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Evaluation of Demographic Characteristics and Laboratory Findings of Children with Measles Admitted to a Pediatric Emergency Department

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What is known on this subject?

Measles is an acute, febrile, highly contagious infectious disease. Vaccination is one of the ways to reduce the incidence and mortality of the disease. Measles is still an endemic disease and causes epidemics periodically.

What this study adds?

We realized that there was little information about the increasing measles cases in our country in 2023-2024, so we thought that our study about the demographic data and follow-up process of the recently increasing measles cases would contribute to the literature.

ABSTRACT

Objective: Measles is a dangerous infectious disease that still threatens public health in our country, as well as all over the world. In this study, we aimed to evaluate the demographic data, clinical and laboratory findings, vaccination status, disease complications, morbidity, and mortality rates of children with measles who applied to our pediatric emergency department.

Material and Methods: A hospital-based retrospective and descriptive study was conducted at the pediatric emergency department in a tertiary hospital in İstanbul from February 2023 to May 2023. Patients who met the exact case definition in accordance with the Surveillance Guidelines for Measles, Rubella, and Congenital Rubella Syndrome, of the Turkish Ministry of Health, were included in the study. Demographic, clinical, and laboratory data of 99 patients were examined using patient files and medical records.

Results: Of the 99 patients, 49 (49.5%) were male. The ages of the children ranged from 2 months to 17 years and 4 months. Of the 99 children diagnosed with measles, only 9 (9%) were fully vaccinated, 4 (4%) had received a single dose of vaccination, and 86 (87%) were unvaccinated. All patients had typical maculopapular rashes and fever. A total of 78 (79%) patients had measles complications, and 95% of them were unvaccinated. The most common complication was pneumonia. A total of 64 (65%) patients had an indication of hospitalization. Only 1 (1%) patient required treatment in the pediatric intensive care unit, and was unvaccinated. The hospitalization indication rate of unvaccinated and incompletely vaccinated children with measles was significantly higher than that of fully vaccinated children.

Conclusion: In our study, it was shown that the majority of children diagnosed with measles were unvaccinated, and that vaccination made a significant difference in measles complications, hospitalization, and the need for the pediatric intensive care unit.

Keywords: Emergency medicine, epidemiology, measles, measles vaccine, pediatric emergency

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Introduction

Measles is an acute, febrile, highly contagious infectious disease caused by an enveloped single-stranded RNA virus from the Morbillivirus genus of the Paramyxoviridae family. Measles is a serious airborne disease that can have many complications and even be fatal. The mortality rate is around 5% in most parts of the world. Its high contagiousness has serious consequences for society, especially for primary health care institutions and emergency services, as well as schools and nurseries where children gather (1).

Measles infects the respiratory tract and then spreads throughout the body. The symptoms appear 7 to 14 days after contact with the virus and typically include high fever, cough, runny nose, and watery eyes. Measles rash appears 3 to 5 days after the first symptoms. The disease is contagious for four days before and after the rash appears (2,3). It is most often a self-limiting disease, but after a rash lasting a few days or weeks, various complications such as pneumonia, otitis media, diarrhea, and encephalitis may occur (4). The diagnosis of measles is made after laboratory tests, such as detection of anti-measles immunoglobulin M (IgM) and/or viral RNA, accompanied by clinical findings (5).

Vaccination is the only way to reduce the incidence and mortality of the disease. Since 15% of vaccinated children fail to gain immunity after the first vaccination dose, World Health Organization recommends two doses of vaccination on a flexible schedule (2). In our country, according to the current national childhood vaccination calendar of the Ministry of Health, measles vaccine is given in two doses as measles, rubella, mumps vaccine, at the end of the 12th month and as a booster at the 48th month. However, if there is a risk of an epidemic, an additional dose is administered in the 9th month (6).

In this study, we aimed to evaluate the demographic data, clinical and laboratory findings, vaccination status, disease complications, morbidity, and mortality rates of children with measles who were seen at our tertiary pediatric emergency clinic.

Material and Methods

A hospital-based retrospective and descriptive study was conducted at the pediatric emergency department in a tertiary hospital in İstanbul from February 2023 to May 2023. Approval for the study was received from University of Health Sciences Turkey, Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (protocol number: 2023-584, decision no: 584, date: 22.11.2023). The study was carried out in accordance with the latest version of the Declaration of Helsinki.

Study Participants and Procedure

Patients who met the exact case definition in accordance with the Surveillance Guidelines for Measles, Rubella, and Congenital Rubella Syndrome of Turkish Ministry of Health were included in the study. Criteria for inclusion in the study were determined as being under 18 years of age and older than 1 month; measles IgM positivity or an intermediate value; or measles polymerase chain reaction (PCR) positivity, in addition to measles clinical symptoms. The demographic, clinical, and laboratory data of 99 patients who met the inclusion criteria were examined from patient files and medical records. Gender, age, vaccination status, fever, hospitalization status, white blood cell count, absolute neutrophil count, absolute lymphocyte count, hemoglobin, urea, creatinine, sodium, potassium, alanine aminotransferase, aspartate aminotransferase, C-reactive protein, measles-specific IgM antibody, and PCR values were recorded. Contact with a measles patient was noted. The presence of symptoms such as rash, koplik spots, fever, cough, and conjunctivitis, and complications including otitis, pneumonia, diarrhea, sinusitis, pericarditis, meningoencephalitis, and mortality were noted. Children were considered fully vaccinated if they received two doses of vaccine appropriate to their age, incompletely vaccinated if they received a single dose of vaccine, and unvaccinated if they were not vaccinated. Vaccination statuses were checked using the parental declaration in the patient files and from the website https://enabiz.gov.tr/, where all vaccination administrations in Turkey are compulsorily electronically recorded and have encrypted access by physicians.

Statistical Analysis

The database was created using SPSS (Statistical Product and Service Solutions, IBM) version 29.0 software. The suitability of the variables for a normal distribution was examined visually (using histograms and probability graphs) and by analytical methods (Kolmogorov-Smirnov and Shapiro-Wilks). In descriptive analyses, mean and standard deviation were used for normally distributed variables, and median [minimum-maximum (min-max)] values were used for non-normally distributed and ordinal variables. In the comparison of continuous values between groups, the Mann-Whitney U test, and in ratio comparison the chi-square or Fisher tests were used, as appropriate (in cases where the values observed in the cells did not meet the chi-square test assumptions). Student's t-test was used to compare normally distributed values. A p value of <0.05 was considered as the threshold for significance.

Results

During the study period, 99 of the patients admitted to the pediatric emergency department were diagnosed with measles. Of the 99 patients, 49 (49.5%) were male and 50 (50.5%) were female. The age of the children with measles was between 2 and 208 months, and the median age was 60 months. Of the 99 children diagnosed with measles, only 9 (9%) were fully vaccinated, 4 (4%) had received a single dose of vaccination, and 86 (87%) were unvaccinated. Since 25 (25%) of the 86 unvaccinated children were under the age of one, they had not yet been vaccinated in accordance with the vaccination schedule of the Ministry of Health in our country.

Of the 99 children diagnosed with measles, 71 (71%) were Turkish and 28 (29%) were refugees. Of the 71 Turkish children, 59 (83%) were unvaccinated, 4 (6%) were incompletely vaccinated, and 8 (11%) were fully vaccinated. Of the 28 refugee children diagnosed with measles, 27 (96%) were unvaccinated, and 1 (4%) child was fully vaccinated. There was no significant difference between Turkish and refugee children in terms of vaccination status (p=0.09).

All patients had typical maculopapular rash and fever, 73 (73.7%) had cough, 37 (37.4%) had conjunctivitis, and 32 (32.3%) had koplik spots. As complications, pneumonia was observed in 44 (44.4%) patients, diarrhea in 21 (21.2%) patients, otitis in 12 (12.1%) patients, and convulsion in 1 (1.0%) patient, while no cases of encephalitis, pericarditis, or death were noted. A total of 78 (79%) of the patients had measles complications, and 95% of them were unvaccinated. The demographic, clinical, and laboratory characteristics of the patients are summarized in Table 1.

A total of 64 (65%) patients had an indication of hospitalization; 62 (68.9%) of 90 unvaccinated and incompletely vaccinated children and 2 (22.2%) of 9 fully vaccinated children were hospitalized. The rate of hospitalization of unvaccinated and incompletely vaccinated children with measles was significantly higher than that of fully vaccinated children (p=0.005). Only 1 (1%) patient required treatment in the pediatric intensive care unit and was unvaccinated. There was no difference between Turkish and refugee patients in terms of hospitalization (p=0.734). The median age for patients with indication for hospitalization was 42 months (min-max: 6-208), and the median age for patients with no indication for hospitalization was 75 months (min-max: 2-204) (p=0.480).

A significant difference was found in the duration of symptoms, hemoglobin, and creatinine levels between outpatients and patients with indications for hospitalization (p=0.016, p=0.007, p=0.013, respectively).

The average duration of symptoms in outpatients was 2.97±1.17 days, while in patients indicated for hospitalization it was 3.7±1.52 days. The average hemoglobin level of outpatients was 12.5±1.27 g/dL, and the level for patients indicated for hospitalization was 11.6±1.50 g/dL. The average creatinine level of outpatients was 0.49±0.24 mg/dL, and that of hospitalized patients was 0.38±0.18 mg/dL. Laboratory characteristics of no indication for hospitalization and indications for hospitalization patients are in Table 2.

Table 1. Demographic, clinical and laboratory characteristics of measles patients

Variable	p value
Sex, n (%)	
Female	50 (50.5)
Male	49 (49.5)
Age (month), median (min-max)	60 (2-208)
Contact history, n (%)	
Present	25 (25.3)
Absent	74 (74.7)
Clinical findings, n (%)	
Fever	99 (100)
Rash	99 (100)
Cough	73 (73.7)
Conjunctivitis	37 (37.4)
Koplik spots	32 (32.3)
*Pathological pulmonary finding	44 (44.4)
*Pericarditis	0 (0)
*Convulsion	1 (1)
*Otitis	12 (12.1)
*Diarrhea	21 (21.2)
*Encephalitis	0 (0)
Laboratory findings, median (min-max)	
Hemoglobin (g/dL)	11.8 (8.5-16.2)
White blood cell count (mm^3)	5570 (2460-15780)
Neutrophil count (mm^3)	2760 (330-11010)
Lymphocyte count (mm^3)	1240 (200-11650)
CRP (mg/dL)	9.6 (0.1-269)
AST (IU/L)	48 (28-233)
ALT (IU/L)	22 (8-235)
Sodium (mEq/L)	134 (127-147)
Potassium (mEq/L)	4.1 (3.1-5.2)
Urea (mg/dL)	17.9 (3.9-112.8)
Creatinine (mg/dL)	0.3 (0.1-1.1)
Measles IgM (U/mL), n (%)	
Positive	80 (80.8)
Intermediate value	3 (3.0)
Measles PCR (+), n (%)	96 (97.0)

**Situations considered as complications of measles*

min-max: Minimum-maximum, CRP: C-reactive protein, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, IgM: Immunoglobulin M, PCR: Polimerase chain reaction

Table 2. **Laboratory characteristics of no indication for hospitalization and with indication for hospitalization**

Variable	No indication for hospitalization Mean ± SD Median (min-max)	With indication for hospitalization Mean ± SD Median (min-max)	p value
Age (month)	79.57±63.97 75 (2-204)	65.25±60.69 42 (6-208)	0.480[&]
Hemoglobin (g/dL)	12.51±1.27 12.40 (9.20-15.20)	11.68±1.20 11.55 (8.50-16.20)	**0.007***
White blood cell count (mm^3)	6230±3397.39 5610 (2590-15780)	6282.50±2995.66 5565 (2460-15510)	0.693[&]
Lymphocyte count (mm^3)	2544.57±2661.92 1050 (200-11650)	2435.47±2092.08 1455 (450-8430)	0482[&]
Neutrophil count (mm^3)	3248.00±1894.86 2910 (330-11010)	3426.88±2018.32 2645 (680-9810)	0.962[&]
CRP (mg/dL)	15.99±21.27 7.10 (0.10-82.20)	21.27±37.48 10.30 (0.20-269.20)	0.214[&]
Sodium (mEq/L)	134.85±3.22 135 (132-141)	134.41±3.52 134 (127-147)	0.540*
Potassium (mEq/L)	4.15±0.46 4.10 (3.10-5.10)	4.07±0.43 4.10 (3.10-5.20)	0.454*
Urea (mg/dL)	20.90±8.69 18.90 (5.30-43.00)	19.75±14.34 17.25 (3.90-112.8)	0.176[&]
Creatinine (mg/dL)	0.49±0.24 0.45 (0.10-1.05)	0.38±0.18 0.33 (0.10-0.87)	**0.013**[&]
AST (IU/L)	52.79±28.95 45 (23-167)	57.84±37.13 48 (23-233)	0.313[&]
ALT (IU/L)	33.53±37.56 22 (8-184)	33.11±44.47 21 (8-235)	0.771[&]

**Student's t-test, [&]Mann-Whitney U test*

min-max: Minimum-maximum, SD: Standard deviation, CRP: C-reactive protein, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

Discussion

In our study, we confirmed that measles is a dangerous infectious disease that still threatens public health in our country and worldwide, and we presented the complication, hospitalization, vaccination, and mortality rates of patients admitted to our pediatric emergency department.

There was no significant difference between the genders of patients with measles, consistent previous studies (7,8,9,10). The age of the children with measles was between 2 and 208 months, and the median age was 60 months in the study. In the study conducted by Metin et al. (11) in our country, the age of measles cases was between 4 and 191 months (mean age 58.6±59.5 months); in the study by Gezgin Yıldırım et al. (10), between 2 and 216 months; and in the study by Türkkan et al. (12), the age range was between 7 and 196 months (mean age: 63.8 months ±44 months). The prevalence of measles across different age ranges was similar in previous studies from our country.

In the study, 25.3% of the patients had contact with a patient with measles. Exposure to measles infection was reported as 31.2% in Gezgin Yıldırım et al.'s (10) study and 60% in Türkkan et al.'s (12) study from our country. To protect against infection, vaccination should be administered within the first 72 hours after contact with a patient with measles. In cases of pregnancy, immunosuppression, or babies aged ≤6 months, measles hyperimmunoglobulin or intravenous Ig should be administered after exposure (5). None of the patients in our study received post-exposure vaccination or Ig treatment. This situation suggested that some index cases may not have been reported, health care providers may not have been able to reach some of the children exposed to measles infection, or the children may not have applied to a hospital.

A total of 91% of the patients who had measles in the study were unvaccinated or incompletely vaccinated. These results are similar to the other studies from our country and Europe (8,10,12,13). In our study, 9% of the patients were infected with measles despite being fully vaccinated. It was reported that there were 6% in Gezgin Yıldırım et al.'s (10) study, 10% in Türkkan et al.'s (12) study, and 9.8% in Muscat et al.'s (14) study. However, this rate is 1.7% in Gianniki et al.'s (15) study. This situation can be attributed to failures in vaccine administration. Measles vaccination averted 56 million deaths between 2000 and 2021. Even though a safe and cost-effective vaccine is available, in 2021, there were an estimated 128,000 measles deaths globally, mostly among unvaccinated or under-vaccinated children under the age of 5 years. In 2022, 74% of children received both doses of the measles vaccine, and about 83% of the world's children received one dose of measles vaccine by their first birthday. This value is the lowest recorded since 2008. Approximately 22 million infants missed at least one dose of measles vaccine through routine immunization in 2022 (2).

All patients had typical maculopapular rash and fever, followed by cough, conjunctivitis, and koplik spots. A total of 79% of patients had complications. The most common complications were pneumonia (44.4%), diarrhea (21.2%), followed by otitis (12.1%) and convulsion (1%), and 95% of patients with complications were unvaccinated. These data are consistent with previous studies (15,16,17,18,19). Measles mortality is 3-5% in developing countries and 10% in underdeveloped countries (19). However, similar to our findings, no deaths due to measles infection were reported in earlier studies conducted in our country (18,19).

A total of 65% of all patients were hospitalized. The hospitalization rate of unvaccinated and incompletely vaccinated children with measles was significantly higher than that of fully vaccinated children. Of all the patients, only 1 (1%) was treated in the pediatric intensive care unit and was unvaccinated. In previous studies, the hospitalization rate was reported as 20-60%, while the pediatric intensive care unit admission rate was reported as 1.2% to 18% (9,16,17,18,20,21).

Study Limitations

This study was conducted in a single center with a limited number of patients and was retrospectively.

Conclusion

In our study, it was shown that the majority of children diagnosed with measles were unvaccinated and that vaccination made a significant difference in measles complications, hospitalization, and need for the pediatric intensive care unit. Despite all efforts, the incidence of measles is increasing globally. The most effective measure to prevent this situation, in terms of both public health and cost-effectiveness, is to vaccinate all unvaccinated children, complete the vaccination of those who have not been fully vaccinated, and raise awareness among healthcare professionals and society about both early recognition of the disease and vaccination.

Ethics

Ethics Committee Approval: Approval for the study was received from University of Health Sciences Turkey, Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (protocol number: 2023-584, decision number: 584, date: 22.11.2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Concept: R.Y., S.G., Design: R.Y., S.G., Data Collection or Processing: R.Y., S.G., Analysis or Interpretation: R.Y., S.G., Literature Search: R.Y., S.G., Writing: R.Y., S.G.

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