

## Review Article

# Is the surge in respiratory syncytial virus related to the COVID-19 pandemic? a clinical-based review

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## ABSTRACT

Respiratory syncytial virus (RSV) has been around for many years. Symptoms of the virus includes: cough, runny nose, loss of appetite, and a possible ear infection. Often times, the patient presents with bronchiolitis, which eventually escalates to RSV. Children most commonly affected by RSV are between the ages of 0-2. In December 2019, the first case of SARS-CoV-2 was discovered in China. Normally, the RSV virus sparks around the winter months; however, throughout the COVID -19 pandemic, RSV was at its all-time low. When SARS-CoV-2 started to decline in early April 2021, there was a spike in the respiratory syncytial virus among children.

**Keywords:** Respiratory syncytial virus, Coronavirus disease 2019, Severe acute respiratory syndrome coronavirus 2, Pediatrics, Virology, Pathology

## INTRODUCTION

A virus is an internal parasite made up of DNA or RNA, as well as a capsid protein coat and, in certain circumstances, an outer lipoprotein envelope<sup>1,2</sup>. The capsid preserves the genetic material in the form of DNA or RNA. Enzymes or an outer envelope are present in viruses. Viruses are smaller than bacteria, have a unique genetic makeup, and require a host to proliferate. The virus attacks the host and replicates in two ways, the lytic cycle or the lysogenic cycle.

The lytic cycle is when a virus attaches ATP, ribosomes, nucleic acids, and amino acids to healthy cells, creating a copy of its own DNA or RNA. The virus will self-assemble, continue to replicate, and create lyse, which will be used to infect nearby cells. The host cell's DNA is broken down and new virus parts are put together. The cell membrane bursts and new virus particles are released

throughout the body. The lysogenic cycle is when viral nucleic acid becomes part of the host cell chromosome which is replicated. The virus enters the lytic cycle and kills the host cells. Then injects its specific DNA into the host cell. The DNA is then inserted into a specific site in the host cell's chromosome. This DNA is also known as provirus. Then during cellular reproduction, the host cell copies the inactive provirus genes along with its own DNA. When the cell splits, the host genes and the provirus genes remain in the two daughter cells. At any time, the provirus chromosome may leave and enter the lytic cycle.

The respiratory syncytial virus was first diagnosed in chimpanzees in 1956.<sup>2</sup> At the time it was called chimpanzee coryza agent which was later revised to signify that the virus is mainly a human pathogen.<sup>2</sup> A human pathogen is characterized into four subunits. Subcellular biological entities include prions and viruses which contain one type of DNA or RNA.<sup>2</sup> Prokaryotic

microorganisms include chlamydia, which are intracellular parasites that reproduce in human cells, and rickettsia, which are rod-shaped to coccoid and reproduce by binary transverse fission. The next sub-category is classic bacteria which can reproduce by binary transverse fission, creating a rigid cell. Finally, mycoplasmas are included in prokaryotic microorganisms, they are bacteria but they have a nonrigid cell wall. Fungi is a non-motile eukaryote with a rigid cell wall and a classic cell nucleus, they are carbon heterotrophic.<sup>1</sup> Protozoa have a nucleus containing chromosomes and organelles such as mitochondria. Helminths are part of the animal kingdom, they are types of worms. Finally, arthropods transmit viruses through their venom.<sup>1</sup>

## DISCUSSION

### RSV definition

Respiratory syncytial virus (RSV) is a pathogenic infection in children. The virus evades the human immune response. More specifically, the infection 'is a non-segmented negative-sense single-stranded enveloped RNA virus that belongs to the family of Paramyxoviridae, genus Pneumovirus, sub-family Pneumovirinae'. Paramyxoviridae is characterized as a group of big single-stranded RNA viruses with a helical nucleocapsid and lipid-rich envelope.<sup>4</sup>

### Genetic makeup of RSV

The genetic makeup is two overlapping open reading frames in the M2 mRNA create two different matrix proteins, M2-1 and M2-2, its ten genes encode 11 proteins. The G-glycoprotein, the fusion (F) glycoprotein, and the small hydrophobic (SH) protein make up the viral envelope. The G protein is involved in host cell attachment, while the F protein is involved in cell fusion and entrance.<sup>2</sup> RSV includes structural proteins such as the large protein, the nucleocapsid, phosphoprotein (P), matrix (M), and M2-1, and two non-structural proteins. There are two different places where the genes can begin transcription, which gives it a total of 11 proteins over 10 genes. Glycoproteins are used to bind to receptors to enter the cell and a different one is used to integrate within the lipid bilayer. These two, along with a hydrophobic protein, make the envelope. In the sequence 'ATTAGC', transcription can begin at either A or T, which gives the potential for two dusting proteins. The reading of this strand is from 3 prime to 5-prime so it is read from the lagging strand. We can see that we have two non-structural mRNA proteins which lead to a nucleoprotein which includes ribosomes nucleosomes and viral nucleocapsid proteins.

Next, we have a matrix protein that is a protein that forms a layer on the inside of the viral envelope. A viral envelope is an outermost layer of a virus that protects the genetic material, specifically here it is RSV. Following the M

protein, we have a small hydrophilic protein which means it is soluble in water.

The glycoprotein is composed of proteins and carbohydrates that are found outside the plasma membrane. Its function is that viruses usually attach to the blood vessel lining through linked together so that they can be as a single unit, giving a single polypeptide. After that, the matrix two protein serves the same function as the matrix one protein.<sup>2</sup> In Figure 1, the genetic structure of the respiratory syncytial virus on a molecular level has been shown.<sup>1</sup>

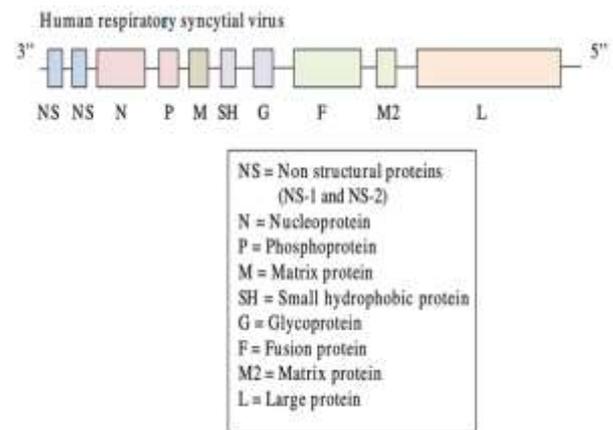


Figure 1: The genetic structure of RSV.

### Symptoms of RSV as a viral infection

The RSV is an infection in the breathing pathways and lungs of infants and young children. According to the CDC, one in every two children under the age of six has been hospitalized for RSV.<sup>8</sup> During the child's first year of life, there is a 68% chance that the child will experience a case of RSV.

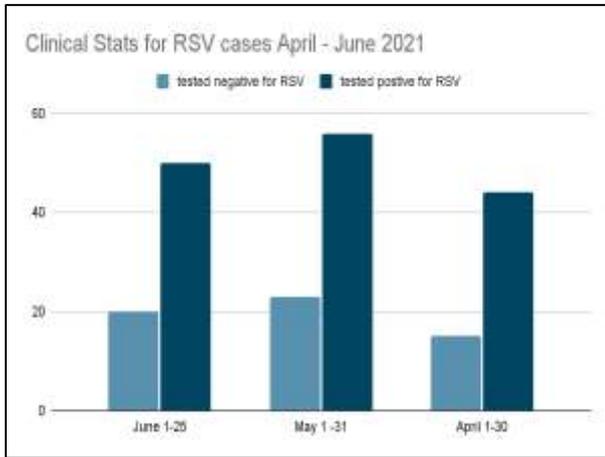
Most children have the infection once before they reach the age of two. More importantly, it is most common in premature infants since their immune system is not fully developed yet.<sup>8</sup> RSV arrives in children as a form of bronchiolitis, including croup, high fever, runny nose, and even loss of appetite. RSV can be very serious in infants as their lungs are not fully developed yet.

An RSV infection is contagious for 2-8 days, and can even last up to three weeks. A pathogenic virus can infect and replicate within the human body and can cause diseases. When pathogenic viruses appear, it is vital to recognize them quickly so that specialized control measures may be implemented and virus transmission can be limited.<sup>8</sup>

### Definition of SARS-CoV-2

SARS-CoV-2 is a virus that contains RNA which is single-stranded and enables the production of proteins for elements of the virus.<sup>3</sup> Bound to this are nucleoproteins

which enable the virus to replicate. The viral envelope, which is composed of a layer of lipids, and includes envelope proteins, is a barrier that surrounds and protects the virus. In SARS-CoV-2, spike proteins act like hooks, attach the host cells, and lyse them to infect the healthy cells.<sup>3</sup>



**Figure 2: How many patients between 0-2 years of age tested positive and negative for RSV between April and June 2021.**

#### **Possible effects of COVID-19**

Additionally, COVID-19 had many harmful effects that were not related to health. For example, children became subject to several changes as a result of lockdown.

Many aspects correlated to confinement dealings are probable to cause increased household pressures, additional stress on care providers, financial instability, job loss or disturbance, and social exclusion. In addition, as the danger of harm against children has increased as a result of the COVID-19 pandemic, children's services have become overwhelmed.<sup>3</sup>

Moreover, COVID-19 can infect children as well. Although many are asymptomatic, some have experienced milder symptoms such as a low-grade fever, fatigue, and cough.<sup>3</sup>

Severe complications have occurred in some children, but they have been uncommon. In many cases, children originally diagnosed with COVID-19 between April and June of 2021, were known to have had RSV.<sup>7</sup> Children with underlying medical problems can be more vulnerable to serious illness.

Many of the toddlers who contracted minor illnesses, hadn't experienced the usual RSV season in 2020 due to the lockdown and have no immunity to RSV.<sup>7</sup> Consequently, these children pass on the virus to their siblings or neighbours. Hence, the surge in the respiratory syncytial virus.<sup>7</sup>

#### **RSV also in adults**

We also saw that RSV is common in kids from newborn to the age of two. However, RSV is also known in adults with immunocompromised lungs.

Therefore, COVID-19 plus the rise of RSV creates a 'super virus' of sorts. COVID-19 leaves many patients with immunocompromised lungs, which causes them to become more susceptible to RSV.<sup>3</sup>

#### **Causes of RSV surge**

A recent clinical study has shown that in the months from April-June the surge in RSV has risen. Since the RSV usually arises around the winter season, when COVID-19 was at its lowest point after April we saw a rise in RSV.<sup>6</sup> Once people got vaccinated and the mask mandate became optional, families started to go out and stopped social distance practices, which likely caused the rise in the cases of RSV due to its highly contagious nature.<sup>6</sup>

Secondly, we can likely look at the patient's family who was diagnosed with COVID-19 at the time to see if there is a relation. Since RSV and COVID-19 are both respiratory viruses there is a correlation between the two.

Furthermore, we drew attention to the pandemic's multifaceted and heterogeneous nature, which presents new concerns and threats to the population most importantly infants. Additionally, there is a possibility that the COVID-19 epidemic will exacerbate pre-existing difficulties and problems in people's lives encompassing the biopsychosocial system in its entirety.

#### **Clinical statics of positive and negative RSV cases**

In Figure 2, the data provided shows the statistics of a busy, community-based pediatric clinic in Brooklyn, New York. We can see that compared to the usual winter season in which RSV usually has its peak, there were underlying differences in the year 2021.

In April-June a total of 58 children between the ages of newborn until the age of two tested negative for RSV and 150 kids tested positive. The surge arose once the SARS-CoV-2 vaccine was administered to over 31.4% of the citizens of New York. Hence, we can see that once people started to feel comfortable going out again with their children the RSV infection spread rapidly.

#### **CONCLUSION**

All in all, there was clinical-based evidence to prove that there is some type of correlation between RSV and COVID-19. When COVID-19 started to decline the respiratory syncytial virus began its peak. Possible explanations for this include lack of social distance and preventative measures taken during the pandemic, lack of immunity to the disease due to lockdown, and

susceptibility due to immunocompromised lungs of previously infected COVID-19 patients. It is strongly suggested to do a long-term study throughout the next year to achieve more reliable results.

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