

Research on the Impact of COVID-19 on People of Different age Groups

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Abstract. In December of 2019, patients with highly contagious respiratory diseases were first disclosed in Hubei, China. Later, in January 2020, the World Health Organization (WHO) declared that this respiratory disease, COVID-19, became a Public Health Emergency of International Concern. With a spiking number of patients and deaths, governments instituted numerous studies, strategies, and medical supplies for people in order to confront this epidemic effectively. COVID-19, then, became a heated topic whether for scientists or the general public due to its research value as an incredible disease and huge impact to daily life. This literature review discusses one of the debates of COVID-19 among people that it tends to have divergent effects on people regarding their ages. Milder symptoms are detected from younger people, and more severe effects are among older people who are above ages of 50s. In allusion to these diverse symptoms and complications, a variety of factors and studies are discussed throughout the passage.

Key word: COVID-19, Age, Transmission, Complications, SARS-CoV2

1. Background

In December, 2019, patients with symptoms of shortness of breath and fever were discovered in Wuhan, Hubei Province, China. With all cases connected to the Huanan Seafood Wholesale Market in Wuhan, the WHO was informed and started the long process of analyzing this unknown disease. Following an increased number of patients with similar symptoms and studies, on January 31, 2020, “The World Health Organization International Health Regulation Emergency Committee reconvenes and declares the coronavirus outbreak a Public Health Emergency of International Concern” (CDC Museum COVID-19 Timeline | David J. Sencer CDC Museum | CDC, n.d.). On February 11, 2020, the WHO announced COVID-19, an abbreviation of coronavirus disease 2019, as the official name for this widely spreading virus. The exploration of the origin of COVID-19 was traced back to connections with animals, especially bats, but the problems caused by it continued. Later, on January 31, 2020, the WHO declared the coronavirus outbreak. Since then, COVID-19 had spread all around the world causing millions of deaths, however, its secrets had been revealed step by step resulting in improved regulations, mild symptoms, and treatments.

2. The CoV Virions, Transmission of COVID, and Its Attack in Human Cells

COVID-19, given by the World Health Organization on February 11, 2020, is an acronym which stands for coronavirus of 2019 which was caused by the coronavirus SARS-CoV2. Coronaviruses, first discovered in the 1930s, are not new to humans or animals. As for humans, some of them caused mild symptoms such as common cold; however, there were a few that caused severe acute respiratory syndrome such as SARS-CoV (severe acute respiratory syndrome) in 2002, MERS-CoV (middle east respiratory syndrome) in 2012, and current SARS-CoV-2. These viruses all share common virions - CoV virions. CoV virions are single-stranded positive-sense RNA that contain a lipid envelope and proteins which are the spike protein, the envelope protein, the membrane protein, and the nucleocapsid protein.

SARS-CoV-2, as one of the highly contagious CoV virion viruses, has some specific features of its transmission. Exposure to SARS-CoV-2 occurs in three principal ways: inhalation, deposition, and touching. When breathing, human exhalation releases droplets that can carry and transmit viruses. In this case, when inhaling air that carries “very small fine droplets and aerosol particles that contain” viruses, there is a high possibility of getting infected by coronaviruses (Scientific Brief: SARS-CoV-

2 Transmission | CDC, 2021). In addition, with the high concentration of these droplets, humans are prone to be infected within three to six feet of a contagious source. As for deposition of the virus, mucous membranes can be infected through exhaled droplets and particles that are at their greatest concentration. Mucous membranes can also be touched by SARS-CoV-2 contaminated hands or inanimate surfaces, which potentially transmit SARS-CoV-2 to human bodies. In this case, while COVID-19 patients speaking, singing, or just simply exhaling, their contaminated tiny droplets and aerosols invisibly in the air can be inhaled by others. Under this pathway, the coronaviruses first reach the mucous membranes in both throat and nostril. Then it starts attacking and reproducing. With detailed study of the coronaviruses, the life cycle of them in cells is concluded within five steps. First, SARS-CoV-2 attaches to the cell membrane, then it penetrates in cytoplasm and viral RNA enters the nucleus for replication. The viral RNA transcription gets into mRNA and subsequent translation gets into proteins. Lastly, viral maturation followed by viral release via exocytosis finishes the cycle.

As coronaviruses attack the host cell in the human body, they have some specific traits. Spike protein is one of the most important elements. First, viruses can stick onto the cell using their spike protein's receptor binding domain that connects to the cell surface through ACE2 receptors. A fusion between the membrane surrounding the virus and the cell's membrane is needed, which requires the spike protein to reform new shapes and release new molecules. Additionally, reforming into new shapes is processed through two cuts of spike protein. The first cut, which appears early, is at the furin cleavage site of the spike protein. The furin cleavage, then, cuts the spike into its subunit 1 and subunit 2, which are in charge of the shape changing. The second cut is in the subunit 2 where enzyme TMPRSS2 cut spike again, which releases new amino acids embedding on the cell wall. These proteins basically combine two membranes and fuse them together, and they allow viruses to hack in cells and reproduce. Therefore, SARS-CoV-2 is able to reproduce and survive in the human body, causing a variable seriousness of symptoms from runny nose, fatigue, and high fever to severe respiratory issues; additionally, these symptoms and complications are largely related to the patient's age.

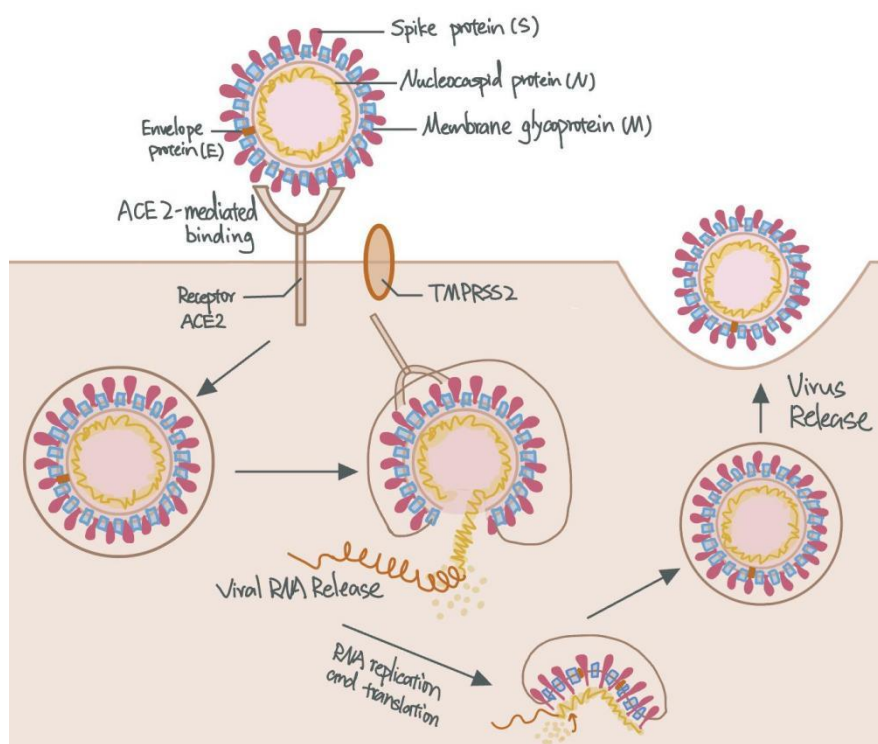


Figure 1: SARS-CoV-2 enters the cell, and spike proteins combine with ACE 2 carrying the virus. Through viral RNA releasing, replication, and translating, the virus is released.

3. SARS-CoV-2 Attacks Children and Younger People

In general, children, especially very young children, develop no symptoms or just mild cold, fatigue, and cough. Most children clear the virus with their distinct immune responses and antibodies which are produced differently for adults regarding the new coronavirus, COVID-19. A study, conducted by the scientists from Columbia University, “provides an in-depth examination of SARS-CoV-2 antibodies in kids, revealing a stark contrast with adults” (Children Produce Different Antibodies in Response to New Coronavirus, 2020). “In kids, the infectious course is much shorter and probably not as disseminated as in adults,” added by Matteo Porotto, PhD, associate professor of viral molecular pathogenesis in Columbia’s Department of Pediatrics; “Kids may clear this virus more efficiently than adults and they may not need a strong antibody immune response to get rid of it” (Children Produce Different Antibodies in Response to New Coronavirus, 2020). Children can recognize a lot of pathogens by having abundant T cells, whereas older adults rely on immunological memories. Additionally, children do not produce many antibodies with great neutralizing activity against the SARS-CoV-2’s spike protein, and they have less strong immune responses, which all lead to milder cases according to the study.

Although most children show easier cases of COVID-19, there are some complications that need to be mentioned. “In a paper published in March 2022 in the journal Pediatrics, researchers described more frequent and severe croup in infants and young children (too young to be vaccinated) infected with COVID-19 during the Omicron surge” (Coronavirus Outbreak and Kids, n.d.). Croup can cause voice box, larynx, and bronchial tubes inflammation and swelling, which can lead to coughing or high-pitched breathing. Another latent severe complication among children is the multisystem inflammatory syndrome (MIS-C) that can cause multiple organs to be inflamed. Additionally, MIS-C symptoms may include neck pain, swollen hands, inflamed hearts, inflamed brain, and fever. Luckily, these inflammation and organ complications have successful treatments from doctors, and most children with MIS-C are cured. A study, from The journal Lancet Child & Adolescent Health, focused on the long-term effects of MIS-C on 46 children. From April to September 2020, most children with MIS-C are recovered without any further complications.

Another reason that younger people tend to fight COVID better is that they possess a complete and active immune system. When viruses first attack, younger people produce a proper amount of cytokines (small proteins for cell signaling) which triggers the adaptive immune system later to destroy the virus. However, older people are barely capable of triggering the later adaptive immune system, thus they aggressively produce an excessive amount of cytokine causing the cytokine storm which further damages their tissue and organ.

Although younger adults, under the age of 50, are able to protect themselves from severe COVID infections through the reasons discussed in the previous paragraphs, syndromes may still occur during the recuperating phase and cause concentration problems, exhaustion, and most importantly muscular weakness. The post COVID-19 complications of young people are not severe, but exhaustion can reflect from their muscles such that some athletes who are infected with the virus cannot avoid short breath while climbing stairs.

4. SARS-CoV-2 Attack Mid-Age Adults and General Severe Symptoms

For mid-age adults, in general, the severity of COVID-19 cases is variable from mild cold and cough to serious organ damage. There is not a clear tendency of how these symptoms distribute among mid-age adults. Though at the beginning phase of the pandemic, a majority of patients had severe organ damages or even death, but three years later, mild cold or no symptoms are more common due to weaker viruses and better medical treatments. One of the typical examples of severe cases is the infected lungs. The lungs are the organs that are vastly affected by the COVID-19. The human body requires the lungs to enable oxygen entering the bloodstream through the alveoli to the blood vessels. When coronavirus reaches and stays between the pulmonary alveoli and the blood vessels, inflammation can occur badly making oxygen intake more difficult. Thus, the lungs need a

ventilator since the burdened breathing can vastly increase the workload of the respiratory muscles and cause complications. However, in some severe cases, it is not promising that the situation will get better because the inflammation does not diminish, and the body remains lacking of oxygen. An external machine, ECMO (extracorporeal membrane oxygenation), can be a hopeful and life-saving therapy even though it may cause bleeding or infections. ECMO draws the blood out from the body, pumps oxygen into it, and returns the blood back, thus, it can increase the oxygen level in the body. Nevertheless, the biggest problem of coronavirus in the body is within the immune system. ECMO may only control the situation instead of curing it, so the inflammation needs an immune response to actually fight the virus. However, defense compounds can flatten vastly, and immune cells start attacking inner walls of blood vessels resulting in fluid leaking; then, the blood vessels are no longer sufficient in the circulatory system following deficient blood in organs. In this case, organ failures are indispensable in these severe situations.

5. SARS-CoV-2 Attack Older People

The risk of COVID-19 infection increases for people from 50s to 80s. People 85 and older are the most likely to have serious illnesses. “Adults over 65 years of age represent 80% of hospitalizations and have a 23-fold greater risk of death than those under 65” (Why Does COVID-19 Disproportionately Affect Older People?, 2020). Multiple factors contribute to this difference. Being able to control the viral load is important to the severity of the COVID-19. The aging immune system is not capable of performing four major tasks that can fight the virus, which are recognizing, alerting, destroying, and clearing. During the aging of older people's immune system, two changes are evident: “One is a gradual decline in immune function called immunosenescence, which hampers pathogen recognition, alert signaling and clearance”, and the other “is a chronic increase in systemic inflammation called inflammaging, which arises from an overactive, yet ineffective alert system” (Why Does COVID-19 Disproportionately Affect Older People?, 2020).

Another factor of older people's serious syndromes is from the immune system's detection of a lot of viral antigens released by dying cells. With COVID-19, older patients are able to reduce their viral titers, but their body can get into a state of shock following potential hyperactivation of the immune system. The “rapid and uncontrolled inflammatory signaling cascade typically occurs in the later stages of infection” (Why Does COVID-19 Disproportionately Affect Older People?, 2020). This is known as the life-threatening cytokine storm, caused by a maladaptive host response to an infectious trigger, which stimulates inflammation in organs and tissues including lungs, kidneys, heart, liver, and brain. Combining this with the general severe lung complication, discussed in the previous paragraph, for example, older people can simultaneously undergo more complicated inflammation with their lungs and other organs causing not only shortage of oxygen in lungs, but also more severe escalating organ damages compared to younger people and children.

Additionally, with their senescent immune systems that do not trigger the later adaptive immune system, the effect of producing abundant cytokines is that they may have high risks from the cytokine storm which can add to the damages of their tissues and organs. Also, for older people and their aged body, they do not respond well to vaccines either, whereas younger people can be vastly benefited by vaccinations of COVID.

6. Conclusion

With the vast spread of COVID-19, the severity of the virus affecting people is very different regarding their ages. Children tend to have mild symptoms or even no symptoms, but there can be some less common severe complications such as croup and MIS-C. Younger adults also experience light impact, and the widespread problem after COVID-19 is muscular weakness. Mid-age adults do have higher possibilities than younger people to have serious complications, but there is no clear tendency of how different severity distributes; they normally have symptoms from mild cold and

fever to organ issues. Older people, with their declined immune system and aging organs and bodies, can be exceptionally vulnerable with COVID-19; they should be extra careful with who they talk to and what they touch and contact, and regularly clean their hands which can transmit virus into their mucous membranes.

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