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Comparison of Vaccinated Versus Unvaccinated Children Among Measles Cases Presenting to A Tertiary Care Hospital

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ABSTRACT

Objective: To determine the frequency of vaccinated and unvaccinated children among measles cases and to compare age, gender, and nutritional status between the two groups.

Methodology: This cross-sectional study was conducted in the Department of Pediatrics at Combined Military Hospital Sialkot from 2nd February 2026 to 31st March 2026, vide letter No. CPSP/REU/PED-2022-149-7509 dated 2nd February 2026. A total of 323 children aged 15 months to 5 years with confirmed measles were included using non-probability consecutive sampling. Vaccination status was verified through immunization records.

Results: There were 128 (39.6%) vaccinated and 195 (60.4%) unvaccinated. The mean age was significantly higher in vaccinated children (3.12±1.05 years) compared to unvaccinated children (2.66±1.14 years) (p = 0.021). Gender distribution showed no significant difference (p = 0.332). A significantly higher proportion of unvaccinated children had moderate and severe acute malnutrition compared to vaccinated children (p<0.001).

Conclusion: A higher proportion of measles cases were unvaccinated, and unvaccinated children were more likely to have poor nutritional status. Strengthening immunization coverage is essential to reduce measles burden.

Keywords: Measles, Malnutrition, Pediatrics, Vaccination, Z-scores

Authors' Contribution:
[1,2]Conception; Literature research; manuscript design and drafting; [3,4]Critical analysis and manuscript review; [5,6]Data analysis; Manuscript Editing.

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Introduction

Measles is a highly transmissible viral disease caused by the measles virus. It presents with fever, cough, coryza, conjunctivitis, and a typical maculopapular rash.[1] It is transmitted primarily through airborne aerosols and respiratory droplets. The measles virus remains infective for up to 2 hours after air borne suspension. A patient with measles is infective from 4 days before to 4 days after the rash appears and single case measles can cause 18 secondary infections. It can lead to serious complications like pneumonia, encephalitis and mortality especially in younger and malnourished children. According to the WHO, measles is one of the major contributors to vaccine-preventable infant deaths.[1,2]

Measles vaccination is highly effective and has played a pivotal role in the prevention of measles.[1,2,3] There are 3 types of vaccines available; a monovalent measles vaccine, a combined measles–rubella (MR) vaccine, and a combined

measles–mumps–rubella (MMR) vaccine.

Currently, the combination vaccine MR is being used in expanded programme on immunization (EPI) in Pakistan. According to the EPI schedule, the first dose of the MR vaccine is administered at 9 months of age, followed by a second dose at 15 months.[4] The WHO and EPI have set high targets for the elimination of measles and the role of vaccination is central. However, despite this measles outbreaks are still occurring. Recent data show the re-emergence of measles in Pakistan.

The National Institute of Health Pakistan, Integrated Disease Surveillance & Response (IDSR) Weekly Public Health Bulletin of Week 17, Jun 2025 and week 50, Dec 2025 highlighted an increase in laboratory-confirmed measles cases nationwide exacerbated by the COVID-19 pandemic and recent environmental disasters (floods).[5,6,7,8] resulting in lower herd immunity levels 9. Studies have shown that this was mostly from low vaccine coverage. Similarly, the report on Progress of Measles and Rubella Surveillance in the Context of Measles Elimination in the WHO Eastern Mediterranean Region, 2019–2022 showed similar results,[9] placing Pakistan amongst five nations with the lowest levels of vaccine coverage. Low vaccine coverage maybe due to social factors such as lack of parental awareness, fear of side effects, mistrust, religious and socio-cultural beliefs.[11]

Additionally, and importantly, poor access to vaccination services and a weak health care system also contribute.[12] Occasionally however, it is due to vaccine failure. Vaccine failure may be primary, where the body fails to produce an immune response despite adequate vaccination or secondary, where immunity wanes over time. Primary vaccine failure occurs in about 5% of case who have been given only a single dose. Secondary vaccine failure is uncommon if vaccine has been given appropriately.[13]

Similar, recent measles outbreaks in different regions of the world emphasized a need to identify if the root cause for this is low vaccine coverage or vaccine failure.[14] Identifying this will help in formulating appropriate public health interventions and vaccination policies. Low vaccine coverage suggests a need for vaccination campaigns and the compliance to the vaccination schedule as advocated by CDC. On the other hand, if frequency of measles in vaccinated children will be found to be high, it will draw attention to the need to investigate the quality of measles vaccine and the reasons for vaccine failure. The study also sought to assess the factors such as age, gender and nutritional status, among vaccinated and unvaccinated measles cases.

Methodology

A cross-sectional comparative study was conducted at the Department of Pediatrics at Combined Military Hospital Sialkot from 2nd February 2026 to 31st March 2026. A total sample size of 108 was calculated using a 5% significance level ($\alpha = 0.05$), a 95% confidence interval, and an expected measles vaccination rate of 80%.[11] Non-probability consecutive sampling technique was used.

Children aged between 15 months to 5 years with confirmed cases of measles based on the operational definition and with available documented vaccination status were included in the study, whereas children with doubtful clinical feature and those without documented evidence of measles vaccination status was excluded.

After verification of vaccination status through immunization cards or EPI records and written informed consent from parents or caregivers, data was collected on a well-structured questionnaire. Demographic variables including age and gender, along with nutritional status and vaccination status, were recorded. Nutritional status was based on weight-for-height z-score and categorized as no malnutrition, moderate acute malnutrition and severe acute malnutrition. The following operational definitions were used to define the variables in the study. A measles case was

defined as any individual with fever (temperature ≥38°C) and a generalized maculopapular rash with characteristic progression and at least one of the following: cough, coryza or conjunctivitis. A child was defined as vaccinated if he or she had received two doses of measles vaccine as per the Expanded Program of Immunization (EPI) schedule (first dose at 9 months and second dose at 15 months). Malnutrition was classified according to weight for height/length (WFH/L) z-score or mid upper arm circumference (MUAC). Children with WFH/L ≥ −2 z-scores or MUAC was ≥125 mm was classified as no acute malnutrition. Those with WFH/L between −3 and −2 z-scores or MUAC between 115-124 mm had moderate acute malnutrition and those with WFH/L < -3 z-scores or MUAC < 115 mm had severe acute malnutrition.

The data analysis was conducted using SPSS version 26. Categorical variables (gender, nutritional status and vaccination status) were presented as frequencies and percentages and also were illustrated in bar graphs and pie charts and continuous variables (age) were presented as mean ± standard deviation. The difference between the vaccinated and unvaccinated group was compared using the independent t-test for continuous variables (such as age) and the Chi-square test for categorical variables (such as gender, nutritional status and vaccination status). For statistical purposes, a p-value below 0.05 was deemed significant.

Ethical approval was taken from the ethical review committee of Combined Military Hospital Sialkot vide reference number (ERC/03/2025) dated 3rd March 2025. All children presenting with clinical features of measles during the study period were evaluated, and those fulfilling the inclusion criteria were enrolled.

Permission letters were also taken from Sialkot Children Complex, Sialkot, Islam Medical & Dental College, Sialkot and Dr. Faiz Laboratory, Sialkot

Results

Of a total of 108 patients included 42 were vaccinated and 66 were not.

Table I: Frequency of vaccinated and unvaccinated children among measles cases (n = 108)

Vaccination Status	Frequency (n)	Percentage (%)	p-value
Vaccinated	42	38.8	<0.001
Unvaccinated	66	61.1	

Table II: Comparison of age between vaccinated and unvaccinated children

Group	Mean±SD	p-value
Vaccinated (n = 42)	3.12±1.05	0.021
Unvaccinated (n = 66)	2.66±1.14	

Table III: Comparison of nutritional status between vaccinated and unvaccinated children

Nutritional Status	Vaccinated (n=42)	Unvaccinated (n=66)	p-value
No Malnutrition	20 (47.6%)	19 (28.8%)	<0.001
Moderate Acute Malnutrition	15 (35.7%)	26 (39.4%)	
Severe Acute Malnutrition	7 (16.6%)	30.3%)	

The mean age of vaccinated children was 3.12 ± 1.05 years, whereas the mean age of unvaccinated children were 2.66 ± 1.14 years. There was a statistically significant difference in the mean age of the two groups (p = 0.021). [Table II]. Among vaccinated children, 22 (53.1%) were male and 20 (46.9%) were female, while in the unvaccinated group, 39 (58.5%) were male and 27 (41.5%) were female. The gender variance between the two groups was statistically insignificant (p = 0.332). Regarding nutritional status, 20 (47.6%) vaccinated children had no malnutrition compared to 19 (28.8%) in the unvaccinated group. Moderate acute malnutrition was observed in 15 (35.7%) vaccinated and 26 (39.4%) unvaccinated children, while severe

acute malnutrition was present in 7 (16.6%) vaccinated and 20 (30.3%) unvaccinated children. The difference in nutritional status between vaccinated and unvaccinated children was statistically significant ($p < 0.001$). [Table III].

Discussion

Our study showed that most of the cases were unvaccinated (60.4%, p value <0.001). Zahoor et al and Nayar et al also reported similar finding of 63 % and 64 % unvaccinated children amongst the cases in their studies. Hussain et al however reported an even higher proportion (88%) of cases.[15,16,17] All of which suggest that the major cause for measles outbreak is lack of adequate vaccine coverage. Multiple factors may lead to low vaccine coverage including social factors such as lack of parental awareness, fear of side effects, mistrust, religious and socio-cultural beliefs.[11] Novella et al reported fear of autism to be the most common reason for MMR hesitancy. Khan et al reported in their study that 77.0% of the unvaccinated children were from the rural areas and parental negligence was cited as the reason of missed vaccination in 30.4% of cases.[11,18] Additionally, and importantly, poor access to vaccination services and a weak health care system also contributes. This is highlighted by Tariq et al[8] who reported a decline in vaccination coverage of up to 51% in Sindh, accompanied by a rise in measles cases during the COVID-19 pandemic and the 2022 flooding events. The appearance of measles throughout the COVID-19 pandemic was also brought to light by Rana et al.[7], who also found similar findings.

Of the unvaccinated population who had measles, the average age was 2.66 ± 1.14 years, whereas the mean age of unvaccinated children was 3.12 ± 1.05 years. there was a statistically significant difference in the mean ages of the two group ($p = 0.021$). Hussain et al[17] also reported a slightly younger age of 21.26 ± 26.95 months. However, Khalil et reported a relatively higher age of 6.48±3.72 years.[19]

Further SAM was noted in 58 (29.7%) of the unvaccinated population versus 22 (17.2 %) of the vaccinated population. The difference in nutritional status between vaccinated and unvaccinated children was statistically significant ($p < 0.001$). This is relevant as younger age and malnutrition significantly increase the morbidity and mortality associated with measles.[20]

Finally, 39.6 % of children with measle were vaccinated indicating a high incidence of vaccine failure in these children. Additionally, the mean age of these children was slightly higher 3.12 ± 1.05 years as compared to 2.66 ± 1.14 years ($p = 0.021$), suggesting partial protection in the vaccinated children. According to Memon et al.[21] study that analyzed information collected from 6.2 million children registered in the Sindh Provincial Electronic Immunisation Registry (ZM-EIR) only 58.1% of vaccinated children between the ages of 15 and 23 months got their second dose of measles vaccine as recommended, even though 80.6% of children got their first dose on time.

Furthermore, only about 36.6% receiving the first dose within the recommended age range. Khan et al also reported measles cases in vaccinated children and low second-dose vaccine coverage in a rural population of Peshawar. [22]

Conclusion

Unvaccinated children accounted for a greater proportion of measles cases compared with vaccinated children. Vaccinated children demonstrated comparatively better nutritional status than unvaccinated children. Strengthening immunization coverage and addressing malnutrition is essential to reduce measles-related burden.

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