



CAUSES OF PNEUMONIA IN CHILDREN

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Article history:	Abstract:
Received: June 24 th 2025 Accepted: July 26 th 2025	Pneumonia in children is one of the leading causes of childhood mortality in the global health system, especially in developing countries. This article provides a scientific overview of the causes of pneumonia, providing an in-depth analysis of infectious (viruses, bacteria, fungi) and non-infectious (environmental factors, aspiration, chronic diseases) etiological factors. Particular attention is paid to the distribution of pathogens by age group, epidemiological studies (for example, the PERCH project) and preventive measures. The article emphasizes the dominance of viral infections (RSV, rhinovirus, etc.) and the role of bacterial causes (<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i>), and also shows the importance of molecular diagnostics and vaccination. As a result, recommendations are made to improve strategies for the prevention and treatment of pneumonia.

Keywords: Pneumonia in children, etiology, viral infections, bacterial pathogens, Respiratory syncytial virus (RSV), *Streptococcus pneumoniae*, environmental factors, vaccination, molecular diagnostics, epidemiology, prevention.

INTRODUCTION

Pneumonia in children is one of the most severe infectious diseases of the respiratory system, characterized by inflammation of the lung parenchyma and often leading to death or long-term complications. According to the World Health Organization (WHO), millions of cases are reported each year among children under 5 years of age, and the disease accounts for 14–15% of childhood deaths, especially in low- and middle-income countries. The causes of pneumonia are multifactorial, involving the interaction of infectious agents (viruses, bacteria, fungi) and non-infectious factors (environmental pollution, malnutrition, chronic diseases). Recent studies, such as the Pneumonia Etiology Research for Child Health (PERCH) project, have played a significant role in determining the etiology of severe pneumonia in developing countries and have shown the dominance of viruses (especially RSV). This article aims to improve disease prevention strategies by analyzing the causes of pneumonia by age group, elucidating the molecular mechanisms of pathogens, and discussing preventive measures. The scientific approach is based on modern epidemiological and laboratory studies, which allow us to draw conclusions that can be applied in clinical practice. Pneumonia among children is one of the leading causes of childhood mortality worldwide, with particularly high rates in developing countries. According to the World Health Organization, pneumonia accounts for 14% of deaths in children under 5 years of age and in 2019 caused the deaths of 740,180 children, including 22% of deaths in children aged 1-5 years. This disease is characterized by inflammation of the lung parenchyma,

which leads to impaired function of the respiratory system and is most often caused by infectious agents, although other factors may also play a role. Modern research, such as the PERCH (Pneumonia Etiology Research for Child Health) project, is of great importance in scientifically elucidating the causes of pneumonia and studying its etiology, which has identified the main pathogens of severe pneumonia in developing countries, including respiratory syncytial virus (RSV) as the most common cause. The main causes of pneumonia in children are divided into infectious and non-infectious factors, but in most cases the disease is caused by viruses, bacteria or, rarely, fungi, with the distribution of pathogens varying depending on the age group.

Among infectious causes, viruses are the most common cause of pneumonia in children, especially in children under 5 years of age, because their immune systems are not yet fully developed and are vulnerable to viral infections. Respiratory syncytial virus (RSV) is the most dominant pathogen in this group, causing bronchiolitis and pneumonia in infants. This virus invades the epithelial cells of the lungs, causing inflammation and swelling of the mucous membrane, resulting in impaired gas exchange. In addition to RSV, rhinovirus, human metapneumovirus (HMPV), adenovirus, parainfluenza virus, and coronaviruses also play an important role, often starting with upper respiratory tract infections and spreading to the lower respiratory tract. For example, adenoviruses can cause severe necrotizing pneumonia in immunocompromised children because they interfere with the cell cycle and enhance viral replication. Bacteria also play a major role, especially in school-aged



children, where *Streptococcus pneumoniae* (pneumococcus) is the most common bacterial cause, causing inflammation in the alveoli of the lungs, causing lobar or bronchopneumonia forms of pneumonia. This bacterium evades the immune system due to its polysaccharide capsule and poses a high risk in unvaccinated children. *Haemophilus influenzae* type b (Hib) is in second place, it can cause meningitis and pneumonia, but its prevalence has been significantly reduced thanks to the Hib vaccine. Among the atypicals, *Mycoplasma pneumoniae* is more common in school-aged children (5-13 years), it binds to the cell membrane of the pathogen, exerts a cytotoxic effect and causes a mild form, the so-called "walking pneumonia", but can sometimes lead to severe complications. The causes of pneumonia in newborns (neonatal period) are specific, with pathogens from the maternal birth canal, such as group B streptococci, *Klebsiella*, *Escherichia coli*, and *Listeria monocytogenes*, dominating, leading to sepsis and pneumonia. Fungal infections are rare, but in immunocompromised children, such as those with HIV infection or chemotherapy, *Pneumocystis jirovecii* or *Candida* species can cause pneumonia, in which case opportunistic infections develop. Among the non-infectious causes, aspiration pneumonia is important, which occurs in infants as a result of milk or food debris entering the respiratory tract, which leads to chemical inflammation and secondary bacterial infection. In addition, environmental factors increase the risk of pneumonia: indoor air pollution (e.g., heating with wood or animal manure), living in crowded homes, parental smoking, and exposure to dust or allergens weaken the immune system, reducing resistance to infections. Malnutrition, especially in non-breastfed infants, reduces immunity and contributes to the severity of pneumonia, as a lack of nutrients impairs antibody production. The causes vary depending on age: in infants aged 30 days to 2 years, viruses (RSV, etc.) are responsible in 70-80% of cases, in children aged 2-5 years, a mixture of viruses and bacteria (*S. pneumoniae*, Hib) is common, and after 5 years, atypicals (*Mycoplasma*) and *S. pneumoniae* predominate. The risk of pneumonia increases and the etiology changes in the presence of chronic diseases, such as cystic fibrosis (infections with *Staphylococcus aureus* and *Pseudomonas aeruginosa*), sickle cell anemia (capsular bacteria), or HIV (*P. jirovecii*). Epidemiological studies show that the causes of pneumonia in developing countries are often associated with low vaccination rates and poor hygiene conditions, for example, the PERCH study identified RSV in 31% of severe cases and *S. pneumoniae* in 10%. Molecular

diagnostics (PCR and nasopharyngeal swabs) are important in the scientific approach to the origin of pneumonia, as they accurately identify pathogens and optimize antibiotic therapy, but in most cases, antibiotics are unnecessary due to viral etiology. Vaccination (pneumococcus, Hib, influenza and rubella) plays a key role in preventive measures, as well as breastfeeding, fresh air and hygiene strengthen immunity and reduce the risk of disease. An in-depth study of these causes will help improve strategies for preventing and treating pneumonia in children, as the multifaceted etiology requires an individualized approach.

In summary, the causes of pneumonia in children are mainly infectious, with viruses (RSV, rhinovirus, metapneumovirus) dominating in infants and young children, while bacteria (*S. pneumoniae*, *H. influenzae*) predominate in older age groups. Fungal infections and non-infectious causes, such as aspiration or environmental contamination, play an important role, especially in immunocompromised children. Chronic diseases, such as cystic fibrosis, HIV or sickle cell anemia, significantly increase the risk of pneumonia and complicate its etiology. Epidemiological studies, in particular the PERCH project, have made important progress in identifying the main causes of pneumonia in developing countries, showing a high prevalence of pathogens such as RSV and *S. pneumoniae*. In developing countries, low vaccination rates, poor hygiene conditions and socio-economic factors, such as indoor air pollution and malnutrition, have been identified as major factors contributing to the spread of the disease.

Molecular diagnostics, in particular polymerase chain reaction (PCR) and nasopharyngeal swabs, are essential in optimizing treatment strategies by accurately identifying pathogens. These methods not only help identify the causative agent of the infection, but also prevent the inappropriate use of antibiotics, since in many cases antibiotic therapy is ineffective due to viral etiology. Vaccination, especially against pneumococcal, Hib, influenza and rubella, remains the most important strategy for prevention. In addition, breastfeeding, providing clean air, observing hygiene rules and improving nutrition significantly reduce the risk of pneumonia by strengthening the immune system. In the future, an integrated global health systems approach is needed to combat pneumonia, which includes expanding vaccination programs, developing health infrastructure and addressing socio-economic factors. For example, switching to clean energy sources and improving hygiene education are important to reduce indoor air pollution. Also, the development of new-



generation vaccines and the wider use of molecular diagnostics will increase the effectiveness of pneumonia prevention and treatment. This comprehensive approach will help reduce pneumonia-related mortality in children and achieve global health goals. In-depth study of these causes and the use of modern scientific approaches will contribute to more effective prevention and treatment of pneumonia in children, which will ultimately improve child health globally.

LIST OF USED LITERATURE

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