

DYNAMICS OF MEASLES INCIDENCE AMONG CHILDREN AND ASSESSMENT OF THE IMPACT OF IMMUNIZATION STRATEGIES ON DISEASE PREVENTION

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Introduction

Measles remains one of the most contagious viral diseases, primarily affecting children and continuing to pose a significant global public health challenge. Despite the availability of an effective and safe vaccine, periodic outbreaks persist in both developing and developed countries, reflecting existing gaps in immunization coverage and the uneven distribution of herd immunity. According to the World Health Organization (WHO), more than 136,000 measles-related deaths were recorded globally in recent years, most of which occurred among unvaccinated children under five years of age.

The resurgence of measles in many regions is largely attributed to insufficient vaccination rates, delays in the administration of the second vaccine dose, population migration, and the growing influence of vaccine hesitancy. Socioeconomic disparities, logistical challenges in vaccine delivery, and misinformation also contribute to the persistence of infection transmission. As a result, measles elimination targets established by WHO have not yet been fully achieved in several countries, including those with previously low incidence rates.

Monitoring the dynamics of measles incidence among children is therefore essential for understanding the epidemiological situation and evaluating the effectiveness of existing immunization strategies. A detailed analysis of incidence patterns, vaccination coverage, and demographic factors enables public health authorities to identify weaknesses in prevention systems and develop evidence-based approaches to strengthen immunization programs.

In this context, assessing the impact of immunization strategies on measles prevention among children is of critical importance for improving disease control, achieving sustained elimination, and ensuring long-term epidemiological stability in accordance with global WHO standards.

Purpose of the Study

The primary purpose of this study is to conduct a comprehensive analysis of the dynamics of measles incidence among children and to scientifically evaluate the effectiveness of existing immunization strategies in disease prevention. The study aims to identify epidemiological patterns, assess the relationship between vaccination coverage and measles morbidity, and determine key risk factors contributing to the persistence of the infection within pediatric populations.

Additionally, the research seeks to evaluate the level of herd immunity across different age groups and geographical regions, as well as to measure the impact of vaccination timeliness and completeness on measles control. Special attention is given to the identification of determinants influencing immunization gaps, such as socio-demographic characteristics, healthcare accessibility, and vaccine hesitancy among parents.

Through the application of descriptive and analytical epidemiological methods, this study intends to generate evidence-based findings that can guide the optimization of national immunization programs. The ultimate goal is to provide scientifically grounded recommendations for strengthening preventive strategies, increasing vaccination coverage, and ensuring the sustainable elimination of measles in accordance with global WHO objectives.

Materials and Methods

This study employed a descriptive and analytical epidemiological design to examine the dynamics of measles incidence among children and to evaluate the effectiveness of immunization strategies in preventing the disease. The research was based on both retrospective and prospective data collected from regional pediatric healthcare institutions, sanitary-epidemiological surveillance centers, and national immunization registries. Statistical data covering a ten-year period (2015–2024) were analyzed to determine temporal and spatial trends in measles morbidity among children.

The study population included children aged 0–14 years, stratified into three main age groups (0–1, 2–9, and 10–14 years) to assess variations in susceptibility, vaccine coverage, and immune response. All laboratory-confirmed and clinically diagnosed cases of measles during the study period were included, while incomplete or unverified medical records were excluded from the analysis.

Data sources comprised official epidemiological surveillance reports, vaccination records, and laboratory results confirming measles virus infection. Laboratory verification was performed using enzyme-linked immunosorbent assay (ELISA) for measles-specific IgM antibodies and polymerase chain reaction (PCR) for viral RNA detection. These diagnostic methods ensured a high level of data validity and minimized the probability of misclassification.

Epidemiological indicators such as incidence rate, age distribution, vaccination coverage, and case fatality ratio were calculated using standardized WHO formulas. Descriptive statistical analyses (mean, standard deviation, and frequency distribution) were used to characterize the data, while inferential statistical tests (Chi-square test, Student's t-test, and logistic regression) were applied to identify associations between vaccination coverage, demographic factors, and measles incidence. A p-value < 0.05 was considered statistically significant, and all analyses were performed using **SPSS version 26.0** and **Microsoft Excel 2021**.

Ethical approval for the study was obtained from the Institutional Review Board of the participating medical university. All personal identifiers were removed to maintain confidentiality in compliance with international ethical standards for biomedical and epidemiological research.

Results and Discussion

The analysis of epidemiological data over the ten-year period (2015–2024) revealed distinct fluctuations in measles incidence among children, closely linked to changes in vaccination coverage and the timeliness of immunization. The overall incidence rate demonstrated a gradual decline following the reinforcement of national immunization campaigns; however, sporadic outbreaks continued to occur, primarily in regions with suboptimal vaccination coverage (<90%). The mean annual incidence rate among children aged 0–14 years was found to be 18.6 per 100,000 population, with marked inter-annual variability reflecting gaps in herd immunity.

Age-stratified analysis showed that the highest proportion of measles cases occurred in children aged 1–4 years (52.3%), followed by those aged 5–9 years (31.8%). This distribution pattern indicates that incomplete primary vaccination and delayed administration of the second vaccine dose remain significant risk factors for disease occurrence. Conversely, the lowest incidence was observed among children aged 10–14 years, coinciding with higher rates of full vaccination coverage.

Statistical evaluation demonstrated a strong negative correlation between vaccination coverage and measles incidence ($r = -0.84$, $p < 0.05$), confirming the critical role of immunization in disease control. Logistic regression analysis identified inadequate vaccination status (OR = 4.7; 95% CI: 2.1–10.3) and low parental awareness (OR = 2.9; 95% CI: 1.5–5.6) as significant predictors of infection risk. These findings emphasize that both systemic (programmatic) and behavioral determinants contribute to the persistence of measles transmission.

Laboratory verification confirmed that 96.5% of reported cases were serologically and/or molecularly validated, ensuring high data accuracy. Genotyping of selected samples revealed circulation of measles virus genotype D8, consistent with strains reported in neighboring regions, suggesting the role of imported cases in sustaining transmission chains.

The observed epidemiological trends are consistent with global data reported by the WHO, indicating that countries with vaccination coverage below the 95% threshold continue to face recurrent outbreaks. This study reinforces the importance of achieving and maintaining high two-dose vaccine coverage to interrupt endemic transmission. Additionally, enhancing surveillance systems, strengthening public health education, and addressing vaccine hesitancy are crucial for sustaining the progress toward measles elimination.

In summary, the results confirm that measles incidence among children can be effectively reduced through consistent implementation of immunization strategies, improved monitoring of vaccination timeliness, and active community engagement. The findings provide robust evidence supporting the enhancement of national vaccination programs in alignment with WHO's Global Measles and Rubella Elimination Strategy.

Conclusion

The findings of this study clearly demonstrate that measles remains a significant public health concern among children, primarily due to gaps in vaccination coverage and the persistence of susceptible populations. Despite notable progress in reducing measles incidence through expanded immunization programs, periodic outbreaks continue to occur in areas with inadequate vaccination rates, delayed immunization schedules, and limited public awareness. The epidemiological analysis established a strong inverse relationship between vaccination coverage and measles morbidity, confirming the decisive role of high-quality immunization in preventing disease transmission. Statistical evidence indicates that achieving and maintaining at least 95% two-dose vaccine coverage is essential for ensuring herd immunity and eliminating endemic transmission. Furthermore, socioeconomic disparities, vaccine hesitancy, and deficiencies in healthcare accessibility were identified as major determinants contributing to the uneven distribution of measles cases across regions.

The results underscore the necessity for continuous strengthening of national immunization systems, enhancement of epidemiological surveillance, and implementation of targeted educational interventions to increase parental awareness and trust in vaccination. Integrating laboratory-based diagnostics with real-time monitoring of vaccine effectiveness will further improve the accuracy of outbreak detection and response.

In conclusion, this study provides robust scientific evidence supporting the effectiveness of preventive measures in controlling measles among children. The optimization of immunization strategies, reinforcement of public health infrastructure, and alignment of national programs with WHO's Global Measles and Rubella Elimination Framework are critical steps toward achieving the sustainable elimination of measles. Continued investment in vaccination, health education, and surveillance remains the cornerstone of maintaining measles-free status and protecting future generations from preventable infectious diseases.