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ANALYSIS OF THE EFFECTIVENESS OF MEASLES PREVENTION THROUGH VACCINATION IN THE KHOREZM REGION

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Abstract

Measles remains one of the most contagious viral infections worldwide, posing a persistent public health challenge despite the availability of safe and effective vaccines. Ensuring adequate vaccination coverage and monitoring post-vaccination immunity are essential to maintaining epidemiological stability and achieving sustainable herd immunity. Regional assessments of immunization effectiveness provide important evidence for strengthening national immunization strategies.

This study aimed to analyze the effectiveness of measles prevention through vaccination in the Khorezm region. An analytical cross-sectional study was conducted during 2024–2025 to evaluate post-vaccination immune response and the overall effectiveness of specific prophylaxis. The level of protective IgG antibodies against measles virus was determined using enzyme-linked immunosorbent assay (ELISA). A threshold of ≥200 mIU/mL was considered indicative of protective immunity. Statistical analysis was performed using standard epidemiological methods, including calculation of percentages, confidence intervals, and significance testing.

Keywords: measles, vaccination, specific prophylaxis, immunity, children, Khorezm region.

Introduction

Measles is a highly contagious infectious disease caused by an RNA virus belonging to the genus *Morbillivirus* of the *Paramyxoviridae* family. The infection is primarily transmitted via the airborne droplet route, and the contagiousness index reaches 95–98% [1]. In unvaccinated or non-immune populations, the disease can rapidly acquire epidemic proportions.

According to data from the World Health Organization, in recent years a resurgence in global measles incidence has been observed. During 2022–2023, decreased vaccination coverage and disruptions in immunization programs during the pandemic led to an increase in measles cases in

many countries [2,3]. The risk of mortality and severe complications among children remains significant.

Clinically, measles is characterized by high fever, intoxication syndrome, catarrhal symptoms (cough, rhinitis, conjunctivitis), and maculopapular exanthema. In severe cases, complications such as pneumonia, acute otitis media, laryngotracheitis, and encephalitis may develop [4]. In immunocompromised children, the disease tends to have a more severe course with a higher risk of complications.

The most effective preventive measure against measles is specific prophylaxis, namely the administration of a live attenuated vaccine. Vaccination induces a humoral immune response, resulting in the production of protective IgG antibodies [5]. When herd immunity reaches at least 95%, transmission of the infection can be interrupted [6].

According to the National Immunization Schedule of the Republic of Uzbekistan, measles vaccination is administered at 12 months of age, with revaccination at 6 years of age. However, even in regions with high vaccination coverage, assessing the level of immunity formation through serological monitoring remains highly important. In particular, in provinces with a high density of the pediatric population, analyzing the effectiveness of the immune response is an urgent task to ensure epidemiological stability.

In the Khorezm region, a scientific evaluation of the effectiveness of measles preventive measures among children is essential for reducing epidemiological risk and strengthening herd immunity. Therefore, the present study was aimed at assessing the level of protective immune response formation in children following vaccination.

Objective of the Study

The aim of this study was to evaluate the effectiveness of specific measles prophylaxis among children in the Khorezm region, to determine the level of protective immunity formation following vaccination across different age groups, and to analyze herd immunity indicators.

Materials and Methods

This study was conducted as an analytical cross-sectional observational study in the Khorezm region during 2024–2025. The aim of the study was to assess the level of protective immunity formation in children following measles vaccination. A total of 36 children were enrolled in the study.

The participants were divided into two age groups:

- **Group I** — 24 children (under 1 year of age)
- **Group II** — 12 children (4–13 years of age)

All children had received measles vaccination in accordance with the National Immunization Schedule of the Republic of Uzbekistan.

Inclusion criteria:

- Vaccination according to the National Immunization Schedule;
- Healthy or clinically stable condition;
- Written informed consent obtained from parents or legal guardians.

Exclusion criteria:

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- Presence of immunodeficiency conditions;
- Acute infectious disease at the time of examination;
- History of receiving blood products.

Research Methods

1. Clinical Assessment

All children underwent clinical evaluation, including assessment of general condition, monitoring of post-vaccination reactions (hyperthermia, local injection-site reactions), and identification of any complications.

2. Epidemiological Analysis

Vaccination history, timing of immunization, revaccination status, and epidemiological anamnesis were analyzed.

3. Serological Study

To evaluate the immune response, venous blood samples were collected from all participants. Serum samples were analyzed using the enzyme-linked immunosorbent assay (ELISA) method.

The concentration of IgG antibodies against measles virus was measured in accordance with international standards and expressed in IU/mL.

A protective immunity threshold of ≥ 200 mIU/mL (milli-International Units per milliliter) was established based on laboratory reference values.

Immunity formation was assessed 4–6 weeks after vaccination.

4. Statistical Analysis

Data were processed using Microsoft Excel and SPSS software.

Results were presented as:

- Absolute numbers (n)
- Percentages (%)
- 95% confidence intervals (95% CI)

Differences between groups were evaluated using the chi-square (χ^2) test. A p-value < 0.05 was considered statistically significant.

The study was conducted in accordance with bioethical standards. Written informed consent was obtained from the parents or legal guardians of all participants.

Results

A total of 36 children were enrolled in the study. Of these, 24 (66.7%) were under 1 year of age, and 12 (33.3%) were aged 4–13 years.

According to serological analysis, protective levels of IgG antibodies were detected in 22 children (91.6%; 95% CI: 73.0–98.9%) in Group I (under 1 year of age). In 2 children (8.4%), antibody levels were below the protective threshold.

In Group II (4–13 years of age), stable immunity was observed in 11 children (91.7%; 95% CI: 61.5–99.8%). In 1 child (8.3%), the immune response was insufficient.

No statistically significant difference in immunity formation was found between the two age groups ($\chi^2 = 0.0004$; $p > 0.05$), indicating comparable vaccination effectiveness across both groups.

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In the total study population, protective immunity was observed in 91.7% of participants (33/36; 95% CI: 77.5–98.2%) (Table 1).

Post-vaccination reactions were recorded in 5 children (13.8%; 95% CI: 4.7–29.5%). These reactions were limited to mild subfebrile fever and local hyperemia. No severe adverse events were reported (Table 2).

Table 1. Post-vaccination Protective Immunity Against Measles by Age Group

Indicator	Group I (<1 year)	Group II (4–13 years)	Total
Number of children (n)	24	12	36
Protective IgG level, n (%)	22 (91.6%)	11 (91.7%)	33 (91.7%)
95% CI	73.0–98.9%	61.5–99.8%	77.5–98.2%
Below protective threshold, n (%)	2 (8.4%)	1 (8.3%)	3 (8.3%)
χ^2 / p-value	-	-	0.0004 / >0.05

Table 2. Post-vaccination Reactions

Indicator	n	%	95% CI
Mild reactions (subfebrile fever, local hyperemia)	5	13.8%	4.7–29.5%
Severe adverse events	0	0%	-

Discussion

The obtained results demonstrate that specific measles prophylaxis among children in the Khorezm region exhibits high immunological effectiveness. The overall level of protective immunity in the study population reached 91.7%. Immune response indicators were nearly identical across both age groups, with no statistically significant difference observed ($p > 0.05$).

According to international studies, a live attenuated measles vaccine induces protective immunity in 85–95% of individuals after the first dose, and this rate increases to 95–99% following revaccination [1,2]. In our study, the immunity formation rate exceeded 90%, which is consistent with global data.

The World Health Organization states that vaccination coverage of at least 95% is required to ensure herd immunity [3]. In the present study, overall protective immunity was 91.7%. Although this reflects high effectiveness, it also indicates the need to further increase coverage in order to fully eliminate epidemiological risk.

In a small proportion of children (8.3–8.4%), protective antibody levels were not sufficiently formed. In international literature, such cases are described as “primary vaccine failure” and may be

associated with individual immune characteristics, persistence of maternal antibodies, vaccine storage conditions, or logistical factors [4,5].

Seroepidemiological studies conducted in European and Asian countries have similarly reported insufficient immune responses in approximately 5–10% of children [6]. The approximately 8% observed in our study is consistent with these international findings.

Mild post-vaccination reactions were recorded in 13.8% of cases, which falls within the 10–20% range reported in international data [2]. The absence of severe adverse events further confirms the safety profile of the vaccine.

It should be noted that the limited sample size (n = 36) somewhat restricts the generalizability of the findings. Future multicenter studies involving larger populations are recommended.

Overall, the results of this study indicate that specific measles prophylaxis in the Khorezm region demonstrates high immunogenicity. The findings are consistent with international research and confirm the effectiveness of the national immunization program. At the same time, continued serological monitoring is necessary to ensure that herd immunity levels reach and exceed 95%.

Conclusion

1.Specific measles prophylaxis among children in the Khorezm region demonstrated high immunological effectiveness.

2.The level of protective immunity formation was 91.6% among children under 1 year of age and 91.7% among children aged 4–13 years.

3.No statistically significant difference in immune response indicators was observed between the age groups ($p > 0.05$), indicating consistent vaccination effectiveness in both groups.

4.Post-vaccination reactions were mild and short-term, and no severe adverse events were recorded, confirming the safety of the vaccine.

5.Although the overall immunity level reached 91.7%, maintaining vaccination coverage at 95% or higher and continuing serological monitoring is recommended to ensure full herd immunity.

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