

Clinical and Demographic Characteristics of Hospitalized Pediatric Measles Cases; The 2023 Outbreak in Northern Jordan

Jomana W Alsulaiman¹, Khalid A Kheirallah², Ahmad Alrawashdeh³, Ziydoun Abu Sanad⁴, Asma'a M Al-Mnayyis⁵, Ahmed Yassin⁶, Mohammad Issa Rawabdeh³, Hamed Alzoubi⁷

¹Department of Pediatrics, Faculty of Medicine, Yarmouk University, Irbid, Jordan; ²Department of Public Health, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan; ³Department of Allied Medical Sciences, Jordan University of Science and Technology, Irbid, Jordan; ⁴Department of Pediatrics, Princess Rahma Pediatric Teaching Hospital, Irbid, Jordan; ⁵Department of Radiology, Faculty of Medicine, Yarmouk University, Irbid, Jordan; ⁶Department of Neurology, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan; ⁷Department of Pathology and Microbiology, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan

Correspondence: Khalid A Kheirallah, Department of Public Health, Faculty of Medicine, Jordan University of Science and Technology, P.O. Box 3030, Irbid, 22110, Jordan, Email kkheiral@gmail.com

Background: Measles remains a leading vaccine-preventable cause of childhood morbidity and mortality globally. Despite immunization efforts, outbreaks persist, including a 2023 outbreak in Irbid, Jordan.

Objective: To describe the clinical, demographic, and vaccination characteristics of pediatric measles patients hospitalized during the 2023 Irbid outbreak and assess complications and outcomes.

Methods: A retrospective observational study included all children (0–14 years) hospitalized with laboratory-confirmed measles at Princess Rahma Pediatric Hospital, Irbid, from April to December 2023. Data on demographics, vaccination status, symptoms, complications, management, and outcomes were analyzed using descriptive statistics and comparisons between vaccinated/unvaccinated groups.

Results: Of 63 hospitalized children, 61.9% were under one year old, and 49.2% were male. Most (63.5%) were unvaccinated; 47.6% of these were ineligible due to age (<9 months). Among eligible children (≥9 months), 27.2% were fully vaccinated, 42.5% under-vaccinated, and 30.3% unvaccinated. Fever (95.2%) and rash (96.8%) were the most common symptoms. Pulmonary complications affected 68.3% (bronchopneumonia: 55.5%; pneumonia: 12.7%). Dehydration (34.9%) and gastrointestinal symptoms (vomiting: 30.1%; diarrhea: 28.5%) were frequent. One unvaccinated 7-month-old infant died from measles-associated pneumonia. Vitamin A was administered to all patients, and 82.5% received empirical antibiotics. The average hospital stay was 4.4 days.

Conclusion: The measles outbreak in Northern Jordan predominantly affected unvaccinated children, particularly those under nine months of age. While vaccination reduced the risk of severe complications (eg, pneumonia occurred in 75% of unvaccinated vs 25% of vaccinated cases), breakthrough infections in vaccinated children underscore the need for optimized immunization strategies. Respiratory complications, including pneumonia, were the leading cause of hospitalization and mortality, highlighting the vaccine's critical role in mitigating disease severity. Strengthening vaccination coverage and revisiting age-specific policies in high-risk regions remain essential to reduce measles-related morbidity and mortality.

Keywords: measles, pediatrics, outbreak, vaccination, Jordan, respiratory complications

Introduction

Measles infection remains a significant vaccine-preventable cause of morbidity and mortality among children worldwide.¹ The widespread use of effective vaccines through routine immunization programs has led to a substantial decline in measles incidence and mortality over the past two decades.^{2,3} Improvements in nutritional and socioeconomic conditions, along with better access to healthcare services, have also contributed to reducing the measles burden.⁴ However, measles outbreaks are still not uncommon around the world.^{5–9}

This highly contagious airborne disease is caused by infection with the measles virus, a member of the genus *Morbillivirus* in the family *Paramyxoviridae*, and is transmitted via the respiratory route.¹⁰ Infection with the measles virus can result in a spectrum of clinical presentations. Immunocompetent patients typically exhibit the classical symptoms of an acute febrile illness and exanthem, while those with pre-existing but incomplete immunity against measles may develop a milder illness.¹¹

The typical symptoms of measles usually appear seven to ten days after exposure and commonly include fever, skin rash, and at least one of the following: cough, coryza, and conjunctivitis.¹² The distinctive measles rash is red and maculopapular, initially appearing on the face and behind the ears before descending to the neck, trunk, and rest of the body.¹³ Numerous complications have been reported in association with measles infection, including respiratory complications such as bronchopneumonia, laryngotracheobronchitis, bronchiolitis, and otitis media; gastrointestinal complications like gingivostomatitis, gastroenteritis, and hepatitis; neurologic complications such as acute encephalitis; and secondary bacterial infections.^{12,14–16} Delayed complications might occur months to years later, including subacute sclerosing panencephalitis (SSPE) and immune amnesia, resulting in recurrent infections and chronic conditions like bronchiectasis.^{17,18}

The National Jordanian Immunization Program was established in June 1979. In 1982, the first dose of the measles vaccine was introduced at nine months of age. The second dose, previously given as a standalone measles vaccine at 18 months, was later replaced with the measles, mumps, and rubella (MMR) vaccine. In 2008, an additional dose of the MMR vaccine was introduced at 12 months of age.¹⁹ According to WHO/UNICEF Joint Reporting Form data, Jordan achieved high measles vaccination coverage rates prior to the pandemic, with 95% of children receiving one dose of a measles-containing vaccine in 2020. However, the onset of the COVID-19 pandemic disrupted routine immunization services, leading to a significant drop in measles vaccine coverage to 76.5% in 2020 due to lockdowns and resource reallocation.²⁰

Globally, the pandemic had a profound impact on measles epidemiology. Disruptions in vaccination campaigns, suspension of outreach activities, and reduced healthcare-seeking behavior during lockdowns contributed to declining measles vaccination rates in many countries.²¹ For example, a modeling study estimated that 22.7 million children missed their first dose of the measles vaccine in 2020, representing a 7% decline in global coverage compared to pre-pandemic levels.²² These gaps in vaccination coverage created pockets of susceptibility, increasing the risk of measles outbreaks in both low- and high-income settings. Regions affected by conflict, displacement, and economic instability were particularly vulnerable. For instance, Lebanon experienced a significant measles outbreak in 2023, with 262 reported cases, 146 of which were laboratory-confirmed. The attack rate was highest among children under five years of age, and a significant portion (77%) of confirmed cases were unvaccinated.⁶ Similarly, other regions affected by war and displacement, such as Syria and neighboring countries, reported increases in measles cases post-pandemic.^{7,8}

In 2023, Jordan faced a measles outbreak, with 179 cases reported across seven of its 12 governorates. More than half of these cases were localized in the Irbid governorate, located in northern Jordan. Of these, 63 cases (64.9%) were admitted to Princess Rahma Pediatric Hospital.²⁰

This study aims to describe the clinical and demographic characteristics of pediatric measles patients admitted to Princess Rahma Pediatric Hospital during the 2023 outbreak in Irbid, Jordan. We also report on patients' vaccination status, length of hospital stay, outcomes, complications, and laboratory findings. The results are expected to enhance our understanding of the clinical profile of the illness, its severity, impact, and burden, providing evidence-based recommendations to healthcare authorities to prevent future measles outbreaks.

Methods

Study Design and Setting

We conducted a retrospective observational study of all pediatric patients with laboratory-confirmed measles who were hospitalized at Princess Rahma Pediatric Hospital in Irbid, Jordan, during the measles outbreak from April 2023 to December 2023. Princess Rahma Pediatric Hospital is a tertiary care public healthcare facility serving the northern region of Jordan and provides specialized pediatric care to children.

Participants

The study included all children aged 0 to 14 years who were admitted with a diagnosis of measles confirmed by positive measles-specific IgM antibodies during the study period. There was no exclusion criteria applied, ensuring that all eligible cases were included in the analysis.

Data Collection

Data were collected retrospectively from patients' electronic medical records using a standardized data collection form. The information extracted encompassed demographic data (age, sex, weight, and presence of any comorbidities) and vaccination status, which included the number of measles vaccine doses received based on vaccination records or caregiver reports. Clinical manifestations at presentation, such as fever, skin rash, cough, coryza, conjunctivitis, and other notable signs, were documented. Laboratory findings, including complete blood count, liver function tests, and results of measles-specific IgM antibody testing, were recorded. Radiological imaging findings, particularly chest X-rays and other relevant imaging studies, were reviewed.

The course of management for each patient was detailed, noting treatments administered, including vitamin A supplementation and antimicrobial therapy. Any reported complications, such as respiratory issues, dehydration, gastrointestinal symptoms, or neurologic involvement, were carefully documented. Outcomes were assessed based on the length of hospitalization, need for intensive care unit admission, and patient outcomes, including recovery or death.

Statistical Analysis

Data was entered into a secure database and analyzed using SPSS statistical software. Descriptive statistics were used to summarize the data. Continuous variables were expressed as means and standard deviations (SDs) and median. Categorical variables were presented as frequencies and percentages.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board at Jordan Ministry of Health (MOH/REC/2023/209). The requirement for informed consent was waived due to the retrospective nature of the study and the use of anonymized data. Patient confidentiality was maintained by removing personal identifiers during data extraction and analysis, ensuring that individual patients could not be identified. The conduct of this study was in compliance with the Declaration of Helsinki.

Data Availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and privacy considerations.

Patient and Public Involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of this research due to the retrospective study design.

Results

Demographic Characteristics

During the study period, a total of 63 children with laboratory-confirmed measles were admitted to Princess Rahma Pediatric hospital. Measles infection was confirmed in all children through positive IgM antibody testing. None of the admitted cases had previous underlying illnesses or comorbidities. Most cases were admitted during the months of May ($n=20$, 31.7%) and June ($n=23$, 36.5%). The number of admissions decreased significantly after August (Table 1).

The cohort included a total of 63 admitted, laboratory confirmed, measles cases. Of which, 31 cases were boys (49.2%) and 32 girls (50.8%), resulting in, approximately, 1 to 1 gender ratio. Patients' ages ranged from 17 days to 8 years, with the most cases (61.9%) being under one year of age (Table 2).

Table 1 Distribution of Admitted Pediatric Measles Cases by Month During 2023 (N=63)

Month	n (%)
January	0
February	0
March	0
April	2 (3.2%)
May	20 (31.7%)
June	23 (36.5%)
July	11 (17.5%)
August	6 (9.5%)
September	1 (1.6%)
October	0
November	0
December	0
Total	63 (100%)

Table 2 Distribution of Admitted Measles Cases by Age, Gender, and Clinical Features

	Number of Measles cases	Percent
Age		
<9 months	30	47.6%
9–24 months	23	36.5%
> 2–8 years	10	15.9%
Gender		
Males	31	49.2%
Females	32	50.8%
Clinical feature		
Fever	60	95.2%
Skin rash	61	96.8%
Cough	43	68.3%
Coryza	34	53.9%
Conjunctivitis	24	38.1%
Vomiting	19	30.1%
Diarrhea	18	28.5%
Cervical Lymphadenopathy	23	36.5%

Vaccination Status

Out of the 63 admitted measles cases, 63.5% (n=40) did not receive any dose of a measles-containing vaccine. Among unvaccinated patients, 47.6% (n=30) were younger than nine months and thus not eligible for measles vaccination according to the national immunization schedule. Eight (12.7%) cases had received a single dose of the vaccine, while the remaining 15 (23.8%) cases received two (n=6) or three (n=9) doses. Only 27.2% of all vaccine eligible children were fully vaccinated, 42.5% were under vaccinated, compared to 30.3% who were unvaccinated. Detailed vaccination status by age groups is presented in [Table 3](#).

Table 3 Vaccination Status and Number of Doses by Age Groups (N=63)

	Age			
	<9 months n (%)	9–18 months n (%)	>18 months to 5 years n (%)	>5 years n (%)
Not immunized	30 (47.6%)	7 (41.2%)	3 (23.0%)	0 (0.0%)
1 dose	Not eligible	8 (47.0%)	0 (0.0%)	0 (0.0%)
2 doses	Not eligible	2 (11.8%)	4 (30.8%)	0 (0.0%)
3 doses	Not eligible	0 (0.0%)	6 (46.2%)	3 (100%)
Total	30 (100%)	17 (100%)	13 (100%)	3 (100%)

Clinical Presentations

The most common presenting clinical symptoms were skin rash (n= 61, 96.8%) and fever (n=60, 95.2%). The typical maculopapular rash on the face and behind the ears that descended to the trunk and/or limbs was observed in all the children who were presented with skin rash. Three patients did not present with typical symptoms: two infants (aged 8 weeks and 8 months) had no documented fever, one 7-month-old infant did not exhibit a measles rash, and one fully vaccinated 3-year-old child had neither fever nor rash.

Duration of fever through the course of illness ranged from 1 to 14 days, and the median duration of fever before appearance of rash was two days (Mean (SD) = 2.47 (1.68) days). Rash appeared within one day of onset of fever in 21 (33.3%) cases and within four days in 49 (77.8%) cases. In seven cases, the rash appeared between the fifth and ninth day of fever.

As described in Table 2, other symptoms included cough (n=43, 68.2%), coryza (n=34, 53.9%), conjunctivitis (n=24, 38%), and cervical lymphadenopathy (n=24, 38%). Koplik spots were not observed in any of the patients.

Complications and Outcomes

Average duration of hospitalization was 4.4 days (range: 1–14 days), with no significant differences attributed to the vaccination status. A one-month-old infant, born prematurely at 35 weeks of gestation, was admitted to the neonatal intensive care unit (NICU) due to respiratory distress and was diagnosed with bronchopneumonia. Five children required admission to the pediatric intensive care unit (PICU), three of them due to severe respiratory distress and pneumonia, one with hepatitis due to hypoglycemia and dehydration, and one due to encephalitis. Vitamin A was given to all patients, and antimicrobial treatment was administered to 52 (82.5%) patients.

Pulmonary complications were the most frequent (n=43, 68.3%), including bronchopneumonia (n=35) and pneumonia (n=8). Within the group of eight patients who developed pneumonia, all were below the age of two years, and five were infants under nine months of age. Six of these patients were unvaccinated, one had received one dose, and one had received two doses. Figure 1A shows the chest X-ray of a 7-month-old female patient with pneumonia, revealing thickened and blurry pulmonary markings in both lung fields, with a patchy area of consolidation in the right upper lung. Figure 1B shows the chest X-ray of a 22-month-old female patient diagnosed with bronchopneumonia, demonstrating thickened and blurry pulmonary markings in both lungs with reticular shadows, more evident on the right side, and small patches of blurry shadows in the right lower zone and hilum. Figure 1C shows the chest X-ray of a 2-year-old male patient with pneumonia, displaying an area of consolidation in the right upper lung. One death was reported for a 7-month-old infant who succumbed to measles-associated pneumonia (Figure 1D), where the chest X-ray showed right upper zone consolidation with an air-bronchogram and right hilar lymphadenopathy. Oxygen therapy was required in four cases who were diagnosed with bronchopneumonia or pneumonia.

Dehydration was observed in 22 patients (34.9%), with hyponatremia occurring in three of these cases. Gastrointestinal symptoms, such as vomiting and diarrhea, were reported in 19 (30.1%) and 18 (28.5%) patients, respectively. Malnutrition was observed in nine patients, with weights below the 5th percentile for age, and in 14 patients (22.2%) weight was between the 5th and 10th percentiles.

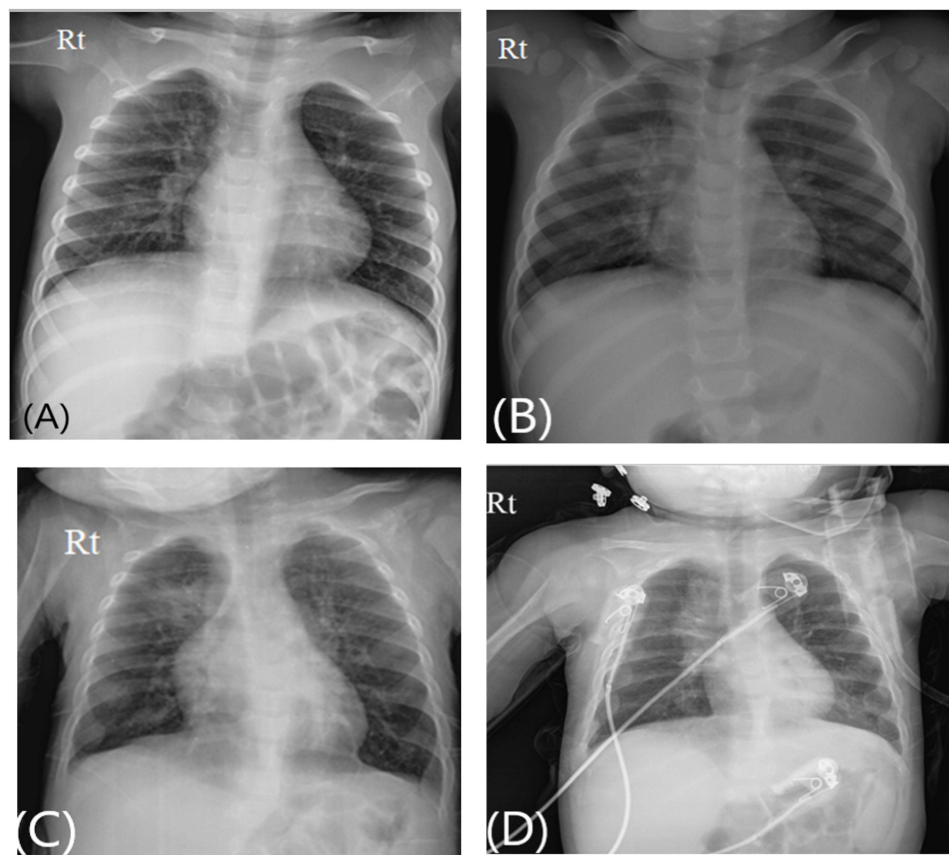


Figure 1 Radiological presentation of selected pediatric measles cases. (A) A 22-month-old female patient; Chest X-ray: Bronchopneumonia. Thickened and blurry pulmonary markings in both lungs with reticular shadows, more evident on the right side. Small patches of blurry shadows in the right lower zone and hilum. (B) A 2-year-old male patient; Chest X-ray: Pneumonia. Area of consolidation in the right upper lung. (C) A 7-month-old female patient; Chest X-ray: Pneumonia. Thickened and blurry pulmonary markings in both lung fields, with patchy area of consolidation in the right upper lung. (D) A 7-month-old male patient (death), Chest X-ray: right upper zone consolidation with air-bronchogram, and right hilar lymphadenopathy.

Alpha-hemolytic streptococcal bacteremia was documented in a 17-day-old infant. Urinary tract infections were identified in two infants: a 6-month-old with *Escherichia coli* and an 11-month-old who had received one dose of the measles vaccine with *Klebsiella pneumoniae*.

Three patients developed ocular bacterial superinfection, diagnosed clinically by purulent discharge and eyelid crusting; however, without documented swap cultures. Gingivostomatitis was documented in four cases. A 22-month-old female presented with fever, diffuse maculopapular rash, hypoactivity, looked very ill and was not responsive to verbal stimulation. Her Hemoglobin was 8.6 g/dL, platelets were $84 \times 10^9/L$ then dropped to $36 \times 10^9/L$, Na was 124 mmol/L, and K was 4 mmol/L. She was admitted to the pediatric intensive care unit as a case of meningoencephalitis. Lumbar puncture was done, on day nine of her admission, and cerebrospinal fluid analysis showed WBC of 30,000; neutrophils of 47% and lymphocytes of 42%, glucose of 3.4 mmol/L, protein of 153 mg/dl, and gram stain and culture of CSF were unyielding. PCRs from CSF for measles and other viruses were not obtained. Initial CT scan at time of presentation showed changes consistent with increased intracranial pressure (ICP) (Figure 2A). The patient received antibiotics, antiviral (acyclovir), and steroids. Follow-up CT showed improvement in features of increased ICP (Figure 2B). MRI brain was not done and the patient fully recovered without neurological sequelae. There was a difference in the rate of different complications, Table 4.

Laboratory Findings

Anemia was detected in 24 (38.1%) cases, with hemoglobin levels below 11 g/dL. Twelve (19.0%) patients exhibited leukopenia, with total white blood counts below $4.5 \times 10^3/mm^3$, ranging between 1.4 and $4 \times 10^3/mm^3$.

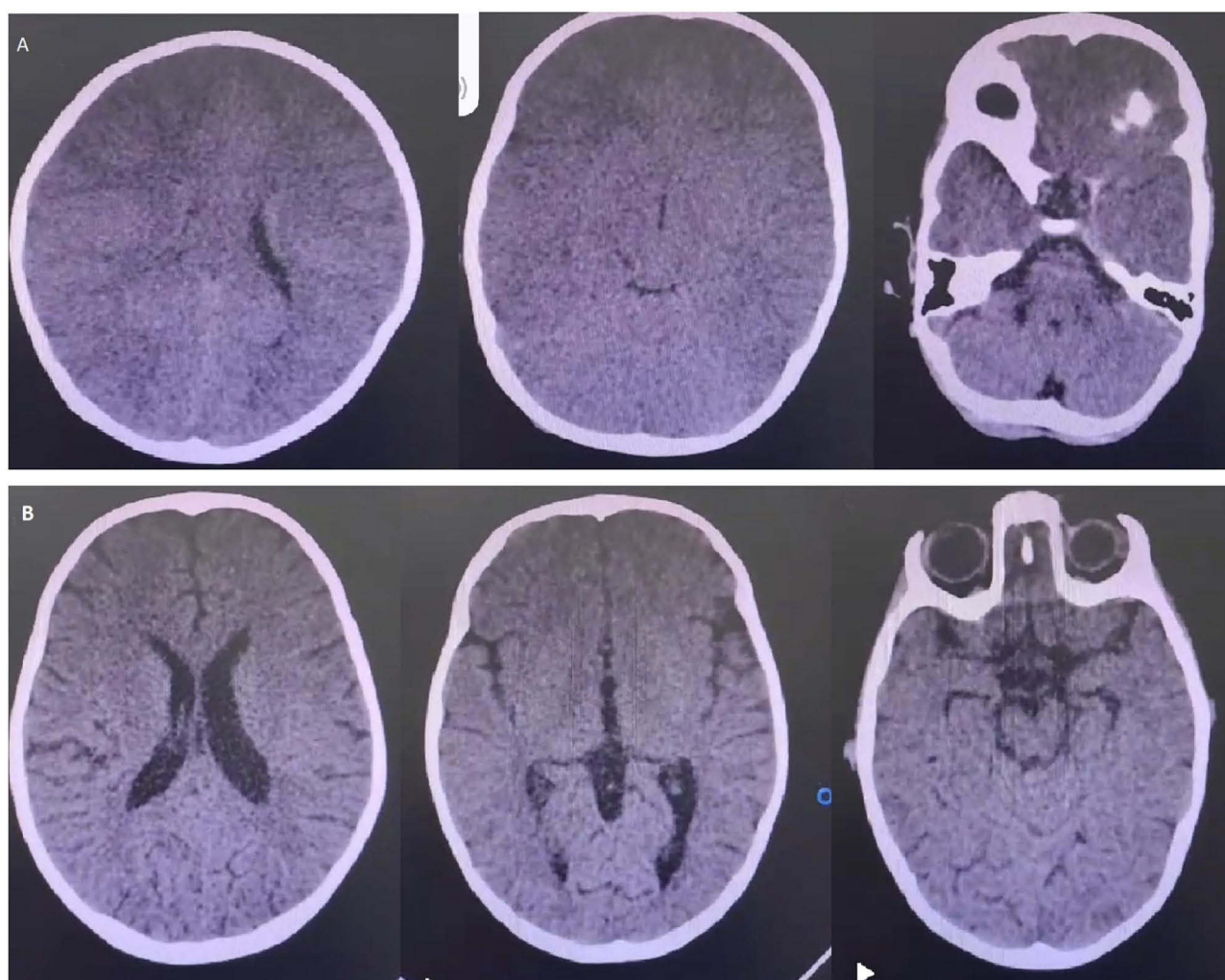


Figure 2 Axial slices from brain CT scan of selected pediatric measles cases. **(A)** Initial CT scan at time of presentation showed effacement of the ventricular system, sulci and basal cisterns; consistent with increased intracranial pressure. **(B)** The follow up CT scan showed improvement with restored spaces of sulci and basal cisterns as well as the ventricular system.

Thrombocytopenia was observed in three patients, with the lowest recorded platelet count was $36 \times 10^9/L$ (Table 5). Elevated liver enzymes levels (aminotransferase levels) were observed in two cases, aspartate transferase (AST) of 95 IU/I and Alanine transaminase (ALT) of 70 IU/I, and the second case had AST level of 193 and ALT of 87.9 IU/I.

Table 4 Distribution of Measles Cases by Complication and Vaccination Status (N=63)

Complication	Total n (%)	Unvaccinated n (%)	Vaccinated n (%)
Bronchopneumonia	35 (57.3%)	23 (65.7%)	12 (34.3%) One dose: 4 Two doses: 2 Three doses: 6
Pneumonia	8 (12.7%)	6 (75.0%)	2 (25.0%) One dose: 1 Two doses: 1

(Continued)

Table 4 (Continued).

Complication	Total n (%)	Unvaccinated n (%)	Vaccinated n (%)
Gingivostomatitis	4 (6.4%)	1 (25.0%)	3 (75.0%) One dose: 1 Two doses: 1 Three doses: 1
Gastroenteritis (vomiting and/or diarrhea)	24 (38.1%)	15 (62.5%)	9 (37.5%) One dose: 3 Two doses: 1 Three doses: 5
Urinary tract infection	2 (3.2%)	1	1 (One dose)
Bacteremia	1 (1.6%)	1	0
Encephalitis	1 (1.6%)	0	1 (Three doses)
Hepatitis	2 (3.2%)	0	2 (Three doses)

Table 5 Total Blood Cells Counts for Pediatric Measles Cases (N=63)

	Minimum	Maximum	Mean	SD
Hb (g/dL)	7.9	14.40	11.32	1.24
MCV (fL)	50.8	89.40	70.71	6.17
WBC ($\times 10^9/L$)	1.40	29.90	9.70	6.68
Absolute Neutrophil Counts ($\times 10^9/L$)	0.56	21.17	4.74	4.65
Absolute Lymphocyte Count ($\times 10^9/L$)	0.57	15.96	4.01	3.05
Platelet count ($\times 10^9/L$)	36.0	798.00	291.76	132.37

Abbreviations: Hb, Hemoglobin; MCV, Mean Corpuscular Volume; WBC, White Blood Cell; SD, Standard Deviation.

Radiological Findings

Chest X-rays were reviewed for all patients with respiratory involvement. Findings varied from normal to significant changes indicative of bronchopneumonia or pneumonia. Common radiographic findings included thickened and blurry pulmonary markings, reticular shadows, and patchy areas of consolidation. These findings are consistent with measles pneumonia or measles complicated by secondary bacterial pneumonia. Such radiographic features underscore the importance of vigilant monitoring and early intervention in patients presenting with respiratory symptoms.²¹ In cases where pneumonia was diagnosed, changes included patchy areas of consolidation with or without prominent hilar shadow, along with thickened and blurry pulmonary markings. Mostly they were due to measles complicated by pneumonia (Figure 1A–D).

Axial slices from brain CT scan of the infant with encephalitis showed initially, at time of presentation, effacement of the ventricular system, sulci and basal cisterns; consistent with increased intracranial pressure (Figure 2A). The follow up CT scan showed improvement with restored spaces of sulci and basal cisterns as well as the ventricular system (Figure 2B).

Malnutrition was observed in nine cases with weights below the 5th percentile, while 3 cases with weight at 5th percentile, and 11 cases weights were between 5th and 10th percentiles. While 24 cases (8%) had anemia with hemoglobin level below 11 g/dL.

Discussion

Despite the availability and safety of cost-effective measles vaccines, significant measles outbreaks continue to occur worldwide. In 2022, it was estimated that there were approximately 136,000 measles-related deaths globally, predominantly among young children under five years of age.²³ However, the global landscape of measles epidemiology has been significantly altered by the COVID-19 pandemic, which disrupted routine immunization programs, reduced healthcare access, and diverted public health resources toward pandemic response efforts.²¹ These disruptions have likely contributed to gaps in measles vaccination coverage and an increased vulnerability to outbreaks, particularly in regions already facing socioeconomic or political challenges.

Our findings revealed that approximately two-thirds of the admitted measles cases were unvaccinated, with 75% of these being younger than nine months—the minimum age to receive the first vaccine dose according to Jordan’s national immunization schedule.²⁴ The remaining unvaccinated children (10/40, 25%) were between 9 and 24 months of age but had not received a single dose of the measles vaccine without any identifiable reason. Additionally, eight cases in the 9–18-month age group had received only one measles vaccine dose, which seems not to have provided optimal immunity against measles.¹² These findings align with reports from other regions where vaccination coverage declined during and after the COVID-19 pandemic, leading to a resurgence of vaccine-preventable diseases such as measles.²²

Consistent with previous reports, respiratory complications, specifically bronchopneumonia and pneumonia, were the most common measles-related complications and the primary indications for hospitalization in our study.^{12,25,26} Pneumonia, occurring in approximately 12.7% of our cases, is known to be the most common severe complication of measles and the leading cause of measles-associated deaths in children.^{27–29} In our cohort, the single reported death was a previously healthy 7-month-old unvaccinated infant who succumbed to measles-associated pneumonia.

Hepatic involvement in measles is uncommon in pediatric patients and is typically associated with a good prognosis.¹⁴ In our study, elevated transaminase levels due to hepatocellular damage were reported in two cases. Both patients recovered completely without any sequelae, aligning with previous observations that hepatic dysfunction in measles is generally self-limiting in children.³⁰

Neurologic complications of measles, such as encephalitis, are rare but serious.³¹ Our data included one case of a vaccinated 22-month-old girl who exhibited neurologic symptoms. This underscores that even vaccinated individuals can experience severe complications, although such occurrences are rare and generally have favorable outcomes.

We also reported two cases of bacterial urinary tract infections in our study population. Although urinary tract infections are not usually reported as direct complications of measles, patients with measles have a higher risk of being diagnosed with all-cause non-measles infectious diseases.³² This is attributed to the immunosuppressive effect of measles virus infection.^{33,34}

The treatment of measles is primarily supportive, and vitamin A supplementation has been shown to reduce complications and mortality, especially in children younger than two years of age.³⁵ In our study, all patients received vitamin A as part of their treatment regimen. A substantial proportion of patients (82.5%) received empirical antibiotics, although not all had clear indications for their use. Given that measles infection can compromise the immune system and increase susceptibility to bacterial superinfections, some studies support the use of antibiotics to prevent secondary infections.³⁴ However, the indiscriminate use of antibiotics should be approached with caution to avoid antibiotic resistance and other associated risks.

The COVID-19 pandemic has had a profound impact on global health systems, including routine immunization programs. Disruptions in vaccination campaigns, suspension of outreach activities, and reduced healthcare-seeking behavior during lockdowns have contributed to declining measles vaccination rates in many countries.²¹ For example, a modeling study estimated that 22.7 million children missed their first dose of the measles vaccine in 2020, representing a 7% decline in global coverage compared to pre-pandemic levels.²² These gaps in vaccination coverage have created pockets of susceptibility, increasing the risk of measles outbreaks in both low- and high-income settings.

In Jordan, measles vaccine coverage dropped to 76.5% in 2020 due to the COVID-19 lockdown, highlighting the potential for localized outbreaks in high-risk areas.²⁰ Our study underscores the consequences of such disruptions, as evidenced by the concentration of measles cases in Northern Jordan during the 2023 outbreak. Similar trends have been

observed globally, with several countries reporting measles outbreaks linked to pandemic-related disruptions in vaccination programs.

For instance, in 2023, Lebanon experienced a significant measles outbreak, with 262 reported cases, 146 of which were laboratory-confirmed. The attack rate was highest among children under five years of age, and a significant portion (77%) of confirmed cases were unvaccinated.⁶ This outbreak was exacerbated by the influx of Syrian refugees and compounded by financial and economic challenges, underscoring the role of population mobility and socioeconomic factors in measles transmission. Similarly, other regions affected by conflict, displacement, and economic instability have reported increases in measles cases post-pandemic.^{7,8}

This study has several limitations. Being a retrospective analysis of hospitalized children, it does not capture measles cases managed in outpatient settings or those who did not seek medical care. Therefore, our results are applicable only to hospitalized pediatric cases and may not represent the full spectrum of measles severity in the community. Additionally, cases treated in private healthcare facilities were not included, which may limit the generalizability of our findings. The reliance on medical records may also introduce information bias due to incomplete or inaccurate documentation. Furthermore, we did not investigate potential factors contributing to the lack of vaccination among eligible children, such as socioeconomic barriers, access to healthcare services, or vaccine hesitancy, which could have provided deeper insights into the challenges of achieving optimal vaccination coverage. While our data did not capture nationality, it is worth mentioning that Rahma Pediatric hospital is a public one and that all children under 6 years of age in Jordan have free health coverage regardless of nationality or status. As well, measles cases are considered a public health threat and have free healthcare services. Accordingly, discrimination according to nationality in our results is minimal, if any.

Conclusion

Measles outbreaks continue to occur globally despite the availability of safe and effective vaccines. Our study highlights the ongoing threat of measles, particularly among young, unvaccinated children, and the significant burden of respiratory complications. These findings underscore the need to enhance measles vaccination coverage and consider policy adjustments, such as lowering the minimum vaccination age in high-risk areas, to prevent future outbreaks and reduce the disease burden.

Disclosure

The authors report no conflicts of interest in this work.

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