Biological Times

Volume No. 3 | Issue No. 11 | Pages 23-24

# Common Winter Infectious Diseases in Humans and Contributing Factors

Neelam Arshad*

Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad-38000, Pakistan

*Corresponding Author: **neelammahar19@gmail.com**

## ABSTRACT

Winter season provides favorable conditions for certain pathogens and causes different infectious diseases in humans. These infectious diseases include respiratory tract infections, gastrointestinal infections, and bacterial infections. The causative agent of the well-known COVID-19 pandemic (coronavirus) flourished in the winter season. Many seasonal variations are cyclic and cause the peak incidence, transmission, and spread of these infectious diseases from person to person. Many factors are responsible for their rapid spread including increased indoor activity, poor ventilation, vitamin D deficiency, weakened immune system, host anti-viral mechanisms, and climate change. Early detection and optimization of preventive strategies e.g., routine vaccination, proper ventilation, boosting the immune system, etc. are necessary to prevent outbreaks of these infectious diseases.

**Keywords:** Winter infectious diseases, Acute respiratory infections (ARIs), gastroenteritis, Immune defence, Indoor crowding, Vaccination

**To cite this article:** Arshad N. Common Winter Infectious Diseases in Humans and Contributing Factors. Biological Times. 2024 November 3(11): 23-24.

**Introduction**

Human populations and their health are potentially threatened by emerging infectious diseases [1]. Perhaps the most potent and pervasive source of external variation affecting both natural and human systems is seasonal variation, which is cyclical and generally predictable. Infectious illness population dynamics is one field where the impact of these seasonal changes has been comparatively thoroughly studied [2]. Winter is when most of these infectious diseases arise. The air gets colder and drier as winter approaches, which makes it easier for the influenza virus and other infectious diseases to thrive [3]. As a result of their obvious wintertime peak incidences, respiratory syncytial virus or RSV, coronavirus, and influenza virus are commonly referred to as winter viruses [4]. When there is cold weather and people are indoors, most infectious diseases thrive. Determining the causes of the seasonal disease may present opportunities for preventive strategies, to promote successful policy development, and effective and efficient use of resources [5].

**Common Winter Infectious Diseases**

**Respiratory Infections**

Incoming respiratory viruses are prevented by the airway defense systems of the host [6]. Seasonal variations in the inhaled air's humidity and temperature have a direct impact on the airways' mucosal surface of these defenses on several levels [4]. Effects of airborne contaminants on the mucociliary action of the host are the cause of seasonal variation in the occurrence of respiratory infections [5]. Direct or indirect contact, droplet spray for short-range transmission, or aerosol for long-range (airborne) transmission are the three ways that respiratory viruses can cause infection [4]. Fever, expectoration, and cough are among the respiratory symptoms that patients with respiratory infectious illnesses frequently exhibit [3]. Particularly in young and old people, respiratory diseases are the main cause of mortality and morbidity [7].

One of the most prevalent diseases in humans is viral infections of the lower and upper respiratory tract [8]. Acute respiratory infections (ARIs) may result in severe symptoms when affecting the lower respiratory tract, even though most of them are still confined to the upper respiratory tract [9]. Rhinoviruses (RV), influenza viruses (FLU), coronaviruses (CoV), and respiratory syncytial viruses (RSV) are the viruses most frequently linked to ARIs [10].

**1. Influenza**

The spread of influenza is frequently influenced by seasonal changes. Infectious respiratory diseases are more common in the winter, which significantly raises the chance of encountering them [1]. Influenza is common around the world, especially in cold climates. Not surprisingly, influenza continued to be widespread in 2023 [11]. Regardless of the availability of antiviral medications and vaccines, influenza viruses cause significant mortality and morbidity globally, however, this virus alone is not the cause of ARIs [12].

**2. Rhinovirus**

Rhinovirus efficiently replicates at the temperature of the upper respiratory tract (33°C) due to lesser innate immune responses than at the temperature of the lower respiratory tract (37°C). In particular, the slowdown of innate immune response and the activation of IFN-stimulated genes during virus infection is due to low relative humidity [13].

**3. Respiratory Syncytial Virus (RSV)**

Cyclic epidemics and seasonal patterns are seen in the case of RSV [14]. In the United States, RSV outbreaks typically emerge during the colder winter and spring. In Singapore, however, there is a strong correlation between the hotter months and RSV outbreaks [15].

**4. SARS-CoV**

In the spring of 2013, Hong Kong encountered an outbreak of SARS-CoV. At intermediate humidity (40–50%) and room temperature (22–25°C), this virus was comparatively stable; however, its vitality rapidly declined at high humidity (> 95%) and high temperatures (38°C) [16]. China's national authorities informed the World Health Organization (WHO) in December 2019 that there were patients suffering from pneumonia with an unidentified cause. The causative agent was formally recognized as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the coronavirus-associated acute respiratory disease was named coronavirus disease 2019 (COVID-19) [17].

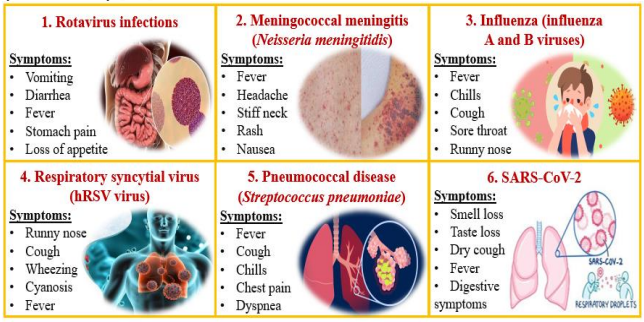


**Fig. 1: Common symptoms of respiratory infectious diseases in humans**

**Gastrointestinal Infections**

Like the flu, other viruses, such as the rotavirus that cause gastroenteritis, also exhibit seasonality during the winter months [18]. The greater viral persistence in cold water may be the cause of inter-time seasonality related to noroviruses [19]. While some non-pharmaceutical treatments for coronavirus were continued in Hong Kong, there was an abrupt decrease in viral gastroenteritis during the winter of 2019-20 and a resurgence of norovirus and rotavirus activity during the winter of 2020–21 [20]. Winter breakouts of gastroenteritis are caused by the increased ability of norovirus and rotavirus to survive at low temperatures [21].

**Bacterial Infections**

Mice in experimental conditions show distinct circadian patterns in their vulnerability to invasive pneumococcal illness, with the risk being higher in the early morning [22]. At high latitudes, the incidence rate of tuberculosis varies seasonally. People with HIV experience a higher TB incidence during winter. Both latently infected people who develop active TB and TB patients frequently have vitamin D insufficiency. Co-infection with HIV-1 accelerates the lower vitamin D status of TB patients, indicating a clear

correlation between the seasonality of TB prevalence in this population [21].

**Factors Contributing to Increased Infections in Winter Season**

**Host Social Behavior and Aggregation**

Pathogens prefer crowded environments. As the winter approaches, individuals remain indoors. Exposure to airborne infections may be increased by inadequate and poorly planned ventilation in public areas [15]. This seasonal trend of these infectious diseases is most likely caused by human behavior, which is influenced by cold weather. However, the likelihood of disease transmission would be reduced if warmer winters led to decreased indoor crowding [23]. In social contexts including homes, businesses, and schools, where people interact closely with one another, the highest rates of transmission have been documented [24]. Fewer influenza infections during vacations are linked to reduced contact among children in school during school closures [25, 26].

**Decreased Human Activity**

Summer and springtime show higher human physical activity than winter [15]. In temperate climates, decreased temperatures in the winter months may force people to stay indoors and engage in crowded activities, which could lead to virus transmission. Compared to warmer, drier weather, people tend to spend more time indoors during cold or rainy weather [16].

**Pathogen-Pathogen Interactions**

The seasonal incidence of some infectious diseases drives the seasonality of certain other infectious diseases. For instance, influenza-induced changes in the host immune response expose people to contracting meningococcal and invasive pneumococcal diseases because the peak incidence of these infections coincides with “influenza season” in North America [27].

**Immune System Response in Colder Weather**

Winter weakens the immune system, according to recent experimental research on humans, birds, and rodents [2]. After a virus infects a cell, innate immune responses are a crucial host defensive mechanism. Increased mortality from SARS-CoV-2 and influenza is linked to greater levels of interleukin 6 (IL-6); in humans, IL-6 signaling is higher in the winter [13]. The total number of white blood cells and B cells increased in the winter, between December and March. Higher adrenocortical hormone activity during winter causes an increase in B-cell and a decrease in T-cell activity resulting in the circannual change in immune function [5].

**Seasonality of Vitamin D and Clothing Style**

Seasonal 1,25-dihydroxyvitamin D deficiency results from reduced conversion of 7-dehydrocholesterol to vitamin D in the skin caused by reduced exposure to UV rays during winter. Seasonal intracellular vitamin D deficiency may be a significant cause of compromised host immune function during the winter months [28]. From November to March, there was minimal pre-vitamin D3 synthesis from pro-vitamin D3. Seasonal variability results from people wearing more clothes during the winter, which causes less skin exposed to sunlight [5].

**Host Antiviral Defense Mechanisms**

The impact of environmental factors on host antiviral defense mechanisms has drawn increased attention in recent years [4]. Dry air delays the elimination of viruses by slowing the passage of mucus along the cilia of the epithelial cell layer and results in the detachment of epithelial cells and the loss of cilia. Therefore, the first line of defense against invading viruses is weakened by reduced humidity during the winter [16].

**Climate Change and Other Environmental Factors**

The burden of infectious diseases is predicted to be significantly impacted by climate change due to altered rainfall patterns and increased temperatures [23]. The rise of infectious diseases is directly related to changes in seasonal and environmental conditions, including sunlight, temperature, humidity, wind, and rain [15]. Variations in weather circumstances that affect virus survival, host susceptibility, and virus transmission are the cause of seasonality in respiratory infectious illnesses [14].

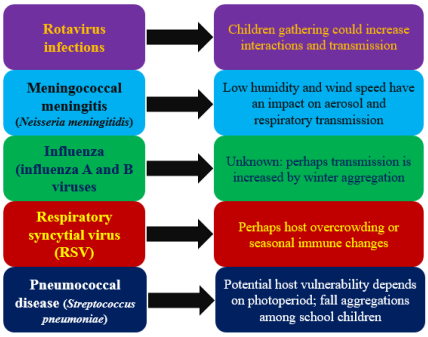


**Fig. 2: Mechanism of seasonality of winter diseases in humans.**

**Conclusion and Future Directions**

To effectively limit the transmission of infectious diseases requires early detection, quick isolation, timely diagnosis, and prompt treatment. Within cost-benefit restrictions, routine vaccination of most of the human population is the most effective way to control epidemics like influenza. Understanding the role of environmental factors could help in improving preventative measures, particularly for individuals who are at risk of infection. People should be made aware of the possible advantages of proper ventilation in homes. Balanced diet and routine exercise routinely should be followed to increase immunity. Adequate vitamin D status may be necessary, especially during the winter, to reduce infection rates. Therefore, future population-based research to assess the overall impact of vitamin D supplementation on infection rates may be necessary.

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