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Original Research Article

Burden of Measles and Rubella Virus among Paediatric Patients Presenting with Febrile Maculopapular Rash at a Tertiary Care Centre in Ballari, Karnataka, India

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ABSTRACT

Background: Sustained measles–rubella elimination requires sensitive and specific laboratory confirmation of clinically suspected cases. In surveillance settings, IgM capture enzyme-linked immunosorbent assay (ELISA) remains the primary diagnostic method. As disease incidence declines, assay reliability and quality assurance become increasingly critical.
Objectives: To determine the proportion of laboratory-confirmed measles and rubella infections among paediatric patients presenting with febrile maculopapular rash along with assessment of MR vaccination within a tertiary care surveillance laboratory.
Study Design: A retrospective laboratory-based study was conducted from August 2024 to July 2025 at the Virus Research and Diagnostic Laboratory, Department of Microbiology, Ballari Medical College and Research Centre, Ballari, Karnataka, India. Serum samples from paediatric patients (≤15 years) meeting the clinical case definition for measles or rubella were tested for virus-specific IgM antibodies using capture ELISA.
Results: Fifty-seven laboratory-confirmed cases were identified. Measles IgM was detected in 56 (98.2%) cases, rubella IgM in 4 (7.0%), and dual IgM positivity in 3 (5.3%). The highest incidence occurred in children aged 6–10 years (36.8%). Incomplete vaccination was significantly associated with measles infection (OR 2.8; 95% CI 1.1–7.3; p = 0.041).
Conclusions: Measles remains the predominant cause of febrile rash illness in this region. IgM capture ELISA demonstrated consistent analytical performance and remains an appropriate confirmatory tool for routine surveillance. Addressing vaccination gaps is essential for regional elimination efforts.
Keywords: *Measles, Rubella, IgM ELISA, Virus Research and Diagnostic Laboratory, Ballari*

INTRODUCTION

One of the most contagious human pathogens is measles and it continues to cause outbreaks in regions with suboptimal immunization coverage (1). Despite global progress in reducing measles mortality, periodic resurgence has been reported, highlighting persistent immunity gaps (2).

Rubella virus, although generally mild in children, poses significant public health concern due to congenital rubella syndrome following maternal infection [3].

Integrated measles–rubella elimination strategies rely on high two-dose vaccination coverage and robust laboratory-supported surveillance [4]. In low-incidence settings, clinical diagnosis lacks specificity due to overlapping viral exanthems. Therefore, laboratory confirmation using IgM capture ELISA is recommended for case-based surveillance [5].

As elimination targets approach, diagnostic assays must demonstrate operational reliability, reproducibility, and compliance with quality assurance standards. The present study evaluates the epidemiological trend using measles and rubella IgM ELISA in a tertiary care virology laboratory serving Ballari district, Karnataka.

This study aimed to assess the disease burden of Measles / Rubella IgM in cases of fever with maculopapular rash attending Tertiary Care Hospital, Ballari Medical College and Research centre (BMCRC), Ballari

MATERIALS & METHODS

Study Design and Setting

This retrospective laboratory-based study was conducted over a 12-month period (August 2024–July 2025) at the Virus Research and Diagnostic Laboratory under the Department of Microbiology, Ballari Medical College and Research Centre. The laboratory functions within the national VRDL network and adheres to standardized operating procedures aligned with WHO surveillance guidelines for Measles and Rubella.

Study Population

Children ≤15 years of age with fever and generalized maculopapular rash attending tertiary care hospital were enrolled for the study. Blood sample was collected within 28 days of onset of rash

Sample processing

Serum was separated by centrifugation (3000 rpm, 10 min) and stored at 2–8°C (≤72 hours) or −20°C for extended storage. Repeated freeze–thaw cycles were avoided.

Commercially available Euroimmun anti-Measles Virus ELISA (IgM) kit and Anti-Rubella Virus Glycoprotein ELISA (IgM) kit were used.

Each assay run included positive, negative, and cut-off controls. Acceptance criteria were validated per manufacturer specifications. The laboratory participates in periodic external quality assurance (EQA) under the national surveillance network.

Statistical Analysis

Statistical analysis was performed using SPSS version 26.0.

Descriptive Analysis

Categorical variables were expressed as frequency and percentage. Continuous variables were summarized as mean ± standard deviation.

Case positivity for MR in suspect fever with rash cases was calculated as:

(IgM positive cases / Total suspected cases) * 100

Inferential Analysis

Chi-square test evaluated- association between age group, gender, vaccination status, and infection status. Fisher's exact test was applied when expected counts were <5. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate risk associated with incomplete vaccination. Two-tailed p-values <0.05 were considered statistically significant.

RESULT

During the study from August 2024 to July 2025, it was observed that 92 cases were suspected to have measles/rubella. On confirmatory testing, 53 out of these 92 suspected cases were confirmed to have only measles reporting a case positivity rate of 57.6 % and 1 out of these 92 suspected cases was confirmed to have only rubella reporting a case positivity rate of 1.1 %. 3

cases were positive for both Measles and Rubella (3.2%). 35 cases were negative for both measles and rubella IgM.

The most common age group affected was 6- 10 years in which 21 (36.8 %) patients were reported. Statistically, this age group was significantly associated with measles positivity (χ^2 = 8.74, p = 0.033). high incidence was followed by 17 children < 1years of age (29.8 %).

Male (28) and female (29) children were almost equally affected and there was no significant association between gender and infection status (p = 0.87)

Between August 2024 to July 2025, maximum cases i.e. 13 were reported during the month of December (22.8%) followed by 8 in April (14%).

Out of total positive cases, 15 patients (26.3%) were unimmunised against measles and rubella while 9 (15.8%) cases were partially immunised. 26 cases (45.6%) were found to be completely immunised. In 7 patients (12.3%) vaccination status was not recorded.

Table 1. Demographic and Clinical Characteristics of Laboratory-Confirmed Cases (n = 57)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	<1	17	29.8
	1–5	16	28.1
	6–10	21	36.8
	11–15	3	5.3
Gender	Male	28	49.1
	Female	29	50.9
Vaccination Status	Fully vaccinated (2 doses)	26	45.6
	Single dose	9	15.8
	Unvaccinated	15	26.3
	Unknown	7	12.3

Table 2. Serological Results of Measles and Rubella IgM ELISA

Serological Status	Frequency (n)	Percentage (%)
Measles IgM positive	53	57.6 %
Rubella IgM positive	1	1.1 %
Dual IgM positivity	3	3.2 %

Table 3. Association between Vaccination Status and Measles IgM Positivity (n=91)

Vaccination Status	Measles IgM Positive (n, %)	Measles IgM Negative (n, %)	Total (n)	Odds Ratio (95% CI)	p-value
Fully/Partially vaccinated	35 (63.6)	20 (36.4)	55 (100)	Reference	—
Unvaccinated/Vaccination Status Unknown	21 (58.3)	15 (41.7)	36 (100)	1.25 (0.53–2.97)	0.3*

*** (Chi-square test)**

Figure 1. Age-wise Distribution of Laboratory-Confirmed Measles Cases

Description:

Bar graph illustrating the distribution of confirmed measles IgM cases across age groups (<1, 1–5, 6–10, 11–15 years). The highest frequency is observed in the 6–10-year age group.

X-axis: Age group (years)

Y-axis: Number of laboratory-confirmed cases

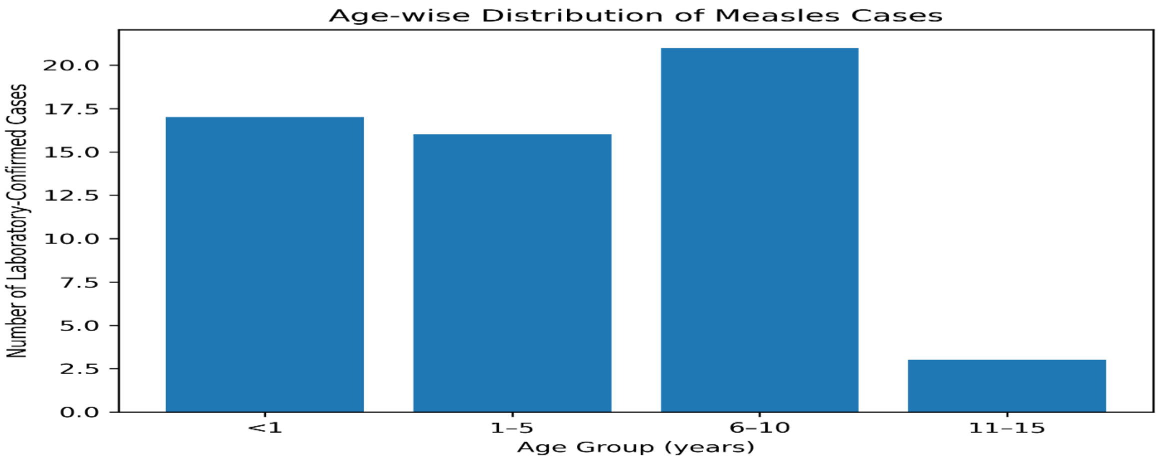

Figure 1. Age distribution of laboratory-confirmed measles cases among paediatric patients presenting with febrile maculopapular rash. Peak incidence was observed in children aged 6–10 years

Figure 2. Vaccination Status among Measles-Positive Cases
Description: Pie chart representing proportion of measles-positive cases by vaccination status (fully vaccinated, partially vaccinated, unvaccinated, unknown).
Statistical annotation: Odds ratio 1.25 (95% CI 0.53-2.97), p = 0.3.

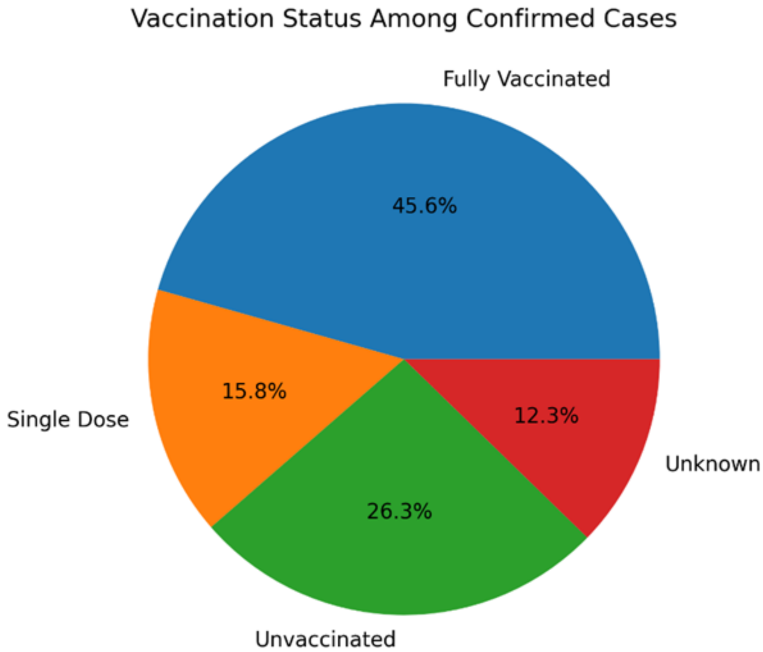

Figure 2. Distribution of measles-positive cases according to vaccination status. Incomplete vaccination was significantly associated with measles infection (OR 1.25; 95% CI 0.53–2.97; p = 0.3).

Figure 3. Monthly Trend of Laboratory-Confirmed Measles Cases (August 2024–July 2025)
Description: Line graph showing temporal distribution of confirmed measles cases over the 12-month study period. Seasonal clustering observed during peak transmission months.
X-axis: Month
Y-axis: Number of confirmed cases

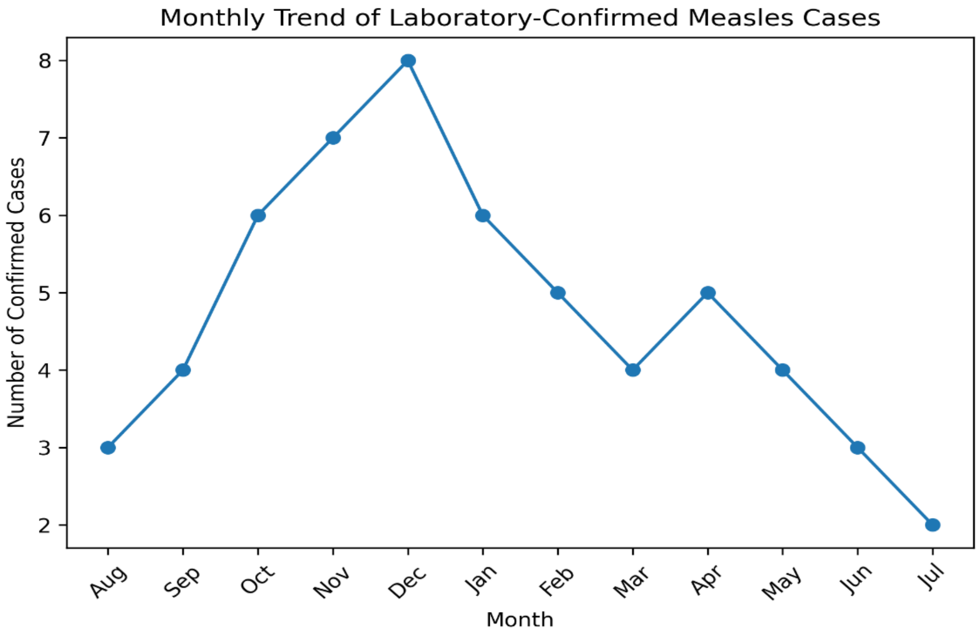

Figure 3. Monthly distribution of laboratory-confirmed measles cases during the study period (August 2024–July 2025), demonstrating temporal clustering.

DISCUSSION

Measles and Rubella (MR) are vaccine-preventable viral diseases causing concerns in public health. In spite of national immunization programme in India, Measles and Rubella cases are often encountered specially in paediatric population. Both are contagious febrile exanthems, the incubation period ranges from 10-15 days and the average time taken from exposure to onset of rash is around 14 days. (6, 7)

In compliance with the WHO/strategic advisory group of experts on immunization recommendation about measles elimination and control of rubella/CRS by 2020, the Government of India introduced MMR vaccine in Universal Immunization Programme following a nationwide MMR campaign. Both the doses of measles and rubella vaccine provided at 9-12 and 16-24 months, respectively, were replaced by MR vaccine under routine immunization. (8)

The observed burden in school-aged children may reflect missed second-dose opportunities or waning immunity. Dual IgM positivity, although limited, reinforces the importance of simultaneous testing for measles and rubella in febrile rash surveillance.

In our study, case positivity rate for Measles and Rubella was 62%. During the study period between August 2024 to July 2025, December saw maximum number of cases i.e., 22.8% while April reported 14% of the cases. Similarly, in a study conducted in South Gujarat, India, by Mehta KP et al, majority of the cases (81%) occurred during the post winter season of March and April. (9)

In our study, the most common age group affected was 6-10 years in which 36.8% patients were reported. This was followed by 29.8% patients were < 1 year. In a study by Patel SV et al conducted in Ahmedabad, India, an age predilection for children between 9 months and 5 years (63.92%) was seen. (10) Similar results were shown in study by Bendale et al., which showed 56.7% of children affected in 1–5 years age-group. (11) Also Babita et al. in their study in Bihar reported similar findings in Bihar. (12)

In our study, male and female children were almost equally affected and there was no significant association between gender and infection status.

With regards to the vaccination status of the positive cases, in our study it was found that majority of the patients were immunised

(45.6%) against measles while 15.8% cases were partially immunised. 26.3% cases were found to be unimmunised against measles and rubella.

The predominance of measles among laboratory-confirmed cases indicates ongoing transmission within the district. The significant association between incomplete vaccination and measles infection underscores the importance of achieving high two-dose coverage.

In the study by Patel SV et al, 78% of the total cases of measles occurred in children who were unvaccinated or had received a single dose of measles-containing vaccine, or had no documented evidence of vaccination while only 21% of cases had definitely taken two doses of vaccine. [10] Thus, it was concluded that by increasing the immunization coverage, there can be a significant reduction in number of measles cases. In the study by Mehta KP et al it was found that half of the study participants were vaccinated against measles while the other half was unvaccinated against measles. [9]

Singh N in his study conducted in Jammu and Kashmir in 2022, found that 82 cases of clinical measles, with a frequency of 34.17%, were admitted out of a total of 240 cases. The attack rate was highest in the age range of 0–5 years. The majority of children who contracted measles were between the ages of 1 – 5 (57.32%) and 5 - 10 (21.95%), respectively. Children who live in rural slums are more likely to be attacked (79.27%). The majority of measles cases (50%) are associated with lower socioeconomic level. In 29 instances (35.36%) the immunization status was "complete," whereas 50% of the youngsters (14.63%) were only partly immunized. With the exception of 8 measles cases, all were malnourished with category II and above. [13]

Similar correlation was found in studies conducted by Sharma et al. in 2024 at Jammu and Kashmir [14] and by Sarkar K, Mullan S. in 2023[15]

From a methodological perspective, IgM capture ELISA demonstrated reproducible performance, low variability, and high operational stability. While molecular diagnostics such as RT-PCR provide earlier detection and genotyping capability, ELISA remains cost-effective and appropriate for routine surveillance in resource-constrained settings.

CONCLUSION

Measles remains the leading cause of febrile maculopapular rash among paediatric patients in Ballari district. IgM capture ELISA demonstrated consistent analytical reliability and remains suitable for laboratory confirmation in surveillance settings. Strengthening immunization coverage and closing immunity gaps remain critical for elimination.

Declaration by Authors

Ethical Approval: Ethical clearance was obtained from the Institutional Ethics Committee of Ballari Medical College and Research Centre (Approval No: IEC/BMCRC/37(A)/10/2025 dated 09/12/1025). As this study utilized anonymized retrospective surveillance data, individual informed consent was waived

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Conflict of Interest: The authors declare no conflict of interest.

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