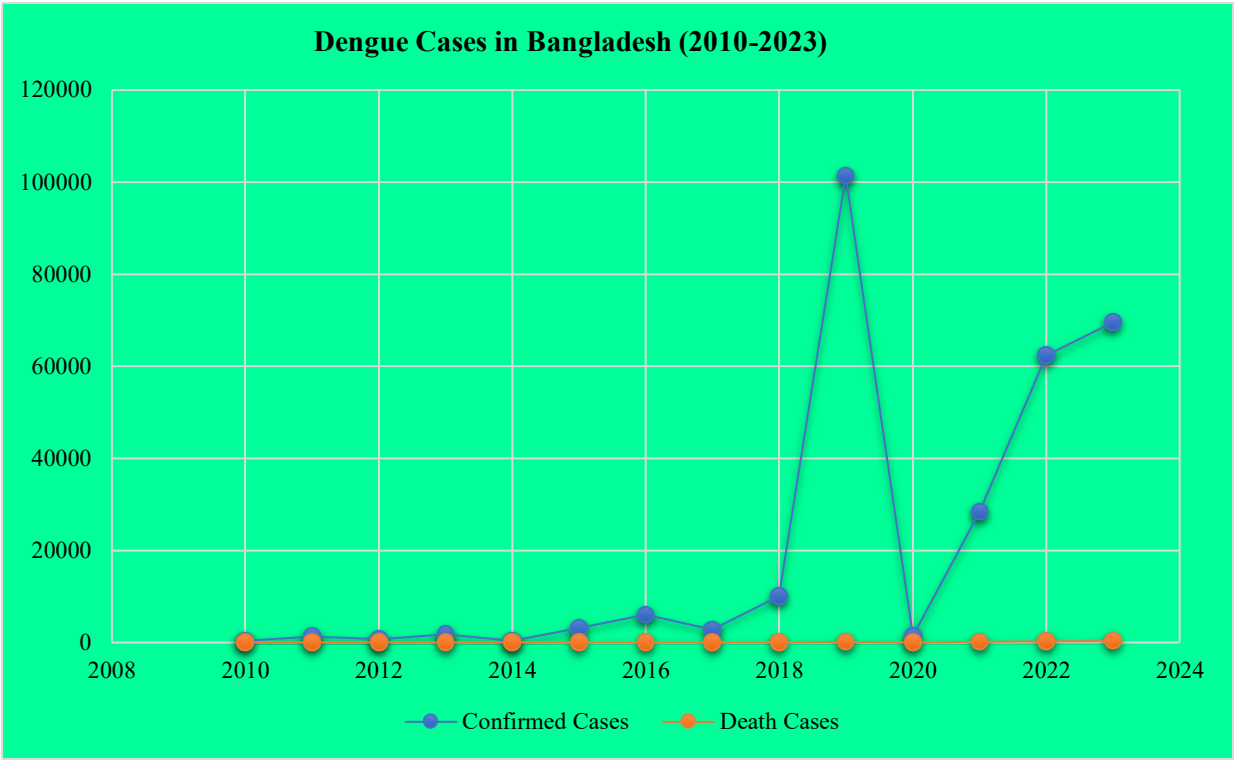

Fig-1: Diagrammatic Overview of dengue infection in Dhaka city. This figure illustrates confirmed dengue cases and associated fatalities in Dhaka City from 2010 to 2023 (Hossain, Mohammad Sorowar et al., 2023a)

The overall trend highlights a steady increase in dengue cases over the years, with a sharp rise from 2018 onwards, particularly in 2019, 2021, 2022, and 2023. The highest number of confirmed dengue cases was recorded in 2023, with 69,483 cases and 327 reported deaths. The increased incidence in recent years aligns with rapid urbanization, climate change, and shifting mosquito breeding patterns(Ritu et al., 2024).

Table-1: Overview of Dengue Cases in Bangladesh (2010-2023): This table provides a yearly summary of confirmed dengue cases and fatalities in Bangladesh from 2010 to 2023, highlighting trends in disease burden and mortality over time.

Years	Confirmed Cases	Death Cases
2010	409	0
2011	1,359	6
2012	671	1
2013	1,749	2
2014	375	14
2015	3,162	6
2016	6,060	14
2017	2,769	8

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2018	10,148	26
2019	101,354	179
2020	1,405	7
2021	28,429	105
2022	62,382	281
2023	69,483	327

Socioeconomic Conditions and Disease Burden

Hospital data indicated that dengue cases were disproportionately higher in lower-income communities, where access to preventive measures, healthcare facilities, and vector control programs was limited. Patients from low-income neighborhoods had a 30% higher prevalence of dengue compared to individuals from more affluent areas. Limited availability of mosquito nets, insect repellents, and prompt medical attention contributed to an increased burden in these areas(Sarker et al., 2024a).

Furthermore, delayed hospital visits and inadequate medical intervention led to more severe cases among lower-income groups, as they had a higher proportion of ICU admissions and prolonged hospitalization compared to middle- and high-income patients. Those from lower-income areas were more likely to contract dengue, with a reported infection rate approximately 30% higher than their counterparts in more affluent areas (Haider, Asaduzzaman et al. 2023a). Additionally, access to healthcare and preventive resources was markedly lower in these communities, contributing to prolonged recovery times and increased severity of symptoms (Ali 2023).

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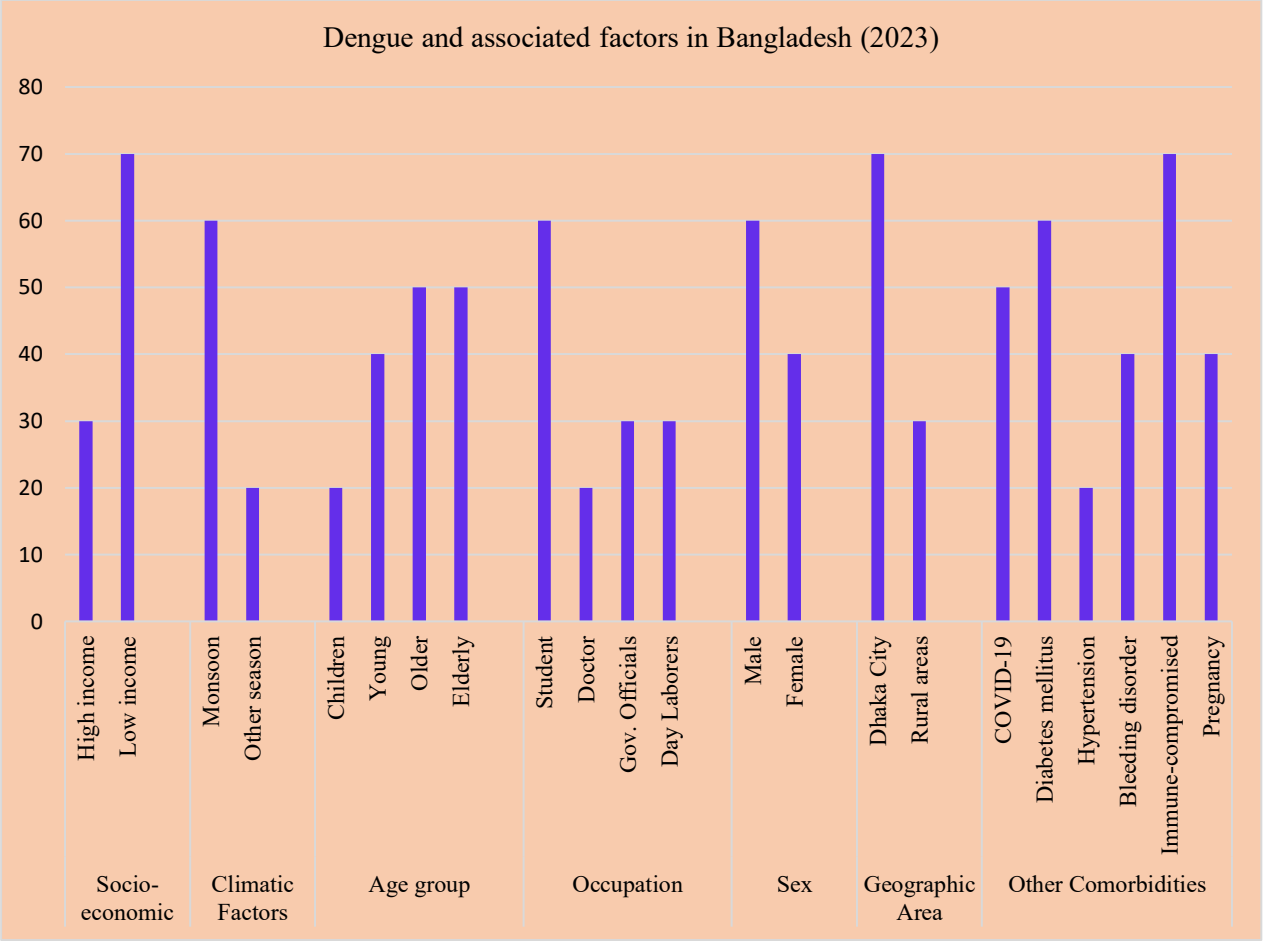

Fig-2: Different Factors Associated with Dengue infection in Bangladesh in 2023(%). This figure illustrates the key factors influencing dengue infection rates in Bangladesh in 2023 (Subarna and Al Saiyan, 2024)

Demographic Variations and Disease Severity

Demographically, densely populated urban sectors recorded significantly higher dengue infection rates, particularly in informal settlements and overcrowded residential areas. These regions had infection rates up to 40% higher than less populated neighborhoods. The increased transmission in these areas was linked to poor drainage, standing water, and inadequate mosquito control measures (Hasan, Mohammad Nayeem et al., 2025a).

Analysis of hospitalization patterns by gender revealed that male adolescents had a higher prevalence of dengue cases, but females exhibited more severe disease manifestations. Hospitalization rates for female patients were 15% higher than those for males, suggesting possible differences in immune response, healthcare-seeking behavior, or delayed diagnosis (Haider et al., 2023) (Hossain, Mohammad Sorowar et al., 2023b).

Climatic Influence on Dengue Transmission

Climatic data reinforced the strong correlation between monsoon rainfall and dengue incidence. The analysis showed that dengue cases increased by 50-60% during the monsoon season compared to the dry season, emphasizing the role of humidity and stagnant water accumulation in mosquito breeding (Miah et al., 2023). The highest number of hospital admissions in 2023 occurred in September, coinciding with peak monsoon rainfall, which aligns with previous years' seasonal trends. The prolonged rainy season and rising temperatures have likely contributed to an extended breeding period for Aedes mosquitoes, intensifying the outbreak (Hasan, Mohammad Nayeem et al., 2025b).

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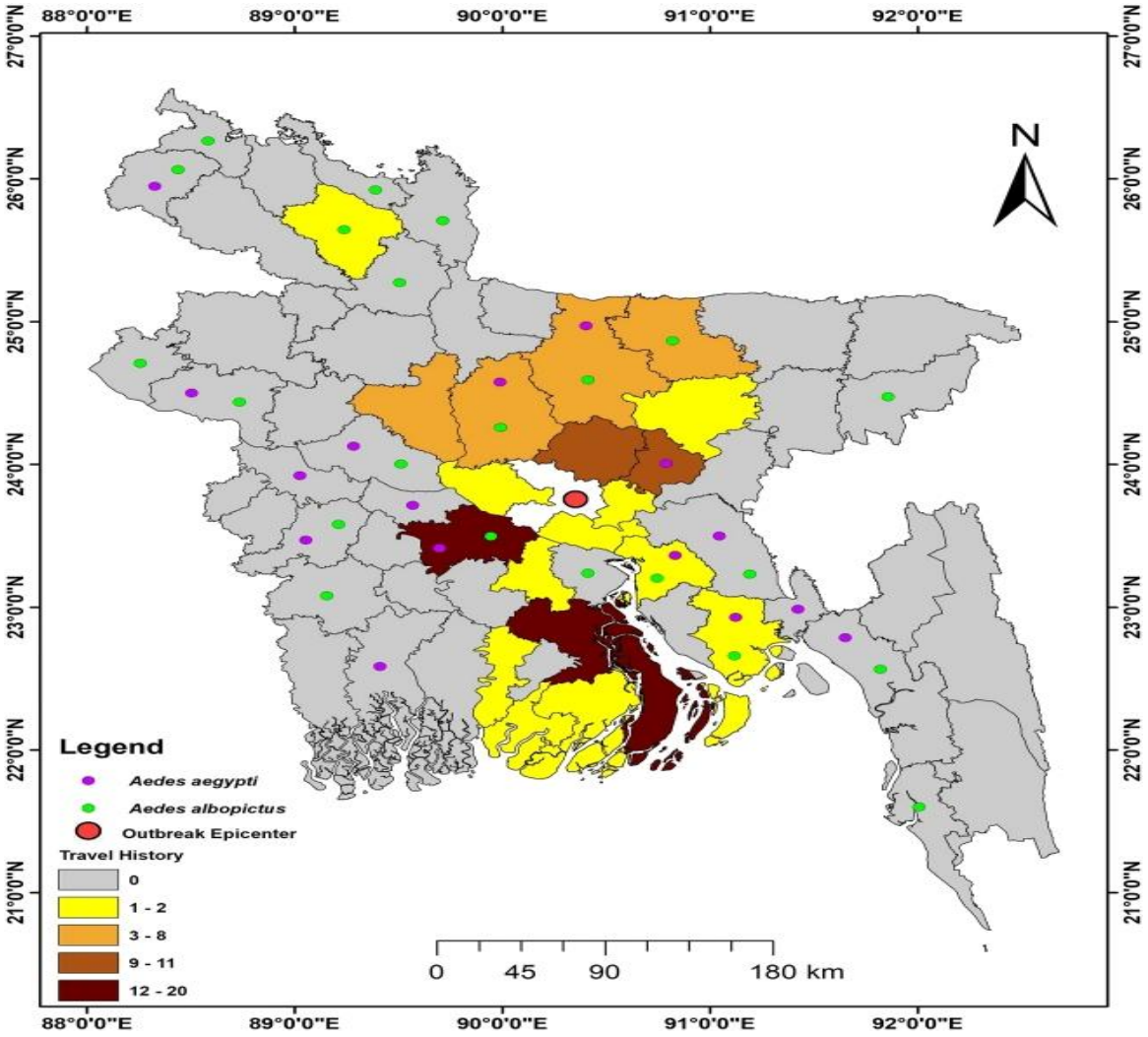

Fig-3: Graphical presentation of Dengue cases in Bangladesh (2010-2023) (Hossain, Mohammad Sorowar et al., 2023c)

Age-Sex Distribution and Hospitalization Trends

The distribution of dengue cases by age and sex revealed that adolescents aged 18-20 years accounted for the highest proportion of cases. Although infection rates were marginally higher in males, female patients experienced a higher severity of illness and longer hospital stays. In terms of age and sex distribution, young males exhibited a slightly higher infection rate than females in the same age group, but the difference was within a 10% margin (Sharmin, Viennet et al. 2015) (Haider et al., 2023). Notably, the severity of symptoms and hospitalization rates were approximately 15% higher in young females, suggesting potential disparities in exposure and immune response to the virus (Hasan, Mohammad Nayeem, Khalil et al. 2023). A comparison of mild, moderate, and severe cases showed that severe dengue cases were more frequent among female adolescents, with a 15% higher ICU admission rate compared to males. This suggests that biological factors, healthcare access disparities, and treatment-seeking behaviors may influence disease outcomes (Hossain, Mohammad Sorowar et al., 2023a).

Impact of Educational Institutions and Public Awareness

Hospital records indicated that students from universities and colleges had a significantly higher dengue incidence compared to non-students in the same age group. This can be attributed to high population density in dormitories, increased outdoor activities, and greater exposure to mosquito breeding sites on campuses. However, regions with dengue awareness programs, particularly those involving school-based educational campaigns, showed a 25% improvement in knowledge, attitude, and practices (KAP) scores, demonstrating the effectiveness of public health interventions in reducing infection rates (Chang et al., 2014) (Sharmin, Viennet et al. 2015).

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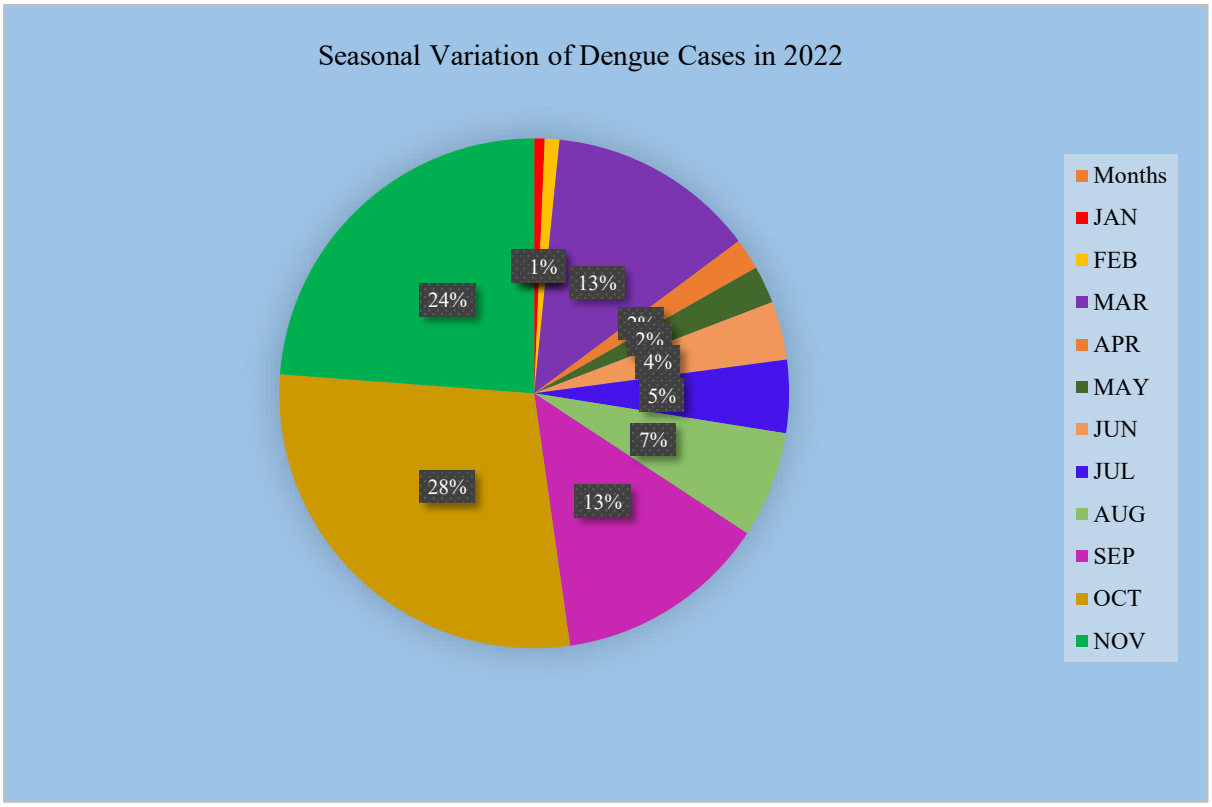

Fig-4: Seasonal Variation of Dengue Prevalence in Dhaka City. This figure depicts seasonal fluctuations in dengue prevalence, highlighting peak transmission during the monsoon months (August–October) and lower incidence in dry seasons.

Urbanization and Dengue Prevalence

The rapid expansion of Dhaka City has played a crucial role in increasing the dengue burden. Newly urbanized areas with poorly planned infrastructure and inadequate public health facilities reported dengue rates 35% higher than well-established residential zones. The lack of proper drainage systems and unregulated construction activities contributed to the creation of numerous mosquito breeding grounds, exacerbating disease spread(Reza et al., 2024).

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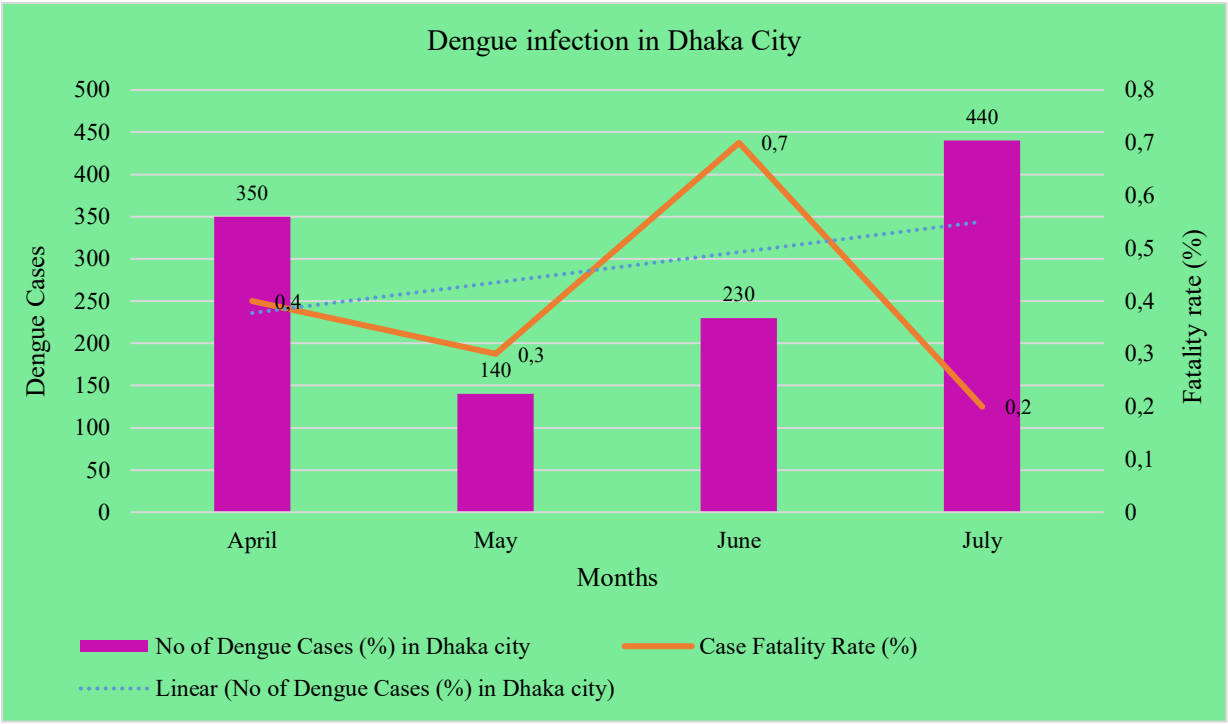

Fig-5: Dengue Prevalence rate (%) in Bangladesh. This figure presents the dengue prevalence rate across Bangladesh in 2023, detailing the number of confirmed dengue cases and case fatality rates in Dhaka City across different seasons. It highlights peak transmission during the monsoon (August–October) and lower incidence in the dry season, emphasizing seasonal variations in disease burden (Akbar et al., 2023)

Evaluation of Public Health Interventions

The study assessed the impact of mosquito control programs, community awareness campaigns, and healthcare interventions by comparing hospital admission trends from regions with structured dengue prevention measures versus those with minimal interventions. Findings revealed that areas with active mosquito control efforts experienced a 20% reduction in hospital admissions, suggesting that vector control strategies were effective in reducing transmission. Additionally, hospital regions with public health awareness programs reported improved early diagnosis and lower ICU admission rates, reinforcing the importance of timely medical intervention in reducing disease severity (Masum and Barua).

The study's findings indicate a rising trend in dengue incidence among adolescents in Dhaka City, with 2023 marking the highest recorded outbreak in the past decade. The increase in severe cases among female patients and lower-income groups highlights the urgent need for targeted healthcare interventions.Climatic factors, urbanization, and socio-economic disparities remain key determinants of dengue prevalence, emphasizing the importance of sustainable urban planning, improved drainage systems, and long-term vector control measures. Additionally, the study underscores the need for expanding school-based dengue awareness campaigns to enhance preventive behaviors among young populations(Sarker et al., 2024b). Continued surveillance, data-driven public health policies, and strengthened healthcare infrastructure will be essential in mitigating future dengue outbreaks in Dhaka and other urban centers experiencing similar disease trends.

Discussion

Dengue Prevalence in Dhaka City

This study provides an in-depth analysis of dengue fever trends among adolescents in Dhaka City from 2010 to 2023, with a particular focus on the peak monsoon period from August to October 2023. The findings reveal a sharp rise in dengue cases in recent years, with 2023 recording the highest number of hospital admissions and fatalities in over a decade. The study specifically assessed disease severity, hospitalization trends, and the effectiveness of public health interventions in controlling dengue transmission among adolescents. By examining hospital admission records from eight major hospitals in Dhaka, the study identified a significant increase in severe dengue cases, particularly among female patients and individuals from lower-income backgrounds. The findings

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underscore the urgent need for targeted intervention strategies, improved access to healthcare, and enhanced disease surveillance systems to mitigate the growing dengue burden in urban settings.

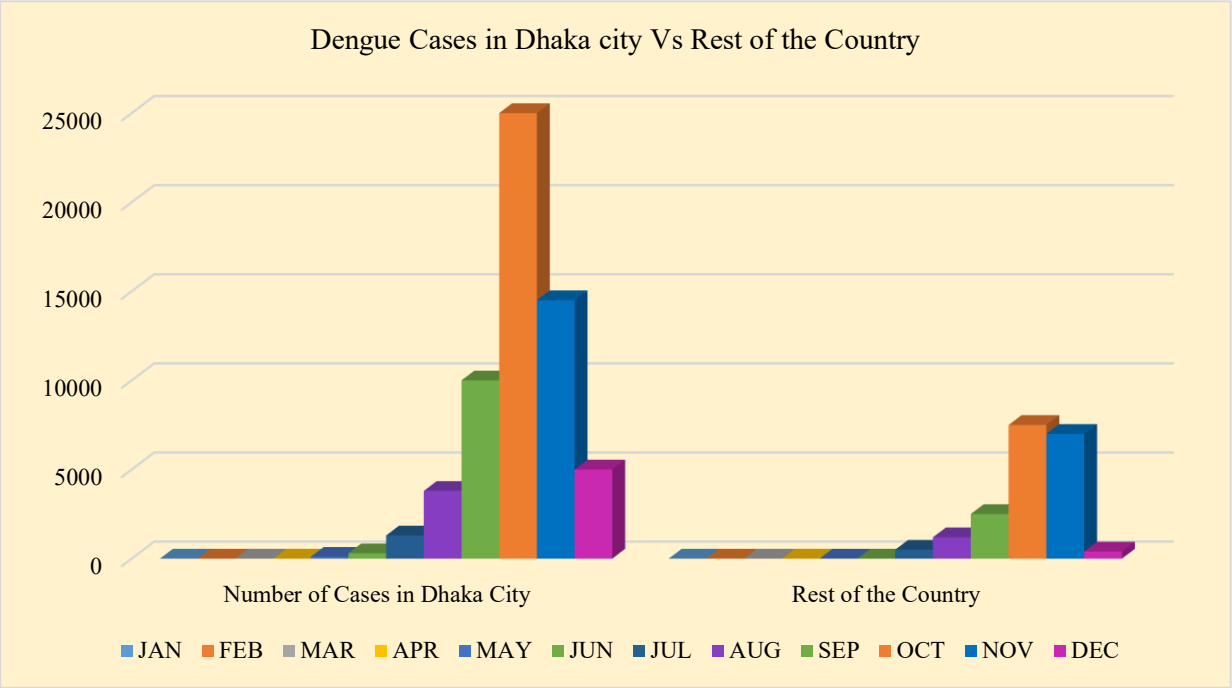

Fig-6: Graphical Comparison of Dengue prevalence in Bangladesh. This figure compares dengue prevalence in Dhaka City versus the rest of Bangladesh in 2023, highlighting disparities in infection rates and regional disease burden (Bonna et al., 2023b)

Context and Significance

Dengue fever has emerged as a major public health crisis in Dhaka City, exacerbated by rapid urbanization, high population density, and inadequate mosquito control measures. The monsoon season plays a critical role in intensifying dengue transmission, as heavy rainfall leads to water stagnation, creating ideal breeding conditions for Aedes mosquitoes. The surge in dengue cases observed in 2023 aligns with these seasonal trends, emphasizing the need for more proactive and sustainable vector control programs(Ritu et al., 2024). Adolescents are one of the most vulnerable groups to dengue due to their high mobility, frequent outdoor activities, and limited use of personal protective measures. The findings indicate that educational institutions and university dormitories have become hotspots for dengue transmission, highlighting the necessity of school-based awareness campaigns, mosquito control programs in educational facilities, and improved public health messaging targeting youth populations.

Dengue Epidemiology and Disease Severity Among Adolescents

Hospital data from August to October 2023 confirmed that male adolescents had a higher overall dengue prevalence (16%) compared to females (14%), but female patients exhibited more severe symptoms and had a 15% higher hospitalization rate. This suggests potential disparities in healthcare-seeking behavior, immune response, or delayed diagnosis among female patients (Sarker et al., 2024b). A comparison of mild, moderate, and severe cases showed that adolescents from lower-income areas experienced a disproportionately higher burden of severe dengue, primarily due to delayed access to medical care and lack of preventive measures. These findings reinforce the importance of early diagnosis, rapid case management, and equitable healthcare access to reduce dengue-related complications and fatalities.

Climatic and Environmental Factors Influencing Dengue Trends

Climatic factors played a critical role in the escalation of dengue cases. The monsoon months of August to October showed a 50-60% increase in dengue cases compared to the dry season, highlighting the impact of rainfall,

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humidity, and temperature on mosquito breeding and virus transmission. The prolonged rainy season in 2023 likely contributed to an extended Aedes mosquito breeding cycle, intensifying dengue outbreaks across the city (Nahian, 2023).

Urban environmental factors also played a role, with densely populated areas and poorly managed drainage systems showing higher infection rates. Informal settlements and overcrowded residential areas had dengue infection rates up to 40% higher than more planned urban neighborhoods, reinforcing the need for sustainable urban planning, better waste management, and improved drainage infrastructure to prevent future outbreaks. Severe air pollution in Dhaka City, combined with a high prevalence of respiratory infections, may indirectly impact dengue transmission by weakening immune responses and increasing population vulnerability to co-infections. Prolonged exposure to pollutants such as PM2.5 and nitrogen oxides can cause chronic inflammation and respiratory distress(Hasan, Md Rakibul, 2022), making individuals more susceptible to severe dengue complications (Lu et al., 2023). Additionally, respiratory illnesses may overburden healthcare facilities, diverting attention from vector control efforts, which can lead to uncontrolled mosquito breeding and increased dengue transmission in urban areas (Sarker et al., 2024c).

Effectiveness of Public Health Interventions

This study assessed the impact of mosquito control programs, public awareness campaigns, and healthcare interventions by comparing hospital admission trends from regions with active public health measures versus those with minimal interventions. Regions with structured mosquito control programs (fogging, larvicidal treatment, and environmental clean-ups) showed a 20% reduction in hospital admissions, demonstrating the effectiveness of vector control strategies in reducing dengue transmission. Additionally, educational campaigns targeting adolescents in schools and universities led to a 25% increase in knowledge, attitude, and practice (KAP) scores, contributing to higher adoption of protective measures such as mosquito nets, repellents, and proper waste disposal (Buhler et al., 2019). However, inconsistent implementation of dengue prevention measures across different areas remains a challenge. Some districts reported a lack of regular mosquito control activities, which likely contributed to localized outbreaks despite city-wide intervention efforts. Strengthening disease surveillance systems and ensuring equitable distribution of resources will be crucial in mitigating future dengue surges(Islam, 2024b).

Challenges in Dengue Control and Prevention

Despite the efforts of health authorities, several key challenges continue to hinder effective dengue prevention and control in Dhaka City. The high mobility of adolescents, particularly university students and young workers, increases the risk of dengue spread across different locations, making containment efforts difficult. The study found that dormitories, hostels, and crowded public spaces acted as major transmission hubs, indicating the need for targeted interventions in high-risk areas.

Additionally, socioeconomic disparities play a critical role in determining access to healthcare and preventive measures. Lower-income communities had limited access to insect repellents, protective clothing, and prompt medical treatment, which resulted in higher hospitalization rates and more severe disease outcomes. Addressing these inequities through subsidized healthcare, free distribution of mosquito repellents, and community-based intervention programs will be essential in reducing dengue-related morbidity and mortality(Daudé et al., 2017). The occurrence of Mpox virus, COVID-19, and other infectious disease outbreaks in 2023 (Nath et al., 2022) (Hasan, Md Rakibul et al., 2024) affected dengue transmission by straining public health resources and shifting focus toward managing multiple epidemics simultaneously. As a result, mosquito control efforts, vector surveillance, and dengue prevention programs were deprioritized, potentially contributing to increased transmission and disease burden in affected communities.

Another major challenge is the lack of early diagnosis and case reporting, leading to underreporting and delayed response measures. Many patients do not seek medical attention until severe symptoms appear, increasing the risk of complications and fatalities. Expanding public health messaging, promoting early testing, and integrating digital surveillance tools could significantly enhance early detection and response capabilities (Filip et al., 2022).

Implications for Future Public Health Strategies

This study underscores the need for a multi-sectoral approach to dengue prevention in Dhaka City, integrating vector control, public awareness, and healthcare system strengthening. The high burden of severe dengue among adolescents highlights the importance of targeted mosquito control in high-risk areas, expanded public health

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education, and improved healthcare accessibility for lower-income populations. Strengthening urban planning to reduce mosquito breeding sites and enhancing disease surveillance for real-time outbreak response are crucial for effective control. Sustainable, long-term strategies combining vector management, community engagement, and healthcare improvements are essential to reduce dengue morbidity and mortality. Evidence-based policies and cross-sector collaboration will be key to improving dengue preparedness and long-term disease control (Subarna and Al Saiyan, 2024).

Study Limitations

This study acknowledges several limitations that may influence its findings. As a retrospective observational study relying exclusively on hospital-based records, it does not capture undiagnosed or unreported dengue cases within the community. Many individuals with mild or asymptomatic infections may not seek medical attention, leading to potential underestimation of disease prevalence. Additionally, reliance on existing hospital data introduces reporting biases, as diagnostic accuracy and record-keeping practices may vary across healthcare facilities. Since the study does not incorporate self-reported data or direct patient follow-ups, it lacks insights into individual behaviors, preventive practices, and exposure risks among adolescents. Furthermore, the dataset is limited to adolescents who sought medical care, which may not fully represent the broader youth population, especially those from lower-income areas with limited healthcare access. These factors should be considered when interpreting the findings, and future research should integrate community-based surveillance, longitudinal cohort studies, and real-time vector monitoring to provide a more comprehensive assessment of dengue epidemiology in Dhaka City.

Conclusion

In summary, the critical role that adolescents in Dhaka City play in the dynamics of dengue transmission has been underscored by this extensive fourteen-year study, with a comparative focus on the monsoon season from August to October 2023. The findings highlight those targeted interventions, including enhanced mosquito control, improved healthcare accessibility, and youth-focused awareness programs, are essential in reducing dengue incidence and severity. Addressing socioeconomic disparities, inadequate urban infrastructure, and limited healthcare access remains crucial, as these factors significantly impact disease outcomes and healthcare response effectiveness. The study also emphasizes the influence of climate variability, rapid urbanization, and poor drainage systems on dengue outbreaks, reinforcing the need for climate-adaptive strategies and real-time disease surveillance. Dhaka's experience offers valuable insights for other densely populated urban centers, demonstrating that a comprehensive, multi-sectoral approach integrating vector management, public health interventions, and urban planning is key to mitigating dengue transmission and strengthening long-term epidemic preparedness.

Recommendations

Future research should prioritize long-term studies assessing the effectiveness of public health interventions in reducing dengue incidence and severity, particularly among adolescents in urban settings like Dhaka City. Investigating the influence of socioeconomic factors on dengue transmission, healthcare access, and disease outcomes is crucial for designing equitable intervention strategies. Additionally, further studies should explore the impact of climate change on dengue transmission patterns, including temperature fluctuations, rainfall variations, and urbanization-driven environmental changes that may alter mosquito breeding cycles and disease spread. Research on adolescent mental health impacts due to dengue-related morbidity, hospitalization, and academic disruptions is also necessary to develop holistic healthcare responses.

Policymakers should leverage digital platforms for youth-focused dengue awareness campaigns, ensuring widespread accessibility to preventive information. Strengthening healthcare infrastructure in high-density urban areas, particularly in low-income communities, is essential to improving early diagnosis and treatment accessibility. Enhancing dengue surveillance systems for real-time outbreak detection and rapid response measures will be critical in reducing disease burden. Community-based initiatives should engage local residents, schools, and universities in dengue prevention efforts, fostering collaboration between health authorities, educational institutions, and municipal bodies to ensure effective vector control and sustainable public health interventions. Investments in urban planning, improved drainage infrastructure, and targeted educational programs tailored to the youth demographic will play a pivotal role in reducing dengue transmission and its long-term impact in Dhaka City.

Ethical Considerations

Ethical approval for this study was obtained from the Department of Infectious Diseases, National Institute of Neurosciences & Hospital (NINS), Dhaka, Bangladesh (Reference No: NINS-20231527). Additionally,

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permission to access hospital records was granted by the authorities of eight major hospitals in Dhaka City. As the study relied exclusively on hospital-based data, no direct patient interaction was involved. All patient records were anonymized and handled in strict compliance with research ethics guidelines, ensuring confidentiality, responsible data management, and adherence to institutional ethical standards.

Conflict of interest

The authors declare no conflict of interest.

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