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The global impact of respiratory infectious diseases and their challenges to public health systems

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Abstract. Respiratory infectious diseases pose a major challenge to public health systems worldwide. Influenza is a highly seasonal respiratory infectious disease. Tuberculosis, a chronic infectious disease caused by Mycobacterium tuberculosis, remains one of the major threats to global public health. Pneumonia is a common and serious respiratory infection in children and adults. This article explores the global health impact of influenza, tuberculosis and pneumonia and the challenges they pose to public health systems. Taken together, influenza, tuberculosis, and pneumonia pose multiple challenges to global public health systems. The results show that understanding the prevalence patterns, risk factors, and social determinants of these diseases is critical to developing effective public health strategies and interventions.

Keywords: influenza, tuberculosis, pneumonia, public health, global impact, vulnerable populations, economic impact, social impact.

1. Introduction

Respiratory infectious diseases are one of the major challenges to global public health. They spread rapidly and have a wide impact, often leading to serious health consequences and economic burdens. Influenza, tuberculosis and pneumonia are the three most representative respiratory infectious diseases, which cause millions of cases and a large number of deaths each year [1].

First, influenza is a highly seasonal respiratory infectious disease, and its different types and subtypes have significantly different epidemic patterns and determinants worldwide. There are complex and heterogeneous interactions between influenza virus types A (A/H3N2 and A/H1N1) and B types, in particular a consistent global negative correlation between A/H3N2 and A/H1N1. The study used machine learning methods (XGBoost) and explanatory frameworks (SHAP) to quantify the contribution of population-related, environmental-related and virus-related factors to these interactions and found that demographic factors had a significant impact on influenza type/subtype interactions. The driving force of the influenza A virus is stronger than that of type B, and the driving force of A/H3N2 is stronger than that of A/H1N1. These findings provide an important basis for understanding the transmission patterns of influenza viruses and formulating public health strategies.

Tuberculosis, a chronic infectious disease caused by Mycobacterium tuberculosis, remains one of the major threats to global public health. Although the World Health Organization's (WHO) global tuberculosis control strategy has achieved some results in diagnosis and treatment, its epidemiological impact is still less effective than expected. Studies indicate that factors such as poor living and working conditions, high-risk TB transmission environments, and compromised host immunity (such as HIV

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infection, malnutrition, smoking, diabetes, alcohol abuse, and indoor air pollution) significantly increase the risk of TB. Therefore, preventive interventions targeting these risk factors and social determinants, in addition to existing diagnostic and treatment strategies, are needed to achieve long-term TB control goals.

Finally, pneumonia is a common and serious respiratory infection in children and adults, with higher morbidity and mortality, especially in low- and middle-income countries. A case-control study was conducted in nine public health hospitals in Sisau District, Ethiopia, to identify predictors of pneumonia in children under five years of age. The study found that factors such as washing hands with water without soap, living close to the street, using animal waste for fuel, having children cared for by domestic workers or domestic helpers, and having a recent acute respiratory infection significantly increased a child's risk of pneumonia. These findings suggest the need for greater public health education and improved living conditions to reduce the incidence of childhood pneumonia.

In recent years, with the acceleration of globalization and the increase in population mobility, the transmission patterns of these diseases have become more complex and changeable. Therefore, it is of great significance to deeply study the global impact of respiratory infectious diseases and their challenges to the public health system.

In existing studies, the seasonal epidemic pattern of influenza and its determinants have received widespread attention. For example, a study used machine learning methods to analyze global influenza surveillance data, revealing the interactions between different types/subtypes of influenza viruses and their influencing factors. In terms of tuberculosis, researchers focused on the impact of socioeconomic factors and host immunity on the spread of tuberculosis and proposed a comprehensive control strategy. For pneumonia, the research mainly focused on epidemiological characteristics, clinical manifestations and prevention and control measures. However, most existing studies focus on a single disease, and there are relatively few studies that systematically compare the global impact of different respiratory infectious diseases and their public health challenges.

This study aims to comprehensively analyze the global impact of three major respiratory infectious diseases: influenza, tuberculosis, and pneumonia, and explore their transmission patterns, risk factors, and challenges to the public health system. By comparing and analyzing the epidemiological characteristics and prevention and control strategies of different diseases, we can reveal their commonalities and differences and provide a scientific basis for the formulation of more effective public health policies.

This study adopts the method of literature review, systematically searching and screening relevant literature to review the latest research progress on influenza, tuberculosis, and pneumonia. This study not only helps to deepen the understanding of influenza, tuberculosis, and pneumonia but also provides new perspectives and methods for the field of public health. By revealing the common risk factors and unique transmission patterns of the three diseases, this study provides a scientific basis for future disease prevention and control and public health policy formulation. In addition, the research results can also be used to predict possible disease outbreaks in the future and make targeted prevention and control recommendations for different regions and populations, thereby improving the response capacity of the global public health system.

2. Scientific response to global respiratory infectious diseases

Respiratory infectious diseases, such as influenza, tuberculosis, and pneumonia, have long posed a major challenge to public health systems worldwide. The scientific response to these diseases requires comprehensive consideration of epidemiology, socioeconomic factors, and the allocation of medical resources.

2.1. Scientific response to influenza

Influenza is a highly contagious respiratory disease with complex and diverse epidemic patterns. According to the research mentioned in "Influenza.pdf", different types and subtypes of influenza viruses (such as A/H1N1, A/H3N2, B) have different prevalence rates around the world [1]. To

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effectively combat the global spread of influenza, scientists have used machine learning methods (such as XGBoost) and explanatory frameworks (SHAP) to quantify the contributions of population-related, environmental-related, and virus-related factors to influenza type/subtype interactions. Research shows that influenza A viruses (particularly A/H3N2) have stronger driving forces globally and interact significantly differently with influenza B viruses [2].

In terms of scientific response, the world needs to strengthen influenza surveillance and early warning systems, and timely detect the outbreak and spread of influenza epidemics through real-time data analysis and prediction models. In addition, promoting and popularizing influenza vaccination is an important measure to prevent influenza. Countries should formulate and adjust vaccination strategies based on epidemiological data to ensure that high-risk groups (such as the elderly, children and patients with chronic diseases) can receive priority vaccine protection [2].

2.2. Scientific response to tuberculosis

Tuberculosis is a chronic infectious disease that mainly affects the lungs. The spread of tuberculosis is not only related to the pathogen itself, but also affected by various factors such as socioeconomic environment, population density, and sanitary conditions [3]. Research shows that social determinants such as poverty, malnutrition, and indoor air pollution play an important role in the TB epidemic.

To effectively combat TB, scientists recommend comprehensive prevention and control measures. First, strengthen screening and early diagnosis of high-risk groups for tuberculosis to ensure that patients can receive timely treatment. Secondly, improve social and economic conditions, reduce poverty and malnutrition, and improve people's quality of life and health [3]. In addition, health education should be promoted to enhance public understanding of tuberculosis prevention and control knowledge and reduce the risk of infection [4].

2.3. Scientific response to pneumonia

Pneumonia is a respiratory infection caused by various pathogens, which seriously threatens the health of children and the elderly. The occurrence of pneumonia in children is related to many factors, such as the use of unclean water sources, poor living environment, improper use of fuel, etc [5]. Studies have shown that factors such as using water instead of soap for handwashing, living close to the street and using animal waste for fuel significantly increase the risk of pneumonia in children.

Scientific response strategies to pneumonia include improving sanitary conditions, promoting the use of clean water sources and sanitation facilities, and reducing the impact of environmental pollution on health [5]. In addition, children's health care should be strengthened and vaccination should be promoted to prevent infections caused by common pathogens such as pneumococcus [6]. For children who are already sick, timely provision of antibiotic treatment and supportive care can reduce mortality and complication rates.

The scientific response to global respiratory infectious diseases requires multi-faceted and comprehensive measures, including strengthening disease surveillance and early warning, promoting vaccination, improving socioeconomic conditions and the health environment, and strengthening health education. Through scientific prevention and control strategies, the global public health system can more effectively respond to the challenges of respiratory infectious diseases such as influenza, tuberculosis, and pneumonia and protect human health.

3. Impact of respiratory infectious diseases on immunosuppressed patients

The impact of respiratory infectious diseases on immunosuppressed patients is an important and complex public health issue. Immunosuppressed patients are more susceptible to respiratory infectious diseases and their condition is more severe due to the weakened function of their immune system. This article will discuss in detail the impact of three major respiratory infectious diseases, including influenza, tuberculosis and pneumonia, on immunosuppressed patients, and propose corresponding scientific response strategies.

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3.1. Impact of influenza on immunosuppressed patients

Influenza is an acute respiratory infection caused by influenza viruses and is highly contagious. The risk of influenza is particularly significant for immunosuppressed patients, such as cancer patients, organ transplant recipients, and people infected with HIV. According to relevant studies, immunosuppressed patients are more likely to develop serious complications after influenza infection, such as pneumonia, respiratory failure, and multiple organ failure [7]. Because their immune systems are unable to effectively fight the virus, these patients' disease progresses rapidly, and their hospitalization and death rates are significantly higher than those of the general population.

To protect immunosuppressed patients, influenza vaccination is the most effective preventive measure. However, due to their immunosuppressed status, these patients have a weaker immune response to the vaccine and the protective efficacy of the vaccine may be reduced. Therefore, in addition to the patient himself being vaccinated, family members and caregivers around him should also be vaccinated to create a protective barrier [8]. In addition, antiviral drugs such as oseltamivir (Tamiflu) used in the early stages of influenza can also effectively reduce the severity of the disease.

3.2. Impact of tuberculosis on immunosuppressed patients

Tuberculosis is a chronic infectious disease caused by Mycobacterium tuberculosis that primarily affects the lungs. Immunosuppressed patients, especially those with HIV infection, are at significantly increased risk of developing tuberculosis. The immune systems of HIV-infected people are severely damaged and cannot effectively control the reproduction of Mycobacterium tuberculosis, leading to a significant increase in the incidence and mortality of tuberculosis. Studies show that people with HIV have a 20 to 30 times higher risk of developing tuberculosis than the general population [9].

Organ transplant recipients and cancer patients receiving immunosuppressive therapy are also susceptible to TB infection after surgery and during treatment. These patients often present with atypical symptoms after being infected with tuberculosis, which can easily lead to misdiagnosis and delayed treatment [9]. Therefore, regular screening and early diagnosis are particularly important for these high-risk groups.

In terms of treatment, immunosuppressed patients need to pay special attention to drug interactions and side effects when receiving anti-tuberculosis treatment. Since they usually need to take immunosuppressive drugs for a long time, the interaction between anti-tuberculosis drugs and immunosuppressive drugs may affect the treatment effect or even worsen the condition [10]. Therefore, the development of treatment plans should be carried out by an experienced multidisciplinary team to ensure the safety and effectiveness of the treatment.

3.3. Impact of pneumonia on immunosuppressed patients

Pneumonia is an acute lower respiratory tract infection caused by a variety of pathogens such as bacteria, viruses, and fungi. Immunosuppressed patients have a significantly increased risk of pneumonia due to their low immune defenses. In particular, bacterial pneumonia, such as Streptococcus pneumoniae infection, poses the greatest threat to immunosuppressed patients. Studies have shown that immunosuppressed patients have more severe illness, longer hospital stays and higher mortality rates when infected with pneumonia [11].

The key to preventing pneumonia lies in vaccination and the rational use of antibiotics. For immunosuppressed patients, vaccination against pneumonia (such as pneumococcal vaccine and influenza vaccine) is an important measure to prevent pneumonia [11]. However, as with the influenza vaccine, immunosuppressed patients may have a weaker immune response to the pneumonia vaccine, requiring a booster dose or a different type of vaccine to increase protection.

In terms of treatment, early use of broad-spectrum antibiotics is key to controlling bacterial pneumonia [12]. However, due to the complex condition of immunosuppressed patients, the selection and use of antibiotics need to be cautious to avoid the development of drug-resistant strains. In addition, for viral pneumonia and fungal pneumonia, the timely use of antiviral drugs and antifungal drugs is also crucial [12].

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The impact of respiratory infectious diseases on immunosuppressed patients is profound and complex. A scientific response to these diseases requires a comprehensive consideration of vaccination, early screening and diagnosis, collaboration of multidisciplinary treatment teams, and individualized treatment plans for patients. By strengthening global health surveillance, promoting vaccine and treatment research, and improving public health infrastructure, the harm of respiratory infectious diseases to immunosuppressed patients can be effectively reduced and their quality of life and survival rate can be improved.

4. Prevalence and incidence of respiratory infectious diseases

Pneumonia is a respiratory disease that severely affects children under five years of age and is particularly prevalent in low- and middle-income countries. More than 1 million children worldwide die from pneumonia every year, accounting for 15% of total child deaths. Pneumonia morbidity and mortality are particularly high in sub-Saharan Africa, South Asia, Nigeria, and the Democratic Republic of the Congo. Ethiopia is one of the worst-affected countries, with more than 3.37 million children contracting pneumonia every year, resulting in high hospitalization and medical costs [13].

Research shows that the main factors that influence pneumonia in children include: using unclean water for handwashing, living in a house close to the street, using animal waste as fuel, having children cared for by domestic workers or nannies, and having acute respiratory infection in the past two weeks. These factors significantly increase the risk of pneumonia in children.

Global control strategies for tuberculosis focus primarily on ensuring effective and equitable delivery of diagnosis and treatment. However, while existing strategies have been somewhat effective in curing patients and saving lives, their epidemiological impact has been lower than expected. The high incidence of tuberculosis is closely related to multiple risk factors, including HIV infection, malnutrition, smoking, diabetes, alcohol abuse and indoor air pollution. These factors weaken the body's resistance to TB infection and disease. Furthermore, TB is considered a “social disease” whose control requires integrated social, economic and environmental interventions. Although mass vaccination with Bacillus Calmette-Guérin (BCG) has historically been hoped to control tuberculosis, its protective efficacy and epidemiological impact have been limited. Currently, the TB control model relies mainly on early detection and effective treatment, but further preventive measures are still needed to reduce people's susceptibility to TB [14].

Influenza is a seasonal respiratory disease that spreads rapidly around the world every year. The main types of seasonal influenza viruses include influenza A (A/H3N2, A/H1N1) and influenza B (B/Yamagata lineage, B/Victoria lineage) [15]. The prevalence of different types and subtypes of influenza viruses varies across seasons and countries, suggesting potential interactions between them.

The study found that there is a significant negative correlation between influenza A/H3N2 and A/H1N1, while the interaction between influenza A and influenza B varies from country to country and is mainly affected by population-related factors. Influenza A is more contagious than influenza B, and A/H3N2 is more contagious than A/H1N1. Influenza A/H3N2 has greater advantages in terms of global transmission frequency, antigen evolution speed and epidemic frequency, and the clinical symptoms it causes are also more severe [15].

Pneumonia, tuberculosis, and influenza are major respiratory infectious diseases with high prevalence and morbidity worldwide. Their spread and onset are not only related to the characteristics of the virus itself but are also affected by socioeconomic conditions, environmental factors and individual health conditions. Effective public health strategies need to comprehensively consider these factors and reduce the prevalence and incidence of these diseases through early detection, effective treatment and preventive measures, and alleviate the challenges they pose to the global public health system.

5. Determinants and risk factors

According to the 2023 study, childhood pneumonia is particularly severe in low- and middle-income countries. The study, conducted in the Sisau region of Ethiopia, found that several factors significantly increased the risk of pneumonia in children under five. Use of unclean water sources: Using untreated

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water sources for drinking and daily living increases the risk of contracting pathogens. Living close to the street: Households living close to the street have increased exposure to air pollution and dust, leading to higher rates of respiratory diseases. Using animal dung as fuel: The smoke produced by burning animal dung contains a lot of harmful substances and can easily cause respiratory infections. Child care is the responsibility of domestic workers: Domestic workers may lack professional child care knowledge, resulting in increased health risks for children.

Acute respiratory infection within the last two weeks: Children with a history of respiratory tract infection are more likely to get pneumonia again.

Research shows that these factors not only affect the health of children but also have a profound impact on the overall health of families and communities. Therefore, improving the quality of water sources, improving the living environment, promoting the use of clean energy, and strengthening the popularization of childcare knowledge is of great significance for the prevention and control of childhood pneumonia.

The prevalence of tuberculosis is not only affected by biomedical factors but also closely related to socioeconomic factors. Poverty and poor living conditions: Residents of poor areas often live in crowded, unsanitary conditions, conditions that increase the risk of TB transmission. Malnutrition: Malnutrition weakens the body's immune system and makes people more susceptible to tuberculosis. HIV infection: People with HIV infection have severely compromised immune systems and are highly susceptible to tuberculosis. Smoking and alcohol abuse: Smoking and alcohol abuse are not only harmful to lung health but also weaken overall immunity and increase the risk of contracting TB. Indoor air pollution: Using traditional fuels (such as wood, and coal) for cooking and heating produces large amounts of harmful smoke and increases the risk of respiratory infections. It is difficult to completely control the epidemic of tuberculosis by relying solely on medical intervention. Comprehensive measures need to be taken to improve socioeconomic conditions, enhance public health awareness, and reduce the spread and infection of tuberculosis.

Seasonal influenza epidemic patterns and determinants are complex and diverse. By analyzing influenza epidemiological surveillance data from 55 countries around the world, the following key factors were discovered. Population density and mobility: High population density and frequent population movements increase the chances of influenza virus transmission. Climatic and environmental factors: Climatic conditions (such as temperature, and humidity) in different regions have a significant impact on the speed and pattern of influenza virus transmission. Interactions of virus types and subtypes: There are complex interactions between different types and subtypes of influenza viruses that influence virus transmission and seasonal prevalence patterns. Public health intervention measures: Vaccination rate, public health publicity and implementation of prevention and control measures have an important impact on the epidemic of influenza. Research points out that understanding the global transmission patterns and determinants of influenza viruses is crucial to formulating effective influenza prevention and control strategies [15]. By strengthening influenza surveillance, increasing vaccination coverage, and promoting scientific prevention and control measures, we can effectively reduce the spread and prevalence of influenza and protect public health.

The determinants and risk factors for respiratory infectious diseases involve multiple aspects, including socioeconomic conditions, environmental factors, individual health status, and public health interventions. Only through comprehensive management can the challenges posed by these diseases to the global public health system be effectively addressed.

6. Those most affected

Respiratory infectious diseases pose a major challenge to public health systems worldwide, particularly in low- and middle-income countries, with certain populations disproportionately affected. Pneumonia is one of the leading causes of death in children under five years of age, particularly in low- and middle-income countries. More than 1 million children worldwide die from pneumonia every year, accounting for 15% of total child deaths [1]. Pneumonia morbidity and mortality are particularly high in sub-Saharan Africa, South Asia, Nigeria, and the Democratic Republic of the Congo. Ethiopia is one of the

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worst-affected countries, with more than 3.37 million children contracting pneumonia every year, resulting in high hospitalization and medical costs [7]. Research shows that the main factors that influence pneumonia in children include: using unclean water for handwashing, living in a house close to the street, using animal waste as fuel, having children cared for by domestic workers or nannies, and having acute respiratory infection in the past two weeks. These factors significantly increase the risk of pneumonia in children.

Tuberculosis is another serious respiratory infectious disease, especially in areas with poor living and working conditions. The prevalence of tuberculosis is closely related to socioeconomic factors. Poverty, malnutrition, crowded living conditions, indoor air pollution and HIV infection are all important risk factors for TB. The global tuberculosis control strategy proposed by the World Health Organization (WHO) mainly focuses on early case detection and effective treatment [9]. However, research shows that while this strategy has been somewhat effective in curing patients and saving lives, its epidemiological impact is still lower than expected. To achieve the long-term goals of global tuberculosis control, additional interventions are needed to reduce people's susceptibility to tuberculosis.

Influenza is a seasonal infectious disease that breaks out every year around the world, especially affecting the elderly, children, patients with chronic diseases and people with weakened immune systems. There are significant differences in the transmission patterns and determinants of influenza viruses around the world. Influenza A (A/H3N2 and A/H1N1) and influenza B (B/Yamagata and B/Victoria) are the main seasonal influenza virus types, and there may be interactions between different types/subtypes [14].

Research shows that population-related factors are one of the important factors affecting the spread of influenza. Influenza A is more transmissible than influenza B, and A/H3N2 is more transmissible than A/H1N1 [14]. By analyzing influenza epidemiological surveillance data from 55 countries, the researchers found that there are complex and heterogeneous interaction patterns between influenza virus types/subtypes in different countries.

Respiratory infectious diseases most severely affect children, the elderly, people with chronic diseases and people with weakened immune systems in low- and middle-income countries. Factors affecting the disease among these groups include socioeconomic conditions, living and working environment, nutritional status, and other health conditions. In order to effectively respond to the challenges of respiratory infectious diseases to the public health system, comprehensive measures are needed, including improving socioeconomic conditions, strengthening disease surveillance and early detection, increasing vaccination rates, and carrying out health education. Through multi-level and multi-faceted intervention measures, the morbidity and mortality of respiratory infectious diseases can be significantly reduced and the health status of the most affected people can be improved.

7. Impact on future work

Respiratory infectious diseases pose a huge challenge to the global public health system and have a profound impact on future work. Studies have found that pneumonia is particularly serious among children under five years old in low-income and middle-income countries. Future work needs to focus on the following aspects. Improve sanitation facilities: Studies have shown that the use of unclean water sources and the burning of animal dung as fuel are important factors causing pneumonia in children. Therefore, improving sanitation facilities, providing clean drinking water and safer fuel sources are the focus of future work. Strengthen health education: Increase awareness and knowledge of pneumonia prevention among families and communities, especially for families who rely on domestic workers to care for children. Health education can help reduce the risk of infection. Strengthen vaccination: Ensure that all children can be vaccinated against pneumonia promptly to reduce the risk of infection. Future work needs to strengthen the coverage and accessibility of vaccination.

The prevalence of tuberculosis is affected by a variety of social and environmental factors. Future work needs to focus on the following aspects. Improve living and working conditions: The spread of tuberculosis is closely related to poverty, crowded living environments and poor working conditions. Future work needs to improve these conditions to reduce the spread of tuberculosis. Strengthen

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interventions for high-risk groups: Studies have shown that HIV infection, malnutrition, smoking, diabetes, alcohol abuse, and indoor air pollution are important factors that increase the risk of tuberculosis. Future work needs to target these high-risk groups for intervention to reduce their risk of tuberculosis infection. Strengthen preventive measures: Current tuberculosis control strategies focus on diagnosis and treatment, but preventive measures have not received sufficient attention. Future work needs to strengthen preventive measures, such as improving nutritional status, reducing smoking and alcohol abuse, and improving indoor air quality.

Influenza

The spread of influenza viruses has seasonal and regional differences, which suggests that there may be interactions between different types/subtypes.

Strengthen monitoring and data analysis: Studies have shown that the interactions and determinants of different types/subtypes of influenza viruses need to be further explored. Future work needs to strengthen influenza monitoring and data analysis worldwide to better understand these interactions [15]. Multidimensional intervention measures: The spread of influenza is not only related to the virus itself but also to multiple factors such as population and environment. Future work needs to take multidimensional intervention measures, such as improving environmental hygiene and enhancing population immunity. Machine learning and big data applications: Studies have shown that machine learning and big data analysis can help reveal the transmission patterns and determinants of influenza viruses [12]. Future work needs to further apply these technologies to improve the efficiency and effectiveness of influenza prevention and control.

In summary, future work requires comprehensive efforts in improving health facilities, strengthening health education, increasing vaccination rates, improving living and working conditions, strengthening interventions for high-risk groups, strengthening preventive measures, strengthening monitoring and data analysis, taking multidimensional intervention measures, and applying machine learning and big data analysis to meet the challenges of respiratory infectious diseases to the global public health system.

8. Conclusion

Respiratory infectious diseases such as pneumonia, tuberculosis, and influenza pose a major challenge to public health systems worldwide. These diseases not only affect the health of a large number of people but also have a profound impact on socioeconomic development. According to studies, pneumonia is particularly serious among children under five years old in low-income and middle-income countries. The use of unclean water sources and burning animal dung as fuel are important factors that cause pneumonia in children. The prevalence of tuberculosis is affected by a variety of social and environmental factors. Although existing control strategies have achieved remarkable results in treating patients and saving lives, the effects on epidemiological impact have not met expectations. Studies on influenza have shown that seasonal influenza viruses have different epidemic patterns in different seasons and countries, indicating potential interactions between different types/subtypes.

Although these studies have provided important findings, there are also some shortcomings. Pneumonia studies are mainly focused on specific regions, lacking global data and comparative analysis, and the research methods are limited to case-control studies, which may have selection bias. The control strategy for tuberculosis is mainly focused on treatment and diagnosis, and preventive measures have not been fully considered. The study lacks an in-depth analysis of social and environmental factors and fails to fully reveal the impact of these factors on the spread of tuberculosis. Influenza research mainly relies on epidemiological surveillance data, which may have problems with inconsistent data collection and reporting, and the understanding of the interaction mechanisms between different types/subtypes is still insufficient and lacks experimental verification.

To improve these studies, it is recommended to expand the scope of research, conduct cross-national comparative analysis to obtain more comprehensive data, and adopt multiple research methods, such as longitudinal studies and randomized controlled trials. In addition, the analysis of social and environmental factors should be strengthened, and comprehensive prevention strategies should be developed, especially for tuberculosis prevention measures. For influenza research, the consistency of

data collection and reporting should be improved, and the interaction mechanisms between different types/subtypes should be verified experimentally. Future research should focus on these improvements to better meet the challenges of global respiratory infectious diseases and provide effective response strategies for public health systems.

References

[1] Chen, Y., Tang, F., Cao, Z., Zeng, J., Qiu, Z., Zhang, C., Long, H., Cheng, P., Sun, Q., Han, W., Tang, K., Tang, J., Zhao, Y., Tian, D., & Du, X. (2024). Global pattern and determinant for interaction of seasonal influenza viruses. Journal of Infection and Public Health, 17(6), 1086–1094. https://doi.org/10.1016/j.jiph.2024.04.024

[2] Iuliano, A. D., Roguski, K. M., Chang, H. H., Muscatello, D. J., Cohen, C., Schanzer, D., Cowling, B. J., Wu, P., Kyncl, J., Ang, L. W., Park, M., Redlberger-Fritz, M., Yu, H., Espenhain, L., Krishnan, A., Emukule, G., van Asten, L., Pereira da Silva, S., Aungkulanon, S., … Mustaquim, D. (2018). Estimates of global seasonal influenza-associated respiratory mortality: a modelling study. The Lancet (British Edition), 391(10127), 1285–1300. https://doi.org/10.1016/S0140-6736(17)33293-2

[3] Lönnroth, K., Jaramillo, E., Williams, B. G., Dye, C., & Raviglione, M. (2009). Drivers of tuberculosis epidemics: The role of risk factors and social determinants. Social Science & Medicine (1982), 68(12), 2240–2246. https://doi.org/10.1016/j.socscimed.2009.03.041

[4] Harling, G., Ehrlich, R., & Myer, L. (2008). The social epidemiology of tuberculosis in South Africa: A multilevel analysis. Social Science & Medicine (1982), 66(2), 492–505. https://doi.org/10.1016/j.socscimed.2007.08.026

[5] Girma, F., Ayana, M., Abdissa, B., Aboma, M., Ketema, D., Kolola, T., & Wake, S. korsa. (2023). Determinants of under-five pneumonia among children visited in nine public health Hospitals in Ethiopia. Clinical Epidemiology and Global Health, 24, 101441-. https://doi.org/10.1016/j.cegh.2023.101441

[6] Girma, F., Ayana, M., Abdissa, B., Aboma, M., Ketema, D., Kolola, T., & Wake, S. korsa. (2023). Determinants of under-five pneumonia among children visited in nine public health Hospitals in Ethiopia. Clinical Epidemiology and Global Health, 24, 101441-. https://doi.org/10.1016/j.cegh.2023.101441

[7] Park, J.-E., & Ryu, Y. (2018). Transmissibility and severity of influenza virus by subtype. Infection, Genetics and Evolution, 65, 288–292. https://doi.org/10.1016/j.meegid.2018.08.007

[8] Agwunobi, J. O. (2007). Pandemic Influenza: The Threat, Health System Implications, and Legal Preparedness. The Journal of Law, Medicine & Ethics, 35(s4), 23–27. https://doi.org/10.1111/j.1748-720X.2007.00203.x

[9] Corbett, E. L., Churchyard, G. J., Clayton, T. C., Williams, B. G., Mulder, D., Hayes, R. J., & De Cock, K. M. (2000). HIV infection and silicosis: The impact of two potent risk factors on the incidence of mycobacterial disease in South African miners. AIDS (London), 14(17), 2759–2768. https://doi.org/10.1097/00002030-200012010-00016

[10] Chen, X., Duanmu, H., Wan, L., Zhao, F., Wang, L., Tu, D., Du, Kim, S., Watt, C., Williams, B. , Chin, D., & Dye, C. (2004). The effect of tuberculosis control in China. The Lancet (British Edition), 364(9432), 417–422. https://doi.org/10.1016/S0140-6736(04)16764-0

[11] Chang, J., Liu, W., & Huang, C. (2018). Residential ambient traffic in relation to childhood pneumonia among urban children in Shandong, China: A cross-sectional study. International Journal of Environmental Research and Public Health, 15(6), 1076-. https://doi.org/10.3390/ijerph15061076

[12] Andualem, Z., Adane, T., Tigabu, A., Yallew, W. W., Wami, S. D., Dagne, H., Azanaw, J., Guyasa, G., Azene, Z. N., & Endalew, M. (2020). Pneumonia among Under-Five Children in Northwest Ethiopia: Prevalence and Predictors—A Community-Based Cross-Sectional Study. International Journal of Pediatrics, 2020, 3464907–6. https://doi.org/10.1155/2020/3464907

[13] Markos, Y., Dadi, A. F., Demisse, A. G., Ayanaw Habitu, Y., Derseh, B. T., & Debalkie, G. (2019). Determinants of Under-Five Pneumonia at Gondar University Hospital, Northwest Ethiopia: An Unmatched Case-Control Study. Journal of Environmental and Public Health, 2019, 9790216–9790218. https://doi.org/10.1155/2019/9790216

[14] HUMPHREY, J. H., NATHOO, K. J., HARGROVE, J. W., ILIFF, P. J., MUTASA, K. E., MOULTON, L. H., CHIDAWANYIKA, H., MALABA, L. C., ZIJENAH, L. S., ZVANDASARA, P., NTOZINI, R., ZUNGUZA, C. D., & WARD, B. J. (2007). HIV-1 and HIV-2 prevalence and associated risk factors among postnatal women in Harare, Zimbabwe. Epidemiology and Infection, 135(6), 933–942. https://doi.org/10.1017/S0950268806007709

[15] Macias, A. E., McElhaney, J. E., Chaves, S. S., Nealon, J., Nunes, M. C., Samson, S. I., Seet, B. T., Weinke, T., & Yu, H. (2021). The disease burden of influenza beyond respiratory illness. Vaccine, 39, A6–A14. https://doi.org/10.1016/j.vaccine.2020.09.048