MAYO CLINIC

PERSPECTIVE AND CONTROVERSY

Indoor Environment and Viral Infections

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The global pandemic of severe acute respiratory coronavirus 2 (SARS-CoV-2) (ie, the cause of COVID-19) has brought the importance of the environment for health to the forefront. As people spend the majority of their time indoors, the quality of the indoor environment has a major impact on overall health. It affects risk of disease through multiple factors,including indoor air pollutants; surface contamination with toxins and microbes; and contact among persons at home, at work, in transportation, and other indoor public and private places.[1-4] Counter measures, which are conceptually amenable to focused interventions guided by science, differ markedly according to the pathogen of interest.

For viral transmission, the role of temperature and humidity has received particular attention. These relationships are critically important for predicting infection growth rates and to counsel people on possible home interventions that could be deployed to mitigate viral transmission.

The purpose of this perspective is to discuss concisely the association between virus transmission and the indoor environment. We will focus on data pertaining to temperature and humidity and comment on implications for current practice and future research.

ENVIRONMENTAL FACTORS AND VIRAL TRANSMISSION

Environmental factors—such as temperature, humidity, and ventilation—play a role in the persistence, infectivity, and dispersal and removal of viruses and can alter human defense mechanisms that protect against respiratory pathogens.[5]

Animal experiments have demonstrated a link between temperature and relative humidity and viral transmission, with a greater persistence and infectivity of influenza A virus at cold temperatures and low relative humidity.[6] Although the relationship between environmental factors and transmission of virus are multifaceted, several factors—likely operating in combination—have been evoked including reduction of mucociliary clearance by desiccation of upper airways, increased stability of viruses with a lipid envelope in dry air, and impact of relative humidity on droplet dynamics.

Cold temperature and low relative humidity are also believed to increase the transmission of other respiratory viruses, including respiratory syncytial virus (RSV), human rhinovirus, and avian influenza virus.[7]

A recent systematic analysis of 37,335 studies reported on seasonal patterns among 4 viruses: influenza virus, RSV, parainfluenza virus (PIV), and human metapneumovirus (hMPV).[8]

Influenza virus exhibited distinct seasonality in winter months in temperate climates, but the timing of epidemics was less seasonal at locations closer to the equator. Epidemics of RSV were seasonal in all regions, starting in late summer in the tropics, and showing increased prominence during the winter in temperate sites. Parainfluenza virus epidemics occurred primarily in spring and early summer. Metapneumovirus epidemics happened in late winter and spring in most temperate sites.

Importantly in this extensive analysis, the association between seasonality and temperature and relative humidity was different for influenza virus and RSV. Lower temperature was associated with higher activity of both viruses; however, higher relative humidity was associated with increased influenza virus activity if temperature was above average. In contrast, RSV activity was higher when the temperature was lower than