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ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2024;13(2):265-70

Demographic and clinical features in patients with vaccinated and unvaccinated measles

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Received 27 December 2023; Accepted 27 March 2024
Available online 31 May 2024 with doi: 10.5455/medscience.2023.12.236

Abstract

This study investigated the demographic and clinical characteristics of measles patients who presented to the emergency department, analyzing the relationship with their vaccination status. This single-center and retrospective study included 110 patients with confirmed measles. The patients were categorized based on their clinical outcomes (ambulatory monitoring and inpatient) and vaccination status (≥2 doses vs. <2 doses). We compared demographic and clinical characteristics between these patient groups. Our study included 57 females (51.82%) and 53 males (48.18%), with a mean age of 9.32±10.47 years. Seventy percent of patients were aged ≤10 years. The most common symptoms upon admission were fever (77.27%), fatigue (49.09%), and cough (35.45%). Complications included otitis media (6.36%), pneumonia (2.73%), and seizure (0.91%). Despite no significant differences in hospitalization and severe disease between those who received ≥2 doses of the measles vaccine and those who did not, all hospitalized patients were unvaccinated. Furthermore, 81.8% of complicated measles cases occurred in patients who were not vaccinated with the effective dose. Our study indicates that measles is more severe in unvaccinated patients compared to vaccinated cases. All hospitalizations and most complications were observed in the unvaccinated group. Additionally, most cases were in the pediatric age group.

Keywords: Measles, vaccination, measles vaccine, hospitalization, vaccination hesitancy

Introduction

Measles is a highly contagious viral disease caused by an enveloped RNA virus, a member of the paramyxovirus family. The virus primarily spreads through respiratory droplets from an infected person. After exposure, approximately 90 percent of susceptible individuals develop measles [1]. Symptoms typically begin with a prodromal phase characterized by elevated body temperature, fatigue, cough, catarrhal symptoms, and conjunctivitis. This is followed by a characteristic maculopapular rash on the face, which then spreads to the rest of the body [1]. Although measles is often a self-limiting illness, it can lead to complications such as pneumonia, encephalitis, and mortality [2].

Effective immunization programs can achieve the control and elimination of measles [3]. However, the effectiveness of initiatives to eradicate the disease is limited by factors such as vaccine hesitancy, societal and political changes, patterns of migration, and the performance of immunization programs. In summary, measles remains a public health concern despite the existence of a safe and effective vaccine for almost six decades [3,4]. Türkiye launched its measles eradication initiative in 2002 and made significant progress, as the incidence of cases remained consistently below 10 from 2007 to 2010. Nevertheless, a troubling trend emerged starting in 2011, characterized by a significant increase in the incidence of measles infections in Türkiye [5].

In this study, we assessed the demographic, epidemiological, and clinical characteristics of confirmed measles patients presented to the emergency department (ED) and analyzed their relationship with vaccination status.

Material and Methods

Ethics Committee Approval and Patient Consent

This study was conducted in accordance with the 1989 Declaration of Helsinki and was approved by the institutional review board of Haseki Research and Training Hospital, İstanbul, Türkiye (approval no. 2023/158). The institutional review board did not

CITATION
Az A, Ozcomlekci M, Sogut O. Demographic and clinical features in patients with vaccinated and unvaccinated measles. Med Science. 2024;13(2):265-70.

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DOI: 10.5455/medscience.2023.12.236

request patient consent to access medical records since there were no potentially identifiable markers or patient identifiers.

Study Design and Setting

This single-center, retrospective, observational study enrolled 228 consecutive patients who presented with a measles-suspicious maculopapular rash to the ED of our hospital from July 2022 to July 2023.

To reduce selection bias, we included all patients admitted to the ED with maculopapular rash during the study period. Via the hospital's automation system and archives, we recorded patients' demographics (age and sex), vital signs upon admission (systolic blood pressure, heart rate, and body temperature), initial complaints (fever, cough, fatigue, sore throat, rhinorrhea, diarrhea, etc.), associated complications (pneumonia, otitis media, seizures, etc.), measles real-time polymerase chain reaction (RT-PCR) test results and serology, measles vaccination status, laboratory parameters including hematological findings (white blood cell [WBC], neutrophil, lymphocyte, and thrombocyte counts, and hemoglobin levels) and biochemical findings (aspartate aminotransferase [AST], alanine aminotransferase [ALT], C-reactive protein [CRP], creatinine, lactate dehydrogenase [LDH], and urea levels), and clinical outcomes (discharge, hospitalization, death).

A nasopharyngeal swab, throat swab, or blood specimen were collected from all measles-suspicious patients. Only cases where measles diagnosis was confirmed by RT-PCR or serology were included in our study. First, the patients were categorized into two groups based on their clinical outcomes (ambulatory monitoring and inpatient). Demographics, epidemiological and clinical characteristics, vaccination status, and laboratory findings were compared between patients who received ambulatory monitoring and those who were admitted as inpatients. Additionally, patients were divided into two further groups: those who had received ≥ 2 doses of vaccine and those who had not. We compared demographic, epidemiological, and clinical characteristics between these patient groups. No specialized examinations, treatments, interventions, or procedures were conducted within the scope of this study, and neither the patient nor the reimbursement institution incurred any costs.

Outcome Definition

We evaluated the relationship between vaccination and clinical outcomes, and also examined the relationships between demographic and clinical characteristics and hospitalization.

Study Population and Sampling

We enrolled a total of 228 consecutive patients who visited the ED of our hospital with a measles-suspicious maculopapular rash. Among these patients, 82 were excluded because they did not receive a diagnosis via RT-PCR or serology tests. An additional 26 patients were excluded due to inaccessible data. Finally, we analyzed data from 110 patients with confirmed measles.

Vaccination Schedule for Türkiye

In Türkiye, the Measles, Rubella, and Mumps (MMR) vaccine is administered to each child as part of the ''Childhood Vaccination Program''. The standard schedule involves giving two doses of the MMR. The first dose is usually administered around the age of 1, and the second dose is given between the ages of 4 and 6. During periods of increased risk or outbreaks, health authorities may recommend additional doses or booster shots to enhance protection [6].

Statistical Analysis

Data analysis was conducted using SPSS software (version 15.0 for Windows; SPSS Inc., Chicago, IL). Categorical variables (sex and age) are expressed as numbers (n) and percentages (%). Numerical data are expressed as means, standard deviations, median, and interquartile range (IQR). Intergroup comparisons were conducted by chi–squared and Student's independent t–tests for normally distributed variables (e.g., sex and age) and Mann–Whitney U–test for non–normally distributed variables (e.g., leukocyte, neutrophil, lymphocyte, and thrombocyte counts). The alpha significance level was set at $p<0.05$.

Results

Table 1 presents the demographic and clinical characteristics of the patients. Our study included a cohort of 110 patients, with 57 females (51.82%) and 53 males (48.18%). The mean age of the patients was 9.32±10.47 years. Patients aged ≤10 years comprised 70.00% (n=77) of the study population. Conversely, only one patient was aged older than 40 years. Out of the total, 103 (93.64%) patients received ambulatory monitoring, while 7 (6.36%) were admitted as inpatients. Remarkably, no fatalities occurred among the patient cohort. The most common complaints on admission to the ED, except for maculopapular rash, were fever (n=85, 77.27%), fatigue (n=54, 49.09%), and cough (n=39, 35.45%). The prodrome lasted a mean of 1.82±2.20 days before the onset of maculopapular rash. Additionally, otitis media (n=7, 6.36%) was the most common complication in patients with measles. Moreover, pneumonia was observed in three (2.73%) patients, and seizure was observed in one (0.91%) patient. Overall, 58.18% (n=64) of the patients were not vaccinated against measles. Furthermore, 21 patients (19.09%) had received <2 doses of vaccine.

Table 2 demonstrates the comparative analysis of demographic and clinical characteristics based on vaccination status. Neither age nor sex differed significantly between patients who had received ≥2 doses of the vaccine and those who had not (p=0.454 and p=0.983, respectively). Additionally, there was no significant difference between the groups in terms of hospitalization or the presence of complications.

Comparative analyses of demographic characteristics between patients who received ambulatory monitoring and those who were admitted as inpatients revealed no significant difference in terms of age or sex (p=0.255 and p=0.259, respectively). None of the hospitalized patients had received measles vaccine, and a significant difference in vaccination status was observed between the groups (p=0.007). Fatigue and cough were more common in hospitalized patients than those receiving ambulatory monitoring

DOI: 10.5455/medscience.2023.12.236

(p=0.006 and p=0.008, respectively). Moreover, otitis media and pneumonia were significantly more common in inpatients than in those who received ambulatory monitoring (p<0.001 and p=0.010, respectively). Furthermore, inpatients had significantly higher levels of hemoglobin and hematocrit, lymphocyte count, as well as AST and ALT levels compared to those who received ambulatory monitoring (p=0.004, p=0.011, p=0.018, p=0.011, and p=0.033, respectively) (Table 3).

Table 1. Demographic and clinical characteristics of the patients with measles

		n (%)
Sex	**Female**	57 (51.82)
	Male	53 (48.18)
Age distribution, years	**<2**	38 (34.55)
	2–10	39 (35.45)
	11–20	18 (16.36)
	21–30	8 (7.27)
	31–40	6 (5.45)
	≥41	1 (0.91)
Monitoring	**Ambulatory monitoring**	103 (93.64)
	Inpatient	7 (6.36)
Symptoms at admission	**Maculopapular rash**	110 (100.00)
	Fever (>37.8°C)	85 (77.27)
	Fatigue	54 (49.09)
	Cough	39 (35.45)
	Rhinorrhea	28 (25.45)
	Sore throat	22 (20.00)
	Diarrhea	15 (13.64)
	Lymphadenopathy	11 (10.00)
	Conjunctivitis	9 (8.18)
	Arthritis	7 (6.36)
	None	14 (12.73)
Complication	**Otitis media**	7 (6.36)
	Pneumonia	3 (2.73)
	Seizure	1 (0.91)
	None	100 (90.91)
Vaccination	**No**	64 (58.18)
	<2 doses	21 (19.09)
	≥2 doses	25 (22.73)

Data are expressed as numbers (n) and percentages (%)

Table 2. Comparison of demographic and clinical features according to the vaccination status

		<2 Doses Vaccination	≥2 doses Vaccination	p*
		(n=85)	(n=25)	
Age, years	**mean±SD**	10.13±11.61	6.56±3.98	0.454
		n (%)	n (%)	
Sex	**Female**	44 (51.76)	13 (52.00)	0.983
	Male	41 (48.24)	12 (48.00)	
Monitoring	**Ambulatory monitoring**	78 (91.76)	25 (100.00)	0.347
	Inpatient	7 (8.24)	0 (0.00)	
Complication	**Otitis media**	6 (7.06)	1 (4.00)	1.000
	Pneumonia	2 (2.35)	1 (4.00)	0.542
	Seizure	1 (1.18)	0 (0.00)	1.000
	None	77 (90.59)	23 (92.00)	1.000

Data are expressed as numbers (n) and percentages (%), means, and standard deviations (SD). *Intergroup comparisons (<2 doses vaccination vs. ≥2 doses vaccination) were conducted using chi–squared tests for normally distributed data (e.g., sex, monitoring, and complication) and the Mann–Whitney U test for non–normally distributed data (e.g., age)

DOI: 10.5455/medscience.2023.12.236

Table 3. Comparison of demographic, clinical, and laboratory characteristics according to the clinical outcome in patients with measles

		Ambulatory monitoring (n=103)		Inpatient (n=7)		p
Age, years	**mean±SD**	8.83±9.99		16.43±15.24		0.255
		n	**(%)**	**n**	**(%)**	
Sex	**Female**	55	(53.40)	5	(71.43)	0.259
	Male	48	(46.60)	2	(28.57)	
Vaccination	**No**	57	(55.34)	7	(100.00)	0.007
	1 dose	21	(20.39)	0	(0.00)	
	≥2 doses	25	(24.27)	0	(0.00)	
Symptoms at admission	**Maculopapular rash**	103	(100.00)	7	(100.00)	-
	Fever (>37.8°C)	78	(75.73)	7	(100.00)	0.347
	Fatigue	47	(45.63)	7	(100.00)	0.006
	Cough	33	(32.04)	6	(85.71)	0.008
	Rhinorrhea	26	(25.24)	2	(28.57)	1.000
	Sore throat	21	(20.39)	1	(14.28)	1.000
	Diarrhea	12	(11.65)	3	(42.86)	0.052
	Lymphadenopathy	10	(9.71)	1	(14.28)	0.532
	Conjunctivitis	8	(7.77)	1	(14.28)	0.460
	Arthritis	7	(6.80)	0	(0.00)	1.000
	None	14	(13.59)	0	(0.00)	0.592
Complication	**Otitis Media**	4	(3.88)	3	(42.86)	<0.001
	Pneumonia	1	(0.97)	2	(28.47)	0.010
	Seizure	0	(0.00)	1	(14.29)	0.064
	None	98	(95.15)	1	(14.29)	<0.001
		Median	**IQR (25-75)**	**Median**	**IQR (25-75)**	
Laboratory	**WBC (10^3/uL)**	8.00	5.26-11.26	6.78	6.26-6.89	0.094
	Hemoglobin (g/dL)	12.00	10.90-12.85	14.20	12.3-14.8	0.004
	Hematocrit (%)	35.6	33.2-37.8	38.4	37.2-44.4	0.011
	Thrombocyte (10^3/uL)	303	234-358	254	167-408	0.397
	Neutrophil (10^3/uL)	3.78	2.68-6.33	3.78	3.67-4.31	0.984
	Lymphocyte (10^3/uL)	2.90	1.95-3.70	2.10	0.70-2.30	0.018
	AST (U/L)	15	12-20	25	18-51	0.011
	ALT(U/L)	32	22-39	60	26-71	0.033
	CRP (mg/L)	8.25	3.30-16.70	57.2	1.70-95.00	0.356
	Creatinine (mg/dL)	0.41	0.30-0.62	0.55	0.32-0.99	0.200
	LDH (U/L)	320	264-396	507	185-580	0.221
	Urea (mg/dL)	21	17-25	25	15-28	0.390

Data are expressed as numbers (n) and percentages (%), means, standard deviations (SD), median, and interquartile range (IQR). *Intergroup comparisons (Ambulatory monitoring vs. inpatient) were conducted using chi–squared and Student's independent t–tests for normally distributed data (e.g., age, sex, vaccination, and complication) and the Mann–Whitney U test for non–normally distributed data (e.g., leukocyte, hemoglobin neutrophil, lymphocyte, thrombocyte counts, and etc.) WBC, white blood cell; AST, aspartate aminotransferase; ALT, alanine aminotransferase; CRP, C-reactive protein; LDH, lactate dehydrogenase.

Discussion

Measles was not endemic in Türkiye before 2010; however, the incidence of measles infections has increased since then [5]. Studies have identified young age, non-vaccination, and immunodeficiency as risk factors for severe measles [7]. The key finding of our study is that, although there was no significant difference in hospitalization and severe disease between those who received an effective dose of the measles vaccine and

DOI: 10.5455/medscience.2023.12.236

those who did not, all hospitalized patients were unvaccinated. Furthermore, 81.8% of complicated measles cases occurred in patients who were not vaccinated with the effective dose.

In a hospital-based study investigating demographic and clinical differences between vaccinated and unvaccinated children hospitalized with measles, Mohamud et al. observed that 58.1% of 93 cases were male, while 48.9% were female [8]. Similarly, in the study conducted by Tepebaşılı et al. in Van province between 2001 and 2002, 52.5% of 143 cases were male, and 47.5% were female [9]. Similarly, in our study, the numbers of male and female patients were very close to each other. Additionally, in a study involving 161 hospitalized measles cases, Ben-Chetrit et al. found that 63.6% of cases were under 20 years old [10]. Similarly, Medić et al. found the highest incidence among children under 4 years of age in their investigation of the measles resurgence in the Republic of Serbia in 2014-2015 [11]. In our study, consistent with current literature, most cases occurred in the pediatric age group. However, no significant differences in age and sex were observed between ambulatory monitoring and inpatient patients.

Studies indicate that measles is associated with a mild to moderate clinical outcomes in vaccinated individuals [12]. In a study investigating the clinical progression of measles in vaccinated and unvaccinated children in Nigeria, Faneye et al. [12] found that the disease was less severe in vaccinated children than in unvaccinated children. Similarly, in their study of hospitalized measles patients, Mohamud et al., [8] observed that none of them had received two doses of the vaccine. Furthermore, unvaccinated individuals experienced more severe illnesses and complications than their vaccinated counterparts. Another study by Medić et al. [11] stated that the majority of complicated measles cases or hospitalized patients were either unvaccinated or had an unknown vaccination status. Furthermore, only 3 out of 193 hospitalized patients were vaccinated. Similarly, our study revealed that all hospitalized measles cases were non-vaccinated. Furthermore, 81.8% of complicated measles cases involved unvaccinated individuals.

Our findings highlight the importance of vaccination and immunization programs. Measles is a highly contagious viral infection, and immunization plays a crucial role in preventing its spread and reducing the severity of the disease [3]. The fact that all hospitalized patients in our study were unvaccinated individuals emphasizes the need for efforts to improve vaccination rates are essential in limiting measles outbreaks. In addition, it's important to recognize that vaccine protection is not absolute; its maximum effectiveness is achieved only with widespread immunization in the community [13]. Studies demonstrate an elevated risk among the unvaccinated, particularly in areas where vaccination coverage falls below 95%. Additionally, breakthrough cases can occur even in individuals who received the recommended doses of vaccination [13]. In Türkiye, vaccination rates were 97% in 2010 and 96% in 2012 due to a measles elimination program, but these rates gradually declined in subsequent years [5]. Our study indicates that measles cases occurred even among vaccinated individuals. However, complications such as pneumonia and otitis media were less common in those who had received the vaccine. Our findings indicate that vaccines still significantly reduce the risk of severe illness and complications. Similarly, in a study examining the clinical characteristics of measles in vaccinated and unvaccinated patients over a 15-year period, Cherry et al. found that hospitalization and complications were less common in individuals who received ≥2 doses of the measles vaccine compared to those who did not [14]. Additionally, in their retrospective study, Mitchell et al. found that unvaccinated cases were 2.8 times more likely to have more severe disease than vaccinated cases [15].

Our study has several limitations. Most importantly, the single-center design with a small cohort may limit the generalizability of the findings to broader populations or different healthcare settings. Additionally, a retrospective observational study increases the possibility of undiscovered confounding factors. Moreover, cases not included in the study due to missing data or negative PCR tests may affect the ability to draw accurate conclusions.

Conclusion

Our study indicates that measles is more severe in unvaccinated patients compared to vaccinated cases. All hospitalizations and most complications were observed in the unvaccinated group. Additionally, the majority of cases were in the pediatric age group. Although the measles vaccine does not provide absolute protection against infection, it significantly reduces the severity of the disease and the risk of complications. Our findings emphasize the critical role of vaccination in controlling and limiting measles.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the Institutional Review Board of Haseki Research and Training Hospital, İstanbul, Türkiye (approval no. 2023/158). The institutional review board did not request patient consent to access medical records since there were no potentially identifiable markers or patient identifiers.

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