Original Research Article

Distribution and analysis of suspected measles and rubella cases in Bangladesh

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ABSTRACT

Background: Measles and rubella remain significant public health concerns in the WHO Southeast Asia Region. Strengthening surveillance through technology-based systems in Bangladesh aims to enhance data accuracy, reporting efficiency, and timely response for effective disease control.
Methods: This retrospective cross-sectional study analyzed from January 2023 to December 2023 national surveillance data on suspected measles and rubella cases from all eight divisions of Bangladesh. Demographic, laboratory, and epidemiological data were extracted from the DGHS system. Serological testing (IgM ELISA) and PCR confirmation followed WHO protocols. Data were cleaned and analyzed using descriptive and correlation statistics to assess case distribution, confirmation rates, and regional variations.
Results: In 2023, Bangladesh reported 7,061 suspected measles cases, with the highest in Dhaka and Chittagong divisions. Of 6,309 samples tested, 3.4% were measles IgM positive and 2,295 rubella IgM positive, predominantly among children aged 5–14 years. Co-infection occurred in 13 cases. Confirmed measles and rubella incidences were 1.45 and 0.99 per million, respectively. Laboratories reported 98% of results within 4 days, and 98% of investigations were initiated within 48 hours, reflecting strong surveillance and response performance.
Conclusions: This study highlights the distribution and epidemiological trends of suspected measles and rubella cases across Bangladesh. The findings underscore ongoing transmission in certain regions and emphasize the need for strengthened surveillance, timely laboratory confirmation, and improved vaccination coverage to achieve and sustain measles and rubella elimination goals nationwide.

Keywords: Bangladesh, Epidemiology, Measles, Rubella, Surveillance

INTRODUCTION

Measles and rubella continue to pose substantial public health challenges globally. The World Health Organization (WHO) Southeast Asia Regional Office (SEARO) has set a goal to eliminate these diseases.[1] Both measles and rubella are highly infectious, with humans being the only known reservoir of the viruses. The elimination of these diseases relies heavily on robust surveillance programs and prompt responses to emerging cases or outbreaks.[2] Measles and rubella are significant causes of mortality among children worldwide, particularly affecting those of preschool and elementary school age. Surveillance data from WHO for the SEARO region, covering the period from 2017 to 2020, revealed

that the incidence of measles was 5.4% per 1,000,000 population, while the incidence of new rubella cases was 2.3% per 1,000,000 population.[3,4] Indonesia ranks as the second-highest country in the SEARO region for measles and rubella cases, following India. Between 2014 and 2018, the number of suspected and laboratory-confirmed cases of measles and rubella fluctuated, resulting in 22 deaths. Notably, 89% of measles cases and 77% of rubella cases occurred in children under the age of 15, with cases distributed across almost all regions of Indonesia.[5] Measles-rubella surveillance involves the continuous and systematic monitoring of these diseases, encompassing data collection, processing, analysis, interpretation, and dissemination to inform recommendations.[6] This surveillance is crucial for predicting outbreaks or extraordinary events (KLB/Kejadian Luar Biasa) by tracking trends in the incidence of measles. With advancements in information technology, traditional paper-based records have largely been replaced by electronic media, such as computers or smartphones, for documentation purposes.[7] The objective is to significantly improve the distribution and analysis of suspected measles and rubella cases in Bangladesh in 2023. This will be achieved by enhancing the efficiency, precision, and accuracy of the health information cycle. The aim is to implement a robust health information system that leverages modern technology to streamline the collection, transfer, and analysis of data. By utilizing an Android-based application, the system will effectively map the target population and manage logistics, ensuring timely and reliable data transfer. Additionally, the integration of a web-based platform accessible via laptops will support comprehensive tracking, reporting, and analysis through accurate data visualization. These advancements will not only maintain data integrity but also empower healthcare professionals with the tools needed for effective problem-solving and decision-making in the management of measles and rubella cases.

METHODS

This retrospective cross-sectional study analyzed suspected measles and rubella cases reported across Bangladesh from January, 2023 to December 2023, encompassing all eight administrative divisions Dhaka, Chittagong, Khulna, Rajshahi, Rangpur, Sylhet, Barisal, and Mymensingh to ensure comprehensive national representation from both rural and urban settings. Data were extracted from the national surveillance system of the Directorate General of Health Services (DGHS), which compiles reports from healthcare facilities nationwide. The dataset included demographic details, geographic information, laboratory findings, and epidemiological linkages for all suspected cases identified according to World Health Organization (WHO) clinical criteria for measles and rubella, characterized by fever, rash, and at least one of cough, coryza, or conjunctivitis. Serological testing for virus-specific IgM antibodies was performed using standardized enzyme-linked immunosorbent assay (ELISA) protocols at designated regional laboratories,

following WHO-recommended quality assurance procedures. A subset of samples underwent molecular confirmation through polymerase chain reaction (PCR) testing to detect viral RNA and ensure diagnostic precision. For laboratory-confirmed cases, detailed epidemiological investigations were conducted to identify infection sources, trace contacts, and determine vaccination status through structured interviews with patients, healthcare providers, and community informants. Complementary data on vaccination coverage and recent outbreak history were obtained from local health authorities to contextualize the findings. The study used anonymized, routinely collected surveillance data without direct participant involvement, thereby not requiring ethical approval or informed consent. Nonetheless, strict adherence to ethical principles was maintained, with all data handled in accordance with national data protection and confidentiality standards.

Inclusion criteria

All suspected measles and rubella cases reported to the Directorate General of Health Services (DGHS) national surveillance system from January to December 2023 were included if they met the World Health Organization (WHO) clinical case definition and originated from any of the eight administrative divisions of Bangladesh, encompassing both urban and rural settings.

Exclusion criteria

Cases reported outside the study period, not fulfilling the WHO clinical criteria, duplicate records, cases reported outside the DGHS surveillance system, and records with missing or incomplete essential information that precluded meaningful analysis were excluded.

Data were systematically cleaned, coded, and analyzed using statistical software to describe case distributions and explore epidemiological patterns. Descriptive statistics, including frequencies, proportions, means, standard deviations, and incidence rates, were calculated to summarize the characteristics of suspected and confirmed cases across the divisions. Correlation analysis was performed to examine the relationship between population size and the number of suspected cases, while regional comparisons were made to identify variations in disease burden. The proportion of laboratory-confirmed cases among total suspected cases was computed to assess diagnostic yield and surveillance performance. All analyses were stratified by division to visualize spatial trends and to support interpretation of the geographic distribution of measles and rubella cases across Bangladesh.

RESULTS

In 2023, Bangladesh reported 7,061 suspected measles cases, with the highest numbers in Dhaka (1,469) and Chittagong (1,253) divisions and the lowest in Barisal

(417) and Mymensingh (359). A strong positive correlation (r=0.876, p<0.01) was observed between population size and case numbers, indicating that more populous divisions reported more cases. The mean number of cases per division was 883±423, reflecting notable regional variation (Figure 1).
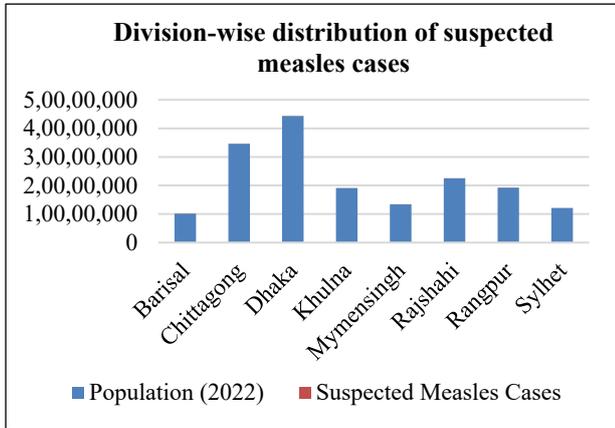

Figure 1: Division-wise distribution of suspected measles cases is illustrated.

6,309 suspected measles cases tested in Bangladesh, only 213 (3.38%) were laboratory confirmed and one clinically confirmed. Most confirmed cases occurred in Dhaka,

Chittagong, Khulna, and Rangpur divisions, with 42 epidemiologically linked cases clustered in Chandpur, Chittagong, indicating a localized outbreak requiring targeted intervention (Table 1).

Analysis of 6,309 specimens showed that rubella incidence varied significantly across age groups. The 5-14 years group accounted for most cases (1,310; 57.8%) and had the highest incidence, while infants (<1 year) also showed notable positivity despite smaller representation. No positive cases were detected among adults aged ≥45 years. ANOVA results (F=36,301.66, p ≈ 2.7e-38) confirmed a highly significant difference in rubella IgM positivity across age groups, indicating age as a key determinant of infection risk (Table 2).

In this table, 120 were laboratory-confirmed and 56 were confirmed through epidemiological linkage. A total of 5,963 cases were discarded after laboratory testing (case-based), while 653 were discarded without available samples, representing outbreak-based (OB) cases. Additionally, 13 cases tested positive for both measles and rubella, indicating co-infection. Overall, the majority of suspected cases were discarded following testing, while a smaller proportion were confirmed, reflecting the effectiveness of surveillance and laboratory screening in differentiating true rubella infections from other rash-fever illnesses (Table 3).

Table 1: The measles testing and confirmation efforts across various divisions are summarized.

Division	Tested for serology	Clinically confirmed measles	Laboratory confirmed measles	Epidemiologically confirmed measles
Barisal	411	0	14	0
Chittagong	1,015	0	42	42
Dhaka	1,361	0	45	0
Khulna	999	1	44	0
Mymensingh	359	0	19	0
Rajshahi	1,021	0	25	0
Rangpur	819	0	14	0
Sylhet	324	0	10	0
National	6,309	1	213	42

Table 2: Age group distribution of rubella IgM positivity and incidence rates.

Age group	Total specimens tested	Proportion (%)	Original rubella IgM positive	Incidence rate/ 100000 population
<1	541	8.58	118	63
1-4	1,381	21.91	685	367
5-14	3,647	57.80	1,310	703
15-44	724	11.47	182	98
≥45	16	0.22	0	0
Total	6,309	100	2,295	1,231

The table presents incidence rates for confirmed measles, rubella, and discarded non-measles/non-rubella cases. Confirmed measles cases show an incidence of 1.45 per million population, slightly higher than rubella at 0.99 per

million. Discarded non-measles/non-rubella cases and unconfirmed suspected measles cases have similar rates (3.77 and 3.87 per 100,000, respectively), indicating

consistency and reliability in case detection and reporting across surveillance categories (Table 4).

Table 3: The distribution of rubella cases.

Category	Count
Laboratory confirmed rubella	120
Epidemiologically confirmed rubella	56
Discarded with sample (case-based)	5,963
Discarded without sample (only OB cases)	653
Both positive cases	13

Table 4: The incidence rates of confirmed measles and rubella cases as well as discarded non-measles, non-rubella cases.

Category	Rate per million / 100,000 population
Annualized incidence of confirmed measles	1.45 per million
Annualized incidence of confirmed rubella	0.99 per million
Annualized discarded (non-measles, non-rubella) rate	3.77 per 100,000
Annualized incidence of non-measles suspected measles cases	3.87 per 100,000

Laboratories reported 98% of measles IgM results within 4 days, and 98% of suspected cases were investigated within 48 hours of notification, indicating efficient laboratory performance and prompt public health response (Table 5).

Table 5: The performance of laboratories in reporting measles IgM.

Category	Total/overall percentage
Number of serums result (measles IgM) reported by lab ≤ 4 days upon receipt	6,209
Percentage of serums result (measles IgM) by lab ≤4 days	98
Proportion of suspected cases with adequate investigation within 48 hours	98

DISCUSSION

The data on measles testing and confirmation in Bangladesh reveals critical insights into the disease's epidemiological landscape. Out of 6,309 suspected cases, only 213 were laboratory-confirmed, a low confirmation rate of 3.38%, suggesting that many suspected cases were due to other illnesses mimicking measles symptoms. The concentration of cases in divisions like Chittagong, Dhaka, Khulna, and Rangpur highlights potential regional disparities in healthcare access or reporting practices. The

clustering of epidemiologically confirmed cases in Chittagong's Chandpur district points to a possible localized outbreak, emphasizing the need for targeted public health interventions, such as vaccination campaigns and enhanced surveillance. This outbreak may reflect gaps in herd immunity, underlining the importance of maintaining high vaccination coverage to prevent the spread of measles. The single clinically confirmed case in Khulna further suggests the need for stringent criteria in diagnosing and reporting measles cases.

The study provides a critical examination of rubella cases in Bangladesh, focusing on the distribution of cases across various age groups and the methods employed for case confirmation. The analysis of 6,309 specimens, where the highest incidence was observed in the 5-14 years age group, underscores the vulnerability of this demographic to rubella infection. This finding aligns with other studies that highlight school-aged children as a key target group for rubella vaccination and prevention efforts.[8,9] The significant differences in rubella positivity across age groups, as revealed by the ANOVA test, suggest that age plays a crucial role in the epidemiology of rubella, which is consistent with the findings of Miller et al, who also identified age as a significant determinant in rubella transmission.[9]

The low confirmation rate of rubella cases, with only 120 out of 6,309 suspected cases being laboratory-confirmed, representing just 1.69% of total discarded cases, raises concerns about the efficacy of current diagnostic practices. Similar issues have been documented in other regions where surveillance systems have been found to be inadequate, resulting in underreporting and misclassification of rubella cases.[10] The presence of only 13 cases that met both laboratory and epidemiological confirmation criteria further emphasizes the need for improved diagnostic accuracy. In contrast to this study, other research has reported higher confirmation rates, suggesting that the disparities may be due to differences in surveillance infrastructure and diagnostic capacities.[11] The implications of these findings are significant, particularly in the context of public health interventions. The data underscores the necessity for enhanced surveillance systems and more accurate diagnostic methods to ensure that rubella cases are correctly identified and managed. Comparatively, other studies have also highlighted the importance of robust public health infrastructure in controlling rubella outbreaks, with particular emphasis on the integration of both laboratory and epidemiological data for more effective disease surveillance.[12]

The incidence rates for confirmed measles and rubella cases, as well as the rates for discarded non-measles, non-rubella cases, provide a comprehensive assessment of the surveillance and reporting systems in Bangladesh. The annualized incidence of confirmed measles cases stands at 1.45 per million population, slightly surpassing the 0.99 per million incidence rate for confirmed rubella cases. This difference may be indicative of several factors, including

variations in transmission dynamics, immunity levels, or differences in vaccination coverage between the two diseases. Studies by Kadjo et al have similarly noted that disparities in vaccination coverage and immunity can significantly influence the incidence of vaccine-preventable diseases like measles and rubella, particularly in regions where routine immunization programs face challenges.[13]

The close similarity between the rates for discarded non-measles, non-rubella cases (3.77 per 100,000) and suspected measles cases that were not confirmed as measles (3.87 per 100,000) suggests that the surveillance and reporting systems in Bangladesh are functioning with a high degree of reliability and consistency. This finding is crucial, as consistent and accurate reporting is essential for effective disease monitoring and timely public health responses, especially in resource-limited settings. Other researchers, such as Otani et al and Musa et al, have emphasized the importance of robust surveillance systems in accurately capturing the epidemiology of infectious diseases. Their work highlights how reliable data is pivotal for guiding public health interventions, reducing misclassification, and ensuring that disease control strategies are appropriately targeted.[14]

However, while the surveillance systems appear to be functioning well, the slightly higher incidence of measles compared to rubella raises questions about potential gaps in vaccination coverage or differences in public health outreach efforts. Comparative studies, like those conducted by Otani et al and Berman et al, have found that even small variations in vaccination program effectiveness can lead to noticeable differences in disease incidence. These studies suggest that a closer examination of the factors influencing vaccination coverage and public health outreach for both measles and rubella could provide further insights into how these diseases are being managed in Bangladesh.[15] In contrast, some regions with well-established vaccination programs have reported lower incidence rates for both measles and rubella, reflecting the success of sustained immunization efforts and robust public health infrastructure.[16] This contrast highlights the importance of continued investment in immunization programs and the need for adaptive strategies to address the unique challenges faced by different regions.

The laboratory performance in processing and reporting Measles IgM results in Bangladesh demonstrates a commendable level of efficiency, with 98% of serum samples being reported within four days of receipt. This rapid turnaround time is crucial for the timely management of suspected measles cases, enabling public health authorities to respond promptly and effectively. Timely reporting of diagnostic results is a cornerstone of infectious disease control, as it facilitates early intervention, limits transmission, and ultimately helps to contain outbreaks. This practice is well-aligned with global best practices, as highlighted by the World Health Organization (WHO), which emphasizes the importance

of rapid diagnostics in the effective management of infectious diseases (WHO, 2017).

Comparative studies have shown that the speed of diagnostic reporting can significantly impact the effectiveness of outbreak response. For instance, a study by Hossain et al in Germany found that faster reporting of measles IgM results led to more rapid implementation of control measures, reducing the spread of the virus during outbreaks. Similarly, a study by Kendall et al in South Korea highlighted that delays in laboratory reporting were associated with longer outbreak durations and higher case counts, underscoring the importance of timely diagnostics in outbreak control.[17,18]

In contrast, regions with slower reporting times have faced challenges in controlling measles outbreaks. For example, Babbage et al reported that in certain parts of sub-Saharan Africa, delays in laboratory processing and reporting contributed to prolonged outbreaks, as public health authorities were unable to implement timely control measures. These findings suggest that improving laboratory turnaround times should be a priority in regions where delays are still prevalent.[19]

The high efficiency observed in the Bangladeshi laboratory system could be attributed to several factors, including streamlined processes, adequate staffing, and the use of modern diagnostic technologies. This contrasts with findings from less resourced settings, where laboratories may struggle with insufficient personnel, outdated equipment, or logistical challenges that slow down the reporting process. The difference in performance highlights the critical role that investment in laboratory infrastructure and training plays in enhancing public health response capabilities.[20]

Moreover, the swift reporting in Bangladesh not only facilitates immediate response but also supports accurate surveillance data, which is essential for monitoring trends in measles incidence and evaluating the impact of vaccination programs. As highlighted by Kuddus et al, reliable and timely surveillance data are vital for informed decision-making and for guiding public health strategies aimed at measles elimination.[21]

Moreover, the data indicates that 98% of suspected cases had adequate investigations initiated within 48 hours of notification, reflecting a robust public health response system. This high level of compliance with investigation protocols underscores the commitment of the public health infrastructure in Bangladesh to managing and controlling measles outbreaks. Prompt investigation is a critical component of effective outbreak management, enabling the rapid identification and isolation of cases, as well as the implementation of appropriate control measures.

When compared to other regions, Bangladesh's performance in laboratory processing and public health response appears commendable. For instance, in some

low- and middle-income countries, delays in laboratory reporting and inadequate investigation timelines have been identified as significant barriers to effective disease control. The high compliance rates in Bangladesh, therefore, highlight the country's progress in strengthening its public health infrastructure, particularly in the context of measles surveillance.

This study has few limitations. Possible underreporting, regional differences in testing capacity, and reliance on self-reported vaccination data may have affected accuracy, though overall findings remain robust.

CONCLUSION

This comprehensive analysis highlights the distribution and incidence of suspected measles and rubella cases across Bangladesh, emphasizing the role of population density, localized outbreaks, and the effectiveness of laboratory and public health responses. Further research is needed to explore the underlying factors contributing to the observed trends, such as healthcare access, vaccination coverage, and mobility patterns within the population.

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