SPECIFIC CAUSES OF THE RAPID SPREAD OF MENINGOCOCCAL INFECTION AMONG CHILDREN AND ADOLESCENTS

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Immunology.Abstract

Meningococcal infection is one of the rapidly spreading infectious diseases among children and adolescents, characterized by severe complications and a high risk of mortality. Hygienic conditions, population density, sanitary conditions in collective institutions, and compliance with personal hygiene rules play an important role in the spread of the disease. This article highlights the epidemiological characteristics of meningococcal infection among children and adolescents, the factors contributing to its spread, and issues related to the systematic assessment of hygienic aspects of prevention. In addition, the importance of sanitary-hygienic measures, immunoprophylaxis, and a healthy lifestyle in disease prevention is analyzed.

Keywords: meningitis, meningococcemia, infectious disease, epidemiology, demographic characteristics, airborne infection, carriage, prevention, vaccination, childhood diseases, immunity, spread of infection.

Meningococcal infection has become a serious public health problem in many countries around the world due to the high mortality and disability rates associated with the disease. Before the use of antibiotics, mortality among patients with

generalized forms of meningococcal infection reached 70–80%. The use of antibiotics reduced mortality to 15%. Among survivors, approximately 20% developed severe complications, including epilepsy, intellectual disability, delayed mental development, and deafness.

Meningococci possess a complex antigenic structure. Currently, 13 serogroups are known: A, B, C, D, H, I, K, L, X, Y, Z, W135, and E29. Not all meningococci are equally pathogenic. The most epidemiologically dangerous serogroups are A, B, C, W, X, and Y, which can cause generalized meningococcal infection. Sporadic cases, outbreaks, and epidemics are mainly caused by serogroups A, B, and C. The strains with the highest virulence belong to serogroup A due to their strong invasive properties. Clinical observations indicate that infections caused by this serogroup often result in severe generalized forms of meningococcal disease.

Aim of the Study

To conduct a comprehensive analysis of the epidemiological dynamics of meningococcal infection among children and adolescents according to territorial and age groups, and to identify its seasonal and socio-hygienic characteristics.

Research Methods

- Sanitary-hygienic examination method
- Socio-hygienic method
- Epidemiological method
- Serological method
- Bacterioscopy
- Molecular genetic method (PCR)
- Analytical method
- Sanitary-statistical analysis

Research Results

In this study, groups of infected and conditionally healthy children were formed to be максимально comparable according to key demographic indicators. This increased the reliability and objectivity of the obtained results.

According to statistical analysis, a p-value greater than 0.05 indicated no significant difference between the groups, meaning that they were comparable in terms of demographic characteristics.

Table 1. Demographic Characteristics

Indicators	Reference Range	Infected (M±SD)	Healthy (M±SD)	p-value
Age (years)	7–17	12.4 ± 2.1	12.1 ± 2.3	>0.05
Boys (%)	45–55	52.3	50.1	>0.05
Girls (%)	45–55	47.7	49.9	>0.05

The analysis showed that the age indicators of children and adolescents in both groups were almost identical. The average age was 12.4±2.1 years in the infected group and 12.1±2.3 years in the healthy group. The difference was statistically insignificant (p>0.05), indicating that age did not significantly influence the study outcomes.

Gender distribution was also balanced. In the infected group, boys constituted 52.3% and girls 47.7%, while in the healthy group boys accounted for 50.1% and girls 49.9%. These differences were not statistically significant ($p>0.05$).

Balanced gender composition is methodologically important because some diseases may develop differently depending on sex-related factors such as immune response, hormonal status, and metabolism. The balanced ratio minimized the impact of these variables.

From an epidemiological perspective, this increased the external validity of the study, allowing broader generalization of the findings.

Personal Hygiene Level

Personal hygiene is one of the key factors determining population health. Among children and adolescents, the development of hygienic habits is considered an essential direction of preventive medicine.

Hand hygiene is important not only individually but also from a public health perspective. Failure to follow hygiene rules in schools and collective environments may lead to rapid transmission of infectious diseases.

The hand hygiene level in this study was assessed according to WHO recommendations. Coverage of 80% or more was considered “good,” while below 80% was classified as “poor.”

Table 2. Personal Hygiene Level

Indicator	WHO Standard	Infected (%)	Healthy (%)	OR (95% CI)	p-value

Good hand hygiene	80% coverage	18.2 ± 1.5	72.4 ± 2.6	1.0 (ref)	—
Poor hand hygiene	<80%	81.8 ± 2.7	27.6 ± 2.6	3.8 (2.4–6.1)	p<0.001

The analysis demonstrated significant differences in hand hygiene levels between the groups. Only 18.2±1.5% of infected participants had good hand hygiene, compared to 72.4±2.6% in the healthy group.

Conversely, poor hand hygiene was found in 81.8±2.7% of infected participants, compared with 27.6±2.6% in the healthy group. These differences were highly statistically significant ($p<0.001$).

The odds ratio analysis showed that poor hand hygiene increased the risk of illness by 3.8 times (OR=3.8; 95% CI: 2.4–6.1). Since the confidence interval did not include 1, the relationship was statistically significant.

These results are consistent with international studies identifying poor hand hygiene as one of the main factors in the spread of infectious diseases, especially among children in collective settings.

The findings suggest that hygienic habits among the examined children were insufficiently developed. This may be related to inadequate sanitary education, insufficient parental and teacher supervision, and poor hygienic conditions.

Improving hand hygiene can reduce disease incidence, lessen the burden on the healthcare system, and improve quality of life. The results support the need for comprehensive preventive measures aimed at increasing hygienic culture among children and adolescents, including:

- hygiene education programs,
- strengthening sanitary requirements in schools,
- regular monitoring

Incidence of Meningococcal Infection in Uzbekistan (1991–2024)

The long-term incidence rates of meningococcal infection in the Republic of Uzbekistan during 1991–2024 generally remained low, with several short-term increases.

Near-zero incidence rates were recorded during 1991–1996 (0–0.7 per 100,000 population). Subsequently:

- 1997: 2.6
- 1998: 1.5
- 1999: 1.3
- 2000: 1.5 per 100,000

The peak incidence occurred in 2001 with 7.5 cases per 100,000 population, after which the rate declined to 1.4 in 2002.

Between 2003–2011, rates fluctuated between 0.2 and 1.5. During 2012–2018, incidence remained near zero. A notable increase was again observed in 2019 with 4.6 cases per 100,000 population. Afterward, rates declined again:

- 2020: 0.3
- 2021–2023: 0

- 2024: 0.6 per 100,000 population.

Thus, the time-series structure demonstrates isolated peaks (1997, 2001, 2019) against a background of prolonged low or near-zero incidence levels.

Conclusion

The study shows that strengthening hygienic control in educational institutions and children's communities, regularly ventilating and disinfecting rooms, promoting a healthy lifestyle, and expanding vaccination measures are effective in reducing the spread of the disease.

In addition, epidemiological monitoring, early diagnosis, and systematic sanitary-educational activities play an important role in preventing meningococcal infection. A comprehensive preventive approach contributes to protecting the health of children and adolescents and preventing large-scale outbreaks of the disease.

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