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Dengue Investigation Research in Bangladesh: Insights From a Scoping Review

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ABSTRACT

Background and Aims: A more accurate assessment of the disease's incidence and fatality rate over the previous years could help with future outbreak detection and containment. Therefore, this scoping review was conducted to compile the results of research on dengue investigation in Bangladesh in terms of knowledge, attitudes, and practices; risk factors; clinical presentations; and stereotypes of dengue.

Methods: The final analysis included 27 studies that satisfied the inclusion criteria. The PRISMA 2020 guidelines served as the basis for data extraction. All included articles were retrieved from PubMed, BanglaJOL, Google Scholar, Embase, Web Sciences, Cochrane Library, and other databases up to October, 2024. The quality of included studies in terms of relevance, reliability, validity, and applicability was also evaluated.

Results: The present study recorded a moderate understanding of dengue infection among slum dwellers and people in rural areas due to a lack of knowledge about it. Insufficient practices regarding dengue fever were also found among them. However, the differences in perception regarding dengue infection were observed in different parts of Dhaka city. Additionally, between 2017 and 2022, different dengue serotypes were the most common at various times. The potential risk factors included monsoon sessions (July to September), static water, scrapyards, and indoor plants; urbanization; population density; being outside in the morning and evening; sleeping during the day; and so forth. Along with the common symptoms of dengue, hematological abnormalities such as thrombocytopenia and leukopenia, as well as elevated levels of ALT and AST, were observed in Bangladeshi dengue patients.

Conclusions: Knowledge gap, moderate understanding, insufficient practices regarding dengue infection among slum dwellers and rural people, and varieties in dengue serotypes are the main obstacles to control the dengue outbreak. Therefore, it is essential to undertake several preventive measures to reduce the dengue infection and also understand the dengue serotypes.

1 | Introduction

Dengue virus, an enveloped RNA virus, causes the dengue fever [1]. Aedes mosquito carries the virus to healthy individuals when it bites them. There are four serotypes of the dengue virus (DENV-1–4) that may be responsible for the dengue fever [2]. The fever can be identified by a slight fever to the life-threatening dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). DSS is

clinically screened out by lower platelets and WBC count and an increase in vascular permeability. Sometimes, the virus is asymptomatic in humans [2, 3]. Furthermore, variations in both the serotype and genotype of this virus add a new dimension to the higher rate of secondary and tertiary infection of this virus, which is becoming a new challenge for global public health [4]. People living in subtropical and tropical areas, such as Bangladesh, in the globe are at risk of dengue virus. Approximately 400 million patients are confirmed with dengue, and 40,000 deaths due to dengue infection are estimated every year [1, 2, 4]. A higher prevalence of dengue infection was reported in developing and underdeveloped countries where the surveillance networks for infectious diseases are not robust [5].

Dengue patients in hospitals may act as a reservoir of DENV. From these hospitalized patients, dengue virus can be transmitted to people residing in hospitals and surrounding areas. Consequently, living close to hospitals has been identified as a risk factor for DENV infection [6]. Areas with higher-density populations, construction sites, and catchment areas of the hospitals were also recognized as risk factors for dengue infection [7]. Warm temperature is very helpful for the reproduction of mosquitoes and the replication of dengue virus. So, it is very challenging to manage the outbreak in tropical regions like Bangladesh. Besides, the limited resources, insecticides, and medical personnel to care for infected patients were considered crucial factors in managing the large-scale dengue outbreak [2]. Thus, Bangladesh has become an ideal environment for the dengue vector and the subsequent increase in dengue transmission [8]. Between 2012 and 2019, the largest dengue cases were reported in Dhaka, the capital and most populous city in Bangladesh [2].

Permanent immunity against different serotypes and genotypes of the dengue virus is the possible pathway to recovery from this infection [9]. However, people get confused about how to fix the infection of the dengue virus due to having similar indicators of the common cold and influenza. The liver can be damaged by dengue infection due to elevating the liver enzymes [10]. Severe dengue infection can also destroy the septum and right ventricular wall, leading to systolic and diastolic cardiac impairment [11]. It can also adversely affect the kidneys, eyes, blood, brain, pancreas, and endothelial cells. However, a distinctive feature of dengue is that the likelihood of a severe and potentially fatal disease increases with each subsequent infection with a new serotype [2].

Development of a safe and effective vaccine against all types of serotypes of dengue virus must be needed to get rid of this dreadful infectious disease [12]. Besides, public awareness and precautions for health-related behavior are necessary to prevent the outbreak [13]. Moreover, a more accurate assessment of the disease's incidence and fatality rate over the previous years could help with future outbreak detection and containment. Therefore, this study was undertaken to screen dengue in Bangladesh from the existing literature in terms of knowledge, attitudes, and practices (KAP); risk factors associated with the dengue infection; clinical presentations and laboratory characteristics of dengue patients; and stereotypes of dengue identified in Bangladesh. The findings of the present study represented the exact scenario of dengue in Bangladesh that will help to deal with dengue in the future.

2 | Methods and Materials

To conduct this scoping review, we followed the five-step methodological framework suggested by Arksey and O'Malley [14].

2.1 | Research Question Identification

The quality of a scoping review is reflected in a well-crafted research question. Consequently, the first priority when initiating a scoping review is to develop a meaningful, transparent, and unambiguous question. The goal of the current study was to compile the major discoveries from previous research to screen for dengue infection in Bangladesh. To scrutinize the existing research in Bangladesh, we formulated the following research enquiries: What details about dengue investigation in Bangladesh are available from the body of existing literature?

2.2 | Relevant Studies Determination

Studies related to the investigation of dengue in Bangladesh before October 5, 2024, were retrieved from different available online databases. Only articles published in English that met the predetermined requirements were selected from PubMed, BanglaJOL, Google Scholar, Embase, Web Sciences, and Cochrane Library. We collected data by searching "Dengue outbreak/endemic/epidemic/prevalence," "knowledge, attitude and practices towards dengue," "epidemiology of dengue," "risk factors," treatment and management", "clinical sign and symptoms," "DENV serotypes," and so forth. All data were collected only from the studies that were conducted in the Bangladeshi population. To find any relevant missing articles, we checked the references of the selected articles and reviews published on this subject.

2.3 | Study Selection

Several criteria were considered during isolating data from the selected articles. Some articles that did not meet the predetermined criteria were omitted from the study. Studies included in the present scoping review were aligned with the following eligibility criteria: (a) only original studies were included in the present study, (b) studies carried out in Bangladesh were considered to be included in the present study, and (c) English language was also one of the prime inclusion criteria of our study. However, studies on animal samples, reviews, comments, editorials, articles containing insufficient data or not related to the formulated question, and studies from outside of Bangladesh were eliminated from this scoping review.

2.4 | Data Extraction

An MS Excel sheet was designed by each author for inputting the collected data while extracting relevant data impartially. Any anomalies during data collection were eliminated by a group discussion among authors. The author's name, Bangladeshi population, publication year, sample size, age, study type, study design, study setting, and location of the study were recorded as

basic characteristics of the included studies in the predesigned Excel spreadsheet. The objective and findings of the selected studies and the eligibility criteria of the present study were taken into consideration during the data extraction process.

2.5 | Interpretation and Reporting Results

The purpose of a scoping review is to present a more comprehensive and wide-ranging summary of the studies carried out on a specific subject. To create a description of the research landscape and provide an overview of Bangladeshi dengue screening research, we used a thematic synthesis approach.

3 | Results

3.1 | Fundamental Characteristics and Literature Review of Selected Studies

Table 1 shows the fundamental characteristics of the included studies. We followed the PRISMA guidelines for the screening of articles included in the present study (Figure 1). Around 181 articles were identified in different available online databases, such as PubMed, Google Scholar, EMBASE, Google, Cochrane Library, and so on. More than 105 studies were gathered after the elimination of the duplicate articles. After the elimination process, about 71 abstracts and titles were scrutinized for the identification of the targeted articles. After that 45 full tests were reviewed to find out the expected findings. Finally, only 27 articles were included in this study to extract both the objectives and the major findings of the included studies [15, 41]. Around 6, 4, 6, and 12 articles, respectively, were selected for the analysis of KAP, risk factors, serotypes, and clinical manifestations associated with dengue infection in the Bangladeshi population. The rest of the studies were excluded from the present scoping review due to failing to meet the expected criteria of data collection. Moreover, we examined the quality of each included study by appraising the evidence for its relevance, reliability, validity, and applicability (Table S1).

3.2 | Themes Derived From the Chosen Studies

According to the study objective of our scoping review, we thematically classify the evidence. Since we did not have any predetermined themes, we classified the data according to the results of our scoping review. We tried to find out the gaps in the literature and let the readers know about those studies so they could understand the scope of the work that has been done and what needs to be done in the future. We identified four major themes under which dengue investigation research studies in Bangladesh could be categorized: (1) KAP, (2) risk factors, (3) serotypes of dengue, and (4) clinical manifestations and laboratory characteristics of dengue patients.

3.2.1 | Theme 1: KAP of Dengue Screening in Bangladesh

After conducting a thorough review, we identified six studies that evaluated various aspects of dengue screening KAP in

Bangladesh [31, 35]. These studies' main objective was to evaluate Bangladeshis' attitudes, practices, knowledge, awareness, and reactions to dengue infection. The goals and key conclusions of the chosen studies are summarized in Table 2. The included studies were carried out across the country and among various populations in various locations, such as cities, rural areas, slum areas, universities, and more. Following our analysis of these articles, we discovered that Dhaka city's citizens had positive attitudes and good knowledge about dengue. Some studies also examined the disparities between the Dhaka North City Corporation and the Dhaka South City Corporation of Dhaka in terms of their knowledge, attitudes, and dengue-related practices [31, 32]. However, a moderate understanding and well knowledge of several preventive measures and inadequate practices toward dengue infection were identified in the rural community members of the Bangladeshi population [35]. Besides, insufficient awareness and knowledge about the preventive measures were found in the slum dwellers [33]. However, the Bangladeshi university students had good knowledge of the deadly consequences, typical signs, and the role of female Aedes mosquitoes in the spread of dengue fever and the preventive behaviors regarding DF [19]. Additionally, a study carried out nationwide found a good knowledge of dengue infection that they learned from TV, radio, newspapers, and social media [34].

3.2.2 | Theme 2: Risk Factors of Dengue Infection in Bangladesh

Multiple studies were undertaken in Bangladesh to assess the risk factors of dengue infection. Table 3 provides a summary of the objectives and potential findings of the chosen studies conducted on themes addressing the risk factors of dengue. All three studies on this theme were conducted in Dhaka city [21, 41–43]. They found workplaces close to dengue-infected patients, being outside in the morning and evening, sleeping during the day, monsoon seasons (particularly July to August, higher humidity), static water, junkyards, and indoor plants as the potential risk factors of dengue in the Dhaka city. Besides, a study conducted nationwide explored urbanization, population density, and also the season of August to September as the risk factors of dengue spread in the Bangladeshi population.

3.2.3 | Theme 3: Dengue Serotype Identified in the Bangladeshi Population

This thematic analysis included six studies that examined the dengue virus's serotype diversity (Table 4) [15, 26, 30]. Among them, four studies investigated the dengue serotype in Dhaka city and one in the Rajshahi district. DENV-1, DENV-2, and DENV-3 serotypes were identified between 2017 and 2018 in Dhaka city. Similarly, DENV-1, DENV-2, and DENV-3 were found in different areas of Rajshahi district, Bangladesh. The previously prevalent DENV-3 genotype II has been replaced by DENV-3 genotype I. Though DENV2 was the most common from 2017 to 2018 in Dhaka city, in 2019 and 2021, DENV-3 took the lead. It was the only serotype in circulation between 2020 and 2022. Moreover, DENV-1, DENV-2, DENV-3, and

TABLE 1 | Characteristics of the included studies.

Study	Study type	Study design	Study setting	Study period	Location of the study	Number of the participants	Gender (M/F)	Age (mean)	Dengue serotype
Dhar-Chowdhury et al. [15]	Quantitative	Prospective cohort study	Urban	June, July, and November 2012	12 Wards of Dhaka city	1125	Both male and female	31.9 years	NR
Hasan et al. [16]	Quantitative	Cross-sectional	DMCH and SHNIBPS	2019	Dhaka city	747	Both male and female	27 years	NR
Rouf et al. [17]	Quantitative	Cross-sectional	Hospital-based	July 2018 to April 2019	Dhaka (Square Hospital)	343	Both male and female, additionally pregnant	NR	NR
Yesmin et al. [18]	Quantitative	Cross-sectional	Hospital-based	June to September 2019	Dhaka city	369	Both male and female	33.27	NR
Rahman et al. [19]	Quantitative	Case-control	Hospital-based (CMCH, BITID)	August to December 2019	Chattogram district	300	Both male and female	23 years	NR
Siddique et al. [20]	Quantitative	Cross-sectional	Urban, semi-urban, and rural area	September 2 to October 10, 2023	Dhaka district	384	Both male and female	22.02 ± 1.58 years	NR
Hossain et al. [21]	Quantitative	Retrospective	NR	2013–2020	Dhaka	2253	NR	NR	NR
Islam et al. [22]	Quantitative	Retrospective observational	Hospital-based	1 July to 31 December 2019	Dhaka	220	Both male and female	18–49 years (68.6%), < 18 years, and 50 years (14.6%) & 37 (16.8%)	NR
Hoque et al. [23]	Quantitative	Prospective cross-sectional study	Hospital-based	July to October 2018	Dhaka	101	Both male and female	< 6 months to > 60 years	DENV-1 & DENV-3
Azad et al. [24]	Quantitative	Prospective observational study	Hospital-based	July 2000 to March 2001	Dhaka	150	Both male and female	26.75 ± 3.69, 27.59 ± 1.18, and 10.67 ± 2.33 years	NR
Aktaret al. [25]	Quantitative	Prospective observational study	Hospital-based	August 1, 2019, to July 31, 2020	Chattogram	425	Both male and female	NR	NR
Muraduzzaman et al. [26]	Quantitative	Retrospective	Hospital-based	2013–2016	Dhaka, Chittagong, and Khulna	1380	NR	NR	DEN1 & DEN2
Rahim et al. [27]	Quantitative	Retrospective observational study	Hospital-based	June 2017 to August 2021	Dhaka (Evercare Hospital)	181 (2017), 167 (2018), 116 (2019), 30 (2020), 221 (2021)	Both male and female	< 1 year to > 70 years	DENV-1,2,3 (2017,2018); DENV-1,3 (2019);

(Continues)

TABLE 1 | (Continued)

Study	Study type	Study design	Study setting	Study period	Location of the study	Number of the participants	Gender (M/F)	Age (mean)	Dengue serotype
Rahim et al. [28]	Both qualitative and quantitative	Retrospective study	Hospital-based	From 2018 to 2022	Dhaka (Evercare Hospital)	(Total 3759): 1016 (2018); 566 (2019); 130 (2020); 1171 (2021); 876 (2022)	Both male and female	1 year to > 65 years	DENV-3 (2020,2021) DENV-1,2,3 (2018); DENV-1,3 (2019); DENV-3 (2020,2021,2-022)
Suzuki et al. [29]	Quantitative	Cross-sectional	Hospital-based	September 2017 to February 2018	Dhaka (Apollo Hospitals)	251	NR		DENV-1(7); DENV-2 (147); DENV-3 (7)
Sumon et al. [30]	Quantitative	Cross-sectional	Hospital-based	2023	Rajshahi (RMC)	30	Both male and female	10–74 years	DENV2 (93%); DENV3 (7%)
Abir et al. [31]	Quantitative	Cross-sectional	Hospital-based	August 30 to September 30, 2019	Dhaka	242	Both male and female	20–40 years	NR
Bashar et al. [32]	Quantitative	Cross-sectional	Hospital-based	November to December 2019	Dhaka	897	Both male and female	> 18 years	NR
Rahman et al. [33]	Quantitative	Cross-sectional	NR	January to March 2021	Dhaka	745	Both male and female	> 18 years	NR
Rahman et al. [19]	Quantitative	Cross-sectional	Urban	NR	Dhaka	625	Both male and female	18–30 years	NR
Hossain et al. [34]	Quantitative	Cross-sectional	NR	July to November 2019	Nine administrative regions across Bangladesh	1010	Both male and female	4 to > 60 (up to 75) years	NR
Banik et al. [35]	Quantitative	Cross-sectional	Urban- and rural-based	August to September 2021	Savar	401	Both male and female	33.47 ± 12.96 years	NR
Yang et al. [36]	Quantitative	Cross-sectional	Hospital-based	August, 15 to September 30, 2019	Dhaka	1090	Both male and female	< 18, 18–39, or > 40 years	NR
Mahmood et al. [37]	Quantitative	Cross-sectional	Hospital-based	August to November 2019	Dhaka	542	Both male and female	26.15 years	DENV-1

(Continues)

TABLE 1 | (Continued)

Study	Study type	Study design	Study setting	Study period	Location of the study	Number of the participants	Gender (M/F)	Age (mean)	Dengue serotype
Rafi et al. [38]	Quantitative	Cross-sectional	Hospital-based	July to September 2019	Bogra	319	Both male and female	33.0 years	NR
Sami et al. [39]	Quantitative	Prospective observational study	Hospital-based	June to November 2022	Dhaka	308	Both male and female	12 to > 60 years	NR
Ahmed et al. [40]	Quantitative	Cross-sectional observational	Urban area	December 2001 to August 2002	Dhaka	NR	NR	NR	NR

DENV-4 were also identified in different regions of Bangladesh between 2013 and 2016.

3.2.4 | Theme 4: Clinical Presentations, Laboratory Characteristics, and Management and Preventive Behaviors

We found a total of 12 studies that assessed different aspects of clinical presentations, treatment and management, and laboratory characteristics of dengue screening in Bangladesh, which we further categorized into three subthemes based on the specific focus of the studies [16, 18, 20, 22, 25, 36, 39]. Table 5 depicts the summary of the aims and potential findings of the studies included in this theme.

3.2.4.1 | Subtheme 4.1: Clinical Presentation and Co-morbidities.
Almost all studies included in this theme focused on the clinical presentation of Bangladeshi dengue patients. These studies explored fever, weakness, headache, myalgia, diarrhea, anorexia, vomiting, nausea, abdominal pain, back pain, skin rash, breathing issues, joint pain, cough, gum bleeding, and hypotension as the most common symptoms of dengue. Some comorbidities, including hypertension, diabetes, menstruation- and pregnancy-related problems, hepatic dysfunction, renal failure, multiorgan failure, encephalopathy, and ARDS, were the most frequent consequences.

3.2.4.2 | Subtheme 4.2: Laboratory Characteristics of Dengue Patients.
The present study identified five of eleven studies that represented the laboratory characteristics of Bangladeshi dengue patients. These studies found some hematological abnormalities such as thrombocytopenia, elevated hematocrit, leukopenia, and low hemoglobin levels are the most common indicators of dengue infection. Three of these studies also found elevated levels of ALT and AST in Bangladeshi dengue patients.

3.2.4.3 | Subtheme 4.3: Management and Preventive Behaviors of Dengue Patients.
A study conducted by Rouf et al. found mechanical ventilation, tracheostomies, ionotropic support, decompressive dialysis, plasma exchange, laminectomy, and hematoma evacuation as potential healthcare procedures to manage dengue infection in Bangladeshi patients. A difference in the Dhaka city residents' perceptions regarding dengue preventive measures was revealed in a study conducted in Dhaka city. It demonstrated that preventive behaviors were linked to gender, education level, work position, and prior exposure to dengue.

4 | Discussion

This scoping review aimed to provide a comprehensive evaluation of the current status of dengue investigation in Bangladesh by identifying and analyzing relevant studies. According to the study objective of our scoping review, we thematically classify the evidence. We identified four major themes under which dengue investigation research studies in Bangladesh could be categorized such as KAP, risk factors,
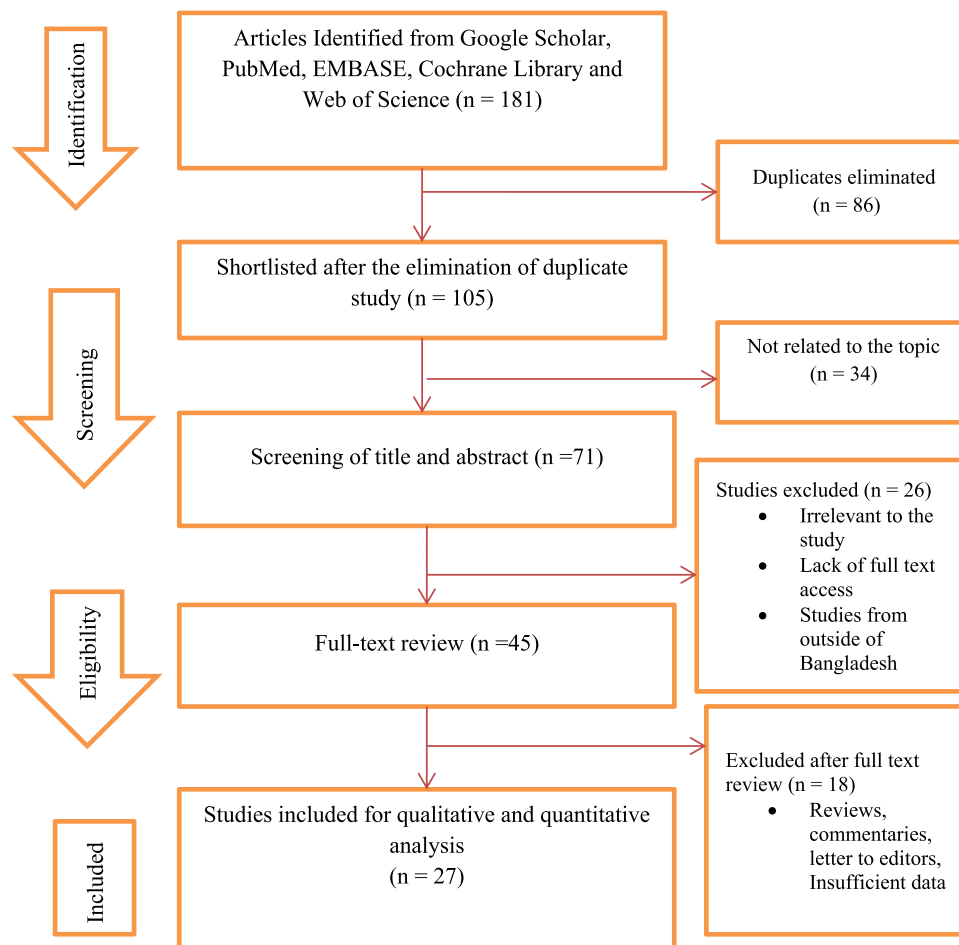
FIGURE 1 | Flow diagram of the study selection.

serotypes of dengue, and clinical manifestations and laboratory characteristics of dengue patients. We selected 27 articles in this study to extract both the objectives and the major findings of the included studies. Among the 27 articles, around 6 studies focused on KAP toward dengue infection; 4 studies related to the risk factors of dengue infection in Bangladesh; 6 studies represented the dengue serotype identified in the Bangladeshi population; and 12 studies described clinical presentations, laboratory characteristics, and preventive behaviors of the Bangladeshi dengue patients.

The studies included in our study for exploring KAP toward dengue infections were conducted in different populations of different areas, including rural areas, city areas, slum areas, universities, and also nationwide. Dhaka city residents had a good knowledge and attitude toward the dengue disease. Besides, the Bangladeshi university students also had good knowledge of several aspects of dengue fever. Similar findings were revealed in several studies conducted in the big cities of Pakistan, Maldives, and India [44, 45]. However, rural community members in Bangladesh had moderate understanding and well knowledge of several preventive measures and inadequate practices toward dengue infection. Besides, insufficient awareness and knowledge about the preventive measures were also found in the slum dwellers. A study carried out in Tamil Nadu of India also revealed insufficient KAP toward the

dengue infection [46]. However, another study conducted in the rural areas of Yemen demonstrated good knowledge of several aspects of dengue infection [47]. Therefore, campaigns for practical, family-centered, and community-based health education must be designed to raise awareness of dengue and dispel and promote dengue prevention measures in Bangladesh's rural areas [35]. Actually, if the knowledge–practice gap is not closed, managing dengue and Aedes populations will become a significant challenge.

The main vector of dengue, *Aedes aegypti*, spreads easily due to several climate factors, including high humidity, rainfall, and temperatures. These factors aid in mosquito development, reproduction, and survival, which in turn promotes the dengue virus's cycle of transmission. Moreover, unchecked urbanization trends in crowded regions lead to greater human mobility, a major factor that increases the risk of dengue spreading [48, 49]. These factors have a great deal of promise to improve dengue control, vector management, and forecasting. Therefore, this scoping review thematically demonstrated the risk factors associated with the dengue outbreak in Bangladesh. Among four studies included in the present study for the evaluation of risk factors associated with dengue infection, three studies were conducted in Dhaka city. They found workplaces close to dengue-infected patients, being outside in the morning and evening, sleeping during the day,

TABLE 2 | Studies related to knowledge, attitude, and practice toward dengue infection in the Bangladeshi population.

Study	Primary aim of the study	Population and area	Major findings from the study
Banik et al. [35]	Assessing the level of knowledge, belief, and preventive practices related to dengue and its associated factors	Rural community members	• Moderate understanding of dengue. • Well on several preventive measures. • Overall practices were inadequate.
Rahman et al. [33]	Assessing how slum residents respond to dengue fever	Slum dwellers	Insufficient awareness and preventive measures.
Rahman et al. [19]	Assessing the KAP toward dengue fevers	University students	• Students had good knowledge about deadly consequences, typical signs, the role of female Aedes mosquitoes in the spread, and the recognition of these mosquitoes. • Participants showed preventive behaviors regarding DF.
Hossain et al. [34]	Analyze the socioeconomic aspects and knowledge, attitudes, and behaviors (KAP) regarding dengue.	Bangladeshi populations	• The majority of respondents knew about dengue infection and Aedes mosquitoes. • The degree of knowledge was somewhat higher than the level of preventive behaviors • They learned about dengue disease from TV/radio/newspapers/social media.
Bashar et al. [32]	Investigating knowledge, attitudes, and practices (KAP) regarding dengue disease and any possible associated factors	Dhaka city residents	• The majority of residents knew about dengue and its causes. • However, over half did not know much about the ecology and breeding seasons of mosquitoes. • Education and career were significantly correlated with dengue-preventative behaviors.
Abir et al. [31]	Evaluating the knowledge, attitudes, and behaviors (KAP) of the general public in Dhaka regarding dengue infection. It aims to comprehend patient viewpoints regarding dengue-related factors.	Dhaka city	• More than half of the people knew about dengue, and the majority of them took precautions and had a good attitude toward the disease. • There were differences in the knowledge, attitudes, and practices (KAP) addressing dengue between the Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) of Dhaka.

higher temperatures, monsoon season (particularly July to August, higher humidity), static water, junkyards, and indoor plants as the potential risk factors of dengue in the Dhaka city. Besides, a study conducted nationwide explored urbanization, population density, and also season of August to September as the risk factors of dengue spread in the Bangladeshi population. A study conducted in Nepal found that DF was associated with the risk factors of traveling to endemic areas; discarded waste containers, receptacles, and tires; uncovered water tanks; middle social class; and crowded households [50]. Therefore, it is essential to take some preventive measures to reduce the dengue infection in Bangladesh. The general public

in Bangladesh should be more aware of the environment as a crucial preventive measure and educated about Aedes mosquitoes and dengue fever through television and radio, as the mass media can spread health information more quickly. Additionally, for a dengue control program to be successful, education about dengue should be prioritized [34, 51]. Furthermore, to guarantee long-term behavioral changes for effective dengue prevention, ongoing monitoring and education should be carried out.

Dengue fever is caused by four major different serotypes (DENV-1–4). A single serotype infection produces long-term

TABLE 3 | Studies related to the risk factors of dengue infection in Bangladesh.

Studies	Primary aim of the study	Population and area	Major risk factors recorded from the studies
Rahman et al. [19]	Looking into possible risk factors for dengue infection.	Dhaka city	Living or working close to dengue-infected patients, being outside in the morning and evening, sleeping during the day, age of the home, number of family members, quality of the living space, static water, junkyards, and indoor plants.
Subarna and Saiyan [42]	Providing insights into the epidemiological traits, geographic distribution, and contributing factors of dengue.	Nationwide	Urbanization, population density, the season of August to September, and inequalities in the availability of hospital beds.
Hossain et al. [21]	Clarifying the connection between dengue disease incidence and weather-related factors.	Dhaka city	Higher temperature and humidity, monsoon season, higher wind speed, and less sunshine.
Ahmed et al. [40]	Investigating the seasonal prevalence of dengue.	Dhaka city	Wet season and months of July and August.

TABLE 4 | Studies represented the dengue serotype identified in the Bangladeshi population.

Study	Primary aim of the study	Study area	Dengue serotypes identified
Dhar-Chowdhury et al. [15]	Measuring seroprevalence and seroconversion rates to determine the level of DENV antibodies in the Dhaka population.	Dhaka city	The only flavivirus that was found to be circulating in Dhaka was DENV.
Rahim et al. [28]	Analyzing the genetic variation of dengue virus (DENV) in Dhaka's severe and non-severe cases.	Dhaka city	• DENV2 was the most common in 2018. • DENV3 emerged as the predominant serotype starting in 2019. • DENV3 was the only serotype in circulation between 2020 and 2022.
Sumon et al. [30]	Identifying serotypes in the Rajshahi district under endemic conditions.	Rajshahi district	DENV-1, DENV-2, and DENV-3 were found in different areas of Rajshahi district.
Muraduzzaman et al. [26]	Determining the circulating serotypes of dengue viruses in Bangladesh.	Nationwide	DENV-1, DENV-2, DENV-3, and DENV-4 were identified in different regions of Bangladesh between 2013 and 2016.
Rahim et al. [27]	Examining shifts in the dengue virus (DENV) serotypes that are currently in circulation in Dhaka City during a five-year span (2017–2021).	Dhaka city	• In 2017 DENV-2 dominated. • But in 2019 and 2021, DENV-3 took the lead.
Suzuki et al. [29]	Aiming to ascertain the nucleotide sequences of the envelope regions from DENV-positive patients between September 2017 and February 2018 to comprehend the present distribution of dengue virus (DENV) genotypes in Bangladesh.	Dhaka city	• DENV-1, DENV-2, and DENV-3 were identified between 2017 and 2018. • The previously prevalent DENV-3 genotype II has been replaced by DENV-3 genotype I. • Furthermore, two separate lineages of the DENV-2 cosmopolitan genotype were discovered, one of which was previously unreported in Bangladesh.

TABLE 5 | Clinical presentation, laboratory characteristics, and management and preventive behaviors of the Bangladeshi dengue patients identified in various studies.

Study	Primary aim of the study	Clinical manifestation identified from the studies
Hasan et al. [16]	Aiming to show the clinical presentation of the 2019 outbreak in Bangladesh.	Fever, diarrhea, anorexia, vomiting, abdominal pain, and hypotension.
Mahmood et al. [37]	Aiming to provide clinical and biochemical profiles of Bangladesh's dengue-infected patients in 2019.	Fever, diarrhea, skin rash and abdominal pain, breathing issues, and gum bleeding.
Sami et al. [39]	Assessing clinical profiles to find early changes that could indicate the level of severity of dengue fever.	Fever, nausea, vomiting, headache, joint pain, cough, dyspnea, and diarrhea.
Azad et al. [24]	Evaluating the clinical requirements for hospitalization, pinpointing the dengue fever risk groups, and examining the patterns of dengue fever presentation in hospital care.	• 3 types of dengue patients were identified by the study: dengue shock syndrome (DSS), dengue hemorrhagic fever (DHF-I and DHF-II), and classical dengue fever. • Profound weakness, headache, myalgia, anorexia, nausea, and vomiting were experienced by the majority of patients. • In some DSS patients, diarrhea, stomach discomfort, ascites, and pleural effusion were unusual but common. • Patients with DHF and DSS frequently experienced hemorrhagic symptoms, with melena being the most frequent.
Rouf et al. [17]	Focusing on the characteristics, treatment, as well as outcomes of patients with dengue shock syndrome (DSS) and expanded dengue syndrome (EDS).	• 62 of the 343 dengue patients experienced complications, resulting in 17 ICU admissions and 45 HDU admissions. Of these, 17 developed dengue shock syndrome (DSS) and 25 had expanded dengue syndrome (EDS). 42 patients had atypical presentations, 16 patients had coinfections, and 45 patients had comorbidities. In most cases (80%), digestive problems were present. Four of the EDS cases died. • For management, mechanical ventilation, tracheostomies, ionotropic support, decompressive dialysis, plasma exchange, laminectomy, and hematoma evacuation were identified.
Yang et al. [36]	Assessing the possible risk factors and determining how their interactions may affect the severity of dengue.	• Fever, muscle pain, vomiting, headaches, abdominal discomfort, back pain, and decreased appetite. • Patients with severe dengue were more likely to experience stomach pain. • Low platelet counts, low hemoglobin, low WBC, elevated ALT, and elevated AST.
Yesmin et al. [18]	Analyzing the clinical, laboratory, and epidemiological characteristics of dengue patients who were hospitalized during the outbreak in 2019.	• Fever, headaches, diarrhea, stomach discomfort, accumulation of fluid, and continuous vomiting. • Thrombocytopenia, leukopenia, and high hematocrit (HCT) levels. • Increased ALT/AST levels were often observed in laboratory results.

(Continues)

TABLE 5 | (Continued)

Study	Primary aim of the study	Clinical manifestation identified from the studies
Islam et al. [22]	Aiming to identify the evolving patterns of dengue and its various manifestations, including uncommon ones.	• Fever, vomiting, headaches, myalgia, stomach discomfort, rash, retro-orbital pain, hypotension, and low pulse pressure were the most frequently reported clinical symptoms. • Patients disclosed hypertension, diabetes, and menstruation- and pregnancy-related problems as comorbidities.
Hoque et al. [23]	This study attempts to characterize the clinical traits and findings of hospitalized cases of dengue fever.	• Fever, headache, myalgia, and regurgitation. • Petechiae, ecchymosis, gum bleeding, hematuria, melena, hematemesis, and epistaxis were among the hemorrhagic symptoms. • Hepatic dysfunction, renal failure, multiorgan failure, encephalopathy, and ARDS were the most frequent consequences.
Rafi et al. [38]	Assessing the clinical and laboratory characteristics of dengue patients in northern Bangladesh during the epidemic.	• Fever, vomiting, abdominal pain, and myalgia were the most common symptoms. • Hematological abnormalities such as thrombocytopenia, elevated hematocrit, and leukopenia were common. • Serum creatinine and ALT or AST levels were also elevated in dengue patients.
Aktar et al. [25]	Evaluating the cost of illness (COI) and clinical features and outcomes for dengue patients hospitalized in a government hospital in Chattogram.	• Fever, headache, myalgia, and nausea. • Leukopenia and thrombocytopenia were frequent hematological disorders.
Siddique et al. [20]	Providing important insights into young people's behavior around dengue infection by examining how they view the danger of dengue and their preventive activities.	• Differences in Dhaka residents' preventive measures were found. • Better preventive behaviors were linked to gender, education level, work position, and prior exposure to dengue.

immunity to that particular serotype but only temporary immunity to the other serotypes [52]. The reason behind this is unclear. When developing a vaccine against dengue fever, this phenomenon must be taken into account, and any potential vaccine should ideally produce long-term immunity against all four serotypes. Therefore, this review isolated the stereotypes found in the Bangladeshi population. This thematic study included six studies to explore the dengue virus's serotype diversity in Bangladesh. DENV-1, DENV-2, and DENV-3 serotypes were identified between 2017 and 2018 in Dhaka city. Similarly, DENV-1, DENV-2, and DENV-3 were found in different areas of Rajshahi district, Bangladesh. Though DENV-2 was the most common from 2017 to 2018 in Dhaka city, in 2019 and 2021, DENV-3 took the lead. It was the only serotype in circulation between 2020 and 2022. Moreover, DENV-1, DENV-2, DENV-3, and DENV-4 were also identified in different regions of Bangladesh between 2013 and 2016. All four serotypes were also identified in the Indian dengue patients [53]. However, another study conducted in Pakistan identified DENV-1 to DNV-3 as the most prevalent serotypes of dengue [54].

Furthermore, the present study found 12 studies conducted in Bangladesh to reveal the different aspects of clinical presentations, treatment and management, and laboratory characteristics of dengue screening in Bangladesh. Fever, weakness, headache, myalgia, diarrhea, anorexia, vomiting, nausea, abdominal pain, back pain, skin rash, breathing issues, joint pain, cough, gum bleeding, and hypotension were identified as the most common clinical manifestations of dengue in the Bangladeshi population. These clinical signs and symptoms were also identified as potential risk factors in patients from China, India, Yemen, Sri Lanka, and Pakistan [55–60]. Hematological abnormalities such as thrombocytopenia, elevated hematocrit, leukopenia, and low hemoglobin levels were determined as the most common indicators of dengue infection. Elevated levels of ALT and AST were also observed in the Bangladeshi dengue patients. A study conducted on the Chinese population also found hematological abnormalities and elevated levels of ALT and AST among the dengue patients [61].

As far as we are aware, this is the first thorough review of the scientific literature on dengue screening conducted in Bangladesh.

Although this review is comprehensive, it should be noted that it has certain limitations. One such limitation is the exclusion of studies published in languages other than English and in local journals that are not indexed, which may have led to the omission of some pertinent studies.

5 | Conclusion

Research on dengue investigation is still being conducted in Bangladesh. According to the results of this scoping review, there are a number of obstacles to dengue screening in Bangladesh, such as a lack of knowledge, a moderate level of understanding, and insufficient practices regarding dengue infection among slum dwellers and people of rural areas. Additionally, between 2017 and 2022, different dengue serotypes were the most common at different times. Therefore, it is essential to undertake several preventive measures to reduce the dengue infection and also understand the dengue serotypes. It will be crucial to address the obstacles with focused awareness campaigns to boost participation in dengue screening programs. Participation may also rise if community health workers are involved in providing screening services. The success of a dengue control program also depends on prioritizing dengue education. Furthermore, to guarantee long-term behavioral changes for effective dengue prevention, ongoing monitoring and education should be carried out. Furthermore, several interdisciplinary approaches involving urban planning and waste management (such as gasification, pyrolysis, compaction, and incineration) will be helpful in addressing the root causes of dengue proliferation.

Author Contributions

Shah Md Muztahid Hasan Chowdhury: investigation, writing – original draft, formal analysis, data curation, methodology, software. **Mohammad Abdur Rashid:** methodology, data curation, formal analysis, validation, investigation, writing – review and editing. **Samina Yesmin Trisha:** investigation, visualization, validation, writing – original draft, data curation, software. **Mohammed Ibrahim:** methodology, investigation, validation, visualization, formal analysis, writing – original draft. **Md. Shafiul Hossen:** conceptualization, methodology, writing – review and editing, supervision, validation, formal analysis, software.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.