ORIGINAL ARTICLE

Measles Complications and Their Related Factors in Children Presenting to the Tertiary Care Hospital of Peshawar. A Cross-Sectional Study

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ABSTRACT

Objective: To determine the vaccination status, complications, and outcome of children infected with measles in a tertiary care hospital of Peshawar.

Study Design: A cross-sectional study.

Place and Duration of Study: The study was conducted at the Department of Pediatrics, Medical Teaching Institute, Lady Reading Hospital, Peshawar, Pakistan, from 1st August to 2024 to 31st January 2025.

Methods: A hundred and seventy-nine children between 2 months and 15 years of age presenting with fever, maculopapular rash, and clinical features suggestive of measles were enrolled through consecutive sampling after informed parental consent and ethical approval from the Institutional Review Board. Data were collected using a predesigned, structured questionnaire covering demographics, contact history, vaccination status, feeding practices, nutritional status, measles-related complications, and in-hospital mortality. Data were analyzed using SPSS version 27. A *P*-value < 0.05 was considered significant.

Results: The mean age was 1.8 ±2.05 years (Mean±S.D.), the mean weight was 10.1± 4.02 kg (Mean ±S.D.), 67% (120) males and 33% (59) females. 15.1% (27) were from urban areas and 84.9% (152) were from rural areas. Of all, 12 % (12) expired, and 7.3% (13) developed motor functional impairment. Encephalitis, myocarditis, and vaccination status were strongly associated with mortality in children. Children who died were not vaccinated against measles.

Conclusion: Measles can be effectively controlled only through complete two-dose vaccination with timely booster doses. An early dose at 6 months of age can reduce the epidemic among children below 1 year of age. Outbreaks place a heavy burden on healthcare systems and disrupt society, highlighting the need for strong, sensitive, and continuous public health surveillance to enable early detection and rapid response to every suspected case.

Keywords: *Child, Measles, Mortality, Risk Factors, Vaccination.*

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Introduction

Measles is a highly contagious communicable disease. Measles can have significant public health implications and is transmitted from person to person through respiratory aerosols. Organisms involved in infectious diseases are transmitted using contact, airborne, droplet and vector. Pakistan has a poverty rate of 40% that results in high prevalence of communicable diseases like measles, dengue, malaria and influenza.[1] Measles is like other exanthema diseases of childhood and is less likely to be in the differential diagnosis in populations who have high vaccine coverage, however, vaccine failure cases have been described.[2]

Symptoms include fever, maculopapular rash, cough, conjunctivitis, and it is a fatal disease, but vaccinated children can have milder or no symptoms at all. Neurological complications though uncommon are

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serious and can include acute disease (acute disseminated encephalomyelitis) or can occur later (measles inclusion body encephalitis and SSPE).[3] Measles is a self-limiting disease but it can become severe in immune suppressed and malnourished children. Measles is associated with secondary opportunistic infections due to its immunosuppressive effects. Studies have highlighted that measles infection erases the already existing immune memory of various pathogens.[4]

As opposed to the anti-vaccine lobby, measles is bad. The death rate in acute measles is 1-3 per 1000 whereas the risk of encephalitis is 1 in 1000.[5] COVID pandemic badly affected the routine immunization programs worldwide and its consequences are also evident in Pakistan.[6] Vaccination against measles through WHO immunization program have reduced the outbreaks. Parental refusal, an influx of unvaccinated refugees, ongoing war, security issues and a lack of awareness among health-care professionals about vaccination and vaccination failure itself are the main reasons behind increasing cases of measles in Khyber Pakhtunkhwa especially the northern belt.[7]

Measles virus is infecting early age children in the Khyber Pakhtunkhwa especially northern regions of Pakistan, which is an alarming situation and is associated with complications such as pneumonia, diarrhea, myocarditis, otitis media and pneumothorax.[8]

Measles due to secondary vaccination failure may be less infectious than in unvaccinated persons. There is a low attack rate of secondary vaccination failure measles cases that suggests that in outbreaks, public health management of unvaccinated measles cases could be prioritized over cases due to secondary vaccination failure.[9]

Pakistan Vision 2025 aims to improve public health by reducing communicable diseases, strengthening healthcare services, addressing rural-urban disparities, improving nutrition and ensuring access to medicines but nothing much has been achieved in this regard.[10] our study aims to highlight the prevailing issue of measles a lethal and debilitating communicable disease. And to guide public health policy.

Measles is a highly contagious communicable disease characterized clinically by maculopapular rash, conjunctivitis, pneumonia, diarrhea.

Methods

The cross-sectional study was conducted at the Department of Pediatrics, Medical Teaching Institute, Lady Reading Hospital, Peshawar, Pakistan, from 1st August 2024 to 31st January 2025. Data was collected using a predesigned structured questionnaire. Children of any age with fever, maculopapular rash, and clinical stigmata of measles were included in the study after informed consent from the parents. Patients' enrolment was started after taking ethical approval from hospital Institutional Review Board, vide letter no: 357/LRH/MTI, dated: 15th July 2024. Data was collected by consecutive sampling technique. Sample size was calculated using Open Epi software taking the prevalence of measles as 13.4%, 90% confidence interval, and 10% margin of error, which was 179.[11]

Postgraduate residents were guided in data collection from parents after informed written consent. Data was collected regarding age, contact with measles patient, measles vaccination, breastfed or bottlefed, Protein-calorie malnutrition, complications of measles-like diarrhea, pneumonia, otitis media, croup/stridor/laryngitis, and meningoencephalitis. And in the hospital, mortality due to measles was recorded as well. Data analysis was done using SPSS software 27, descriptive statistics were performed for both scale and categorical variables, and results were tabulated.

Results

This study included 179 children infected with measles. The mean age was 1.8 ±2.05 yrs (Mean ±S.D.), the mean weight was 10.1± 4.02 kg (Mean ±S.D.), and the mean hospital stay in days was 7.7± 6.6 (mean± S.D.). Table 1 shows descriptive statistics for categorical variables.

The distribution of demographic, nutritional, clinical, and infectious variables was compared between children who survived and those who died (Table 2).

Although a higher proportion of deaths occurred among infants aged <1 year (83.3%) compared with survivors (56.9%), the association between age category and mortality did not reach statistical significance). Similarly, weight categories were not significantly associated with outcome, with comparable distributions observed between

Table 1: Sociodemographic and clinical variables of measles patients

Variables	Category	Frequency	Percentage
Age	<1yr	105	58.7
	1-5 yrs	61	34.1
	>5 yrs	13	7.3
Gender	Male	120	67
	Female	59	33
WHO Z-Score	<-1	5	2.8
	Normal	174	97.2
Vaccination status	Vaccinated with one dose of the measles Vaccine	56	31.3
	Not vaccinated for measles	103	57.5
	Vaccinated with 2 doses	20	11.2
Residence	Urban	27	15.1
	Rural	152	84.9
Hospital visit during the last 2 weeks	No	65	36.3
	Yes	114	63.7
Feeding pattern	Breast fed	99	55.3
	Bottle fed	34	19
	Both	46	25.7
Outcome	Alive	167	93.3
	Dead	12	6.7
Pneumonia	No	7	3.9
	Yes	172	96.1
Diarrhea	No	35	19.6
	Yes	144	80.4
Otitis media	No	162	90.5
	Yes	17	9.5
Stridor/Croup	No	99	55.3
	Yes	80	44.7
Myocarditis	No	174	97.2
	Yes	5	2.8
Conjunctivitis	No	14	7.8
	Yes	165	92.2
Encephalitis	No	157	87.7
	Yes	22	12.3
Long term complications	Motor functional impairment	13	7.3
	none	166	92.7
Fathers Education	<5 grade	101	56.4
	5-10th grade	62	34.6
	>10th grade	16	8.9
Mothers Education	<5 grade	158	88.3
	5-10th grade	19	10.6
	>10th grade	2	1.1

Table 2: Factors associated with mortality in measles patients

Variables	Categories	Outcome	
		Alive	**Dead**
Age	<1	56.90%	83.30%
	1-5 yr	35.30%	16.70%
	>5 yrs	7.80%	0.00%
Weight	<5 kg	3.60%	8.30%
	5-10 kg	72.90%	75.00%
	>10kg	23.50%	16.70%
Encephalitis	No	89.80%	58.30%
	Yes	10.20%	41.70%
Conjunctivitis	No	8.40%	0.00%
	Yes	91.60%	100.00%
Myocarditis	No	99.40%	66.70%
	Yes	0.60%	33.30%
Stridor/croup	No	55.10%	58.30%
	Yes	44.90%	41.70%
Otitis media	No	89.80%	100.00%
	Yes	10.20%	0.00%
Diarrhea	No	20.40%	8.30%
	Yes	79.60%	91.70%
Pneumonia	No	4.20%	0.00%
	Yes	95.80%	100.00%
Feeding pattern	Breast fed	55.70%	50.00%
	Bottle fed	18.00%	33.30%
	both	26.30%	16.70%
Vaccination status	Vaccinated with one dose of measles vaccine	33.50%	0%
	Not vaccinated for measles	54.50%	100%
	Vaccinated with 2 doses	12.00%	0.00%
WHO Z-Score	<-1	3.00%	0.00%
	Normal	97.00%	100.00%
Gender	Male	67.10%	66.70%
	Female	32.90%	33.30%
Residence	Urban	16.20%	0.00%
	Rural	83.80%	100.00%

survivors and non-survivors among comorbid conditions, encephalitis showed a significant association with mortality, being present in 41.7% of deceased children compared with only 10.2% of survivors. Likewise, myocarditis was strongly associated with mortality, occurring in 33.3% of deaths versus 0.6% among survivors, indicating a markedly higher fatality risk in children with cardiac involvement.

Other clinical features, including conjunctivitis,

stridor/croup, otitis media, diarrhea, and pneumonia, did not demonstrate statistically significant differences between outcome groups.

Feeding practices were comparable between survivors and non-survivors, with no significant association observed between feeding pattern and mortality. Nutritional status assessed by the WHO Z-score also showed no significant relationship with outcome, as nearly all children in both groups had normal Z-scores.

Regarding vaccination status, a significant association was observed. None of the deceased children had received a single dose of measles vaccine, whereas 33.5% of survivors had received one dose.

Gender distribution was similar in both groups (male: 67.1% among survivors vs. 66.7% among deaths; indicating no sex-based difference in outcome. Although all deaths occurred among children from rural areas, the association between residence and mortality did not reach statistical significance.

Figure 1 shows the age-wise distribution of measles

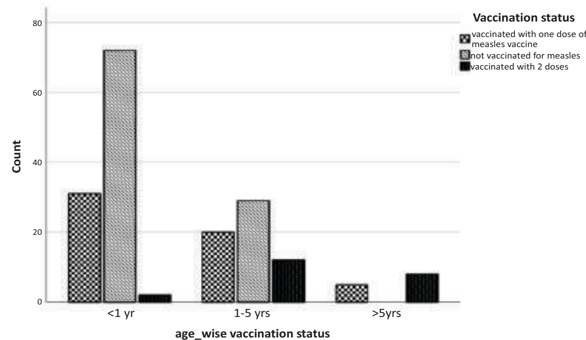

Fig.1: Age wise distribution of children vaccinated against measles vaccine

vaccination status among study participants. The clustered bar chart shows the number of children vaccinated with one dose of measles vaccine, not vaccinated for measles, and vaccinated with two doses across three age groups (<1 year, 1–5 years, and >5 years).

Among children aged <1 year, the highest proportion were not vaccinated against measles, majority of them contracted measles even before 9 months of age when their first vaccine dose was due. A smaller proportion had received one dose, and only a minimal number had received two doses. In the 1–5-year age group, the proportion of unvaccinated children remained high.

Discussion

Measles remains one of the most contagious viral diseases worldwide, posing a significant public health challenge, particularly in regions with low immunization coverage. Despite the availability of a safe and highly effective vaccine, outbreaks continue to occur, highlighting gaps in vaccination programs, access to healthcare, and community awareness.[12,13]

Measles continues to pose a substantial public health threat despite the availability of effective vaccines. Since the beginning of 2025, the United States has reported a marked resurgence, with 607 confirmed cases across multiple states, 97% of whom were unvaccinated or had unknown vaccination status, highlighting persistent immunity gaps even in high-income settings.[14] This trend underscores the global vulnerability to measles transmission and reinforces the urgent need for sustained immunization coverage and preparedness.[14]

The mean age in our study was consistent with findings from Yemen, where measles primarily affected children under five years of age.[15] In a study done in Ethiopia, the mean age was 7.15 ± 8.95 years, with 40% of cases occurring among children aged 1–4 years and 30% among those aged 5–15 years, while infants under one year also showed high vulnerability.[16]

Vaccination coverage in the present study remains suboptimal. In our study, 57.5% of children were unvaccinated, of whom 69.9% were below 1 year of age. 30% children between 1-5 yrs of age were not vaccinated. Similar patterns have been reported in Bale Zone, Ethiopia, where low vaccination coverage and limited healthcare resources influenced outpatient management and hospital admission rates 62% of cases, one dose of measles-containing vaccine, only 24.3% had completed two doses.[16]

Age-specific vulnerability was further supported by surveillance data from South Africa, where the median age of laboratory-confirmed measles cases was 2 years and only 25.9% of confirmed cases had documented vaccination.[17] Consistent evidence demonstrates a strong association between measles incidence and immunization status. Studies from Yemen reported that unvaccinated or incompletely

vaccinated children were up to 30 times more likely to develop measles, with additional risk factors including malnutrition and contact with confirmed cases.[18] Similar associations were observed in Pakistan, where unvaccinated children and close contact with measles patients significantly increased disease risk, along with social misconceptions regarding vaccination and poor access to healthcare facilities.[19]

School-based transmission also remains a concern. Investigations from Iran documented vaccinated schoolchildren acting as both primary and secondary cases, with 42% of cases occurring in children older than seven years, suggesting that schools function as major transmission hubs.[20]

Socio-demographic factors further influence the disease burden. In our study low vaccination coverage was associated with low fathers' education. Studies from Pakistan demonstrated a protective effect of vaccination, despite low coverage of the first measles dose (46.3%), while high maternal illiteracy highlighted the role of education in health-seeking behavior and vaccine acceptance.[21] Similarly, surveillance data from Niger revealed that most cases occurred among young children, with low vaccination coverage and a measurable case fatality rate, even in predominantly urban populations.[22]

The epidemiological characteristics of measles further necessitate rapid response mechanisms. Due to its short incubation period, high infectivity, and the ability to transmit up to 3 days before rash onset, measles outbreaks require immediate case detection, prompt public health action, and adequate resource mobilization, similar to other public health emergencies.[23]

Conclusion

Children must be vaccinated against measles with 2 doses of vaccine, and boosters should be given as well at the specified time. An early dose at 6 months of age can reduce the epidemic among children below 1 year of age. Measles outbreak responses impose substantial burdens and can significantly disrupt healthcare systems and societal functioning. To maximize effectiveness, robust and sensitive public health surveillance systems must operate consistently and universally to ensure rapid detection and prompt response to every suspected case.

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Author Contributions

MA: Conception, design of the work, manuscript writing for methodology design, investigation, and approval for final submission

HP: Revising, editing, supervising for intellectual content, writing the original draft, proofreading, and approval for final submission

AH: Data acquisition, curation, statistical analysis, and approval for final submission

SN: Validation of data, interpretation, write-up of results, and approval for final submission

HP is the nominated guarantor, takes full responsibility for the overall content and integrity of the work

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