

# Post-Covid Syndrome During the COVID-19 Pandemic and its Socio-Economic Consequences

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## Keywords

Post-COVID syndrome; Prolonged covid; Covid-19; SARS-CoV-2; Pandemic impact; World economy; State

## 1. Abstract

The review provides information on the classification, mechanisms of development of infection and multiple organ damage, as well as clinical manifestations of post-COVID syndrome (Post-CoViD Conditions, Long CoViD, Post-acute CoViD). The issues of immunopathogenesis of the development of Covid-19 and possible causes of the development of post-covid syndrome were highlighted. The impact of the pandemic on the state of the world economy is also considered, in particular, an analysis of the negative consequences of the pandemic for global economic growth is carried out.

## 2. Introduction

Much has changed in the familiar world since the coronavirus infection known as Covid-19 (COronaVIrus Disease 2019), which is caused by Sars-CoV-2 (Severe acute respiratory syndrome coronavirus 2), has entered our lives. At the moment, there are many known strains of coronavirus, four of which have received the status of variants of concern to WHO (Variants of concern - VOC). Through the spike protein, namely its receptor-binding domain (RBD fragment), SARS-CoV-2 interacts with ACE2 on the surface of the host cell, resulting in the association of the cell membrane with the virus envelope, followed by the release of the genome into the cytoplasm. Further, vesicles containing the newly formed virion are formed, and the subsequent release of the virus outside the affected cell (1).

## 3. Case

In response to the penetration of the virus, the immune system is activated: its innate and adaptive links. Cellular (NK cells, TNK cells, macrophages, granulocytes,  $\gamma\delta$  T cells and B-1 lymphocytes)

and humoral (complement system components, interferons, inflammatory mediators) components of the innate immune system recognize molecular patterns that are absent in the human body, but associated with pathogens (Pathogen associated molecular pattern - PAMP). In the case of SARS-CoV-2, these include single-stranded RNA, surface proteins. Their detection occurs with the help of pattern recognition receptors - PRR (Pattern recognition receptor), which include transmembrane Toll-like receptors (TLR) and type C lectin receptors (CLR), as well as cytosolic NOD-like receptors (NLR) and RIG-I- similar receptor (RLR) (2). Further, the development of two ways of resisting infection is possible: with the participation of IRF3 (Interferon regulator factors 3), a transcription factor responsible for the release of interferons, mainly classes I and III, or the nuclear transcription factor NF- $\kappa$ B (Nuclear factor  $\kappa$ B, NF- $\kappa$ B), in which results in the production of pro-inflammatory cytokines (mainly IL-1, IL-6, IL-8, IL-12, TNF- $\alpha$ ). They are in turn responsible for the activation and differentiation of leukocytes. It should be noted that success in eliminating the virus largely depends on the level of expression of type I interferons (IFN $\alpha$  and  $\beta$ ) (3).

Clinical manifestations of Covid-19 can vary from asymptomatic infection to severe illness, manifested by severe respiratory failure with the development of a systemic inflammatory response, DIC, and multiple organ failure (4). As mentioned above, Covid-19 must bind its spike protein to the angiotensin converting enzyme 2 (ACE 2) receptor in order to enter the cell. This is due to the polytropism of Sars-CoV-2 and the breadth of the clinical manifestations of the disease, because, as is known, ACE2 receptors are present on the surface of various endothelial cells of most organs, the mucous membrane of the lower and upper respiratory tract,

lungs, intestines, bladder, esophagus, heart, adrenal glands, brain, hypothalamus and pituitary gland, as well as on the endothelial cells of blood vessels.

At the moment, all the forces of the global health system are thrown into the treatment of the acute form and prevention of coronavirus infection. Virtually every country has developed clinical guidelines for the prevention, diagnosis and treatment of patients with Covid-19. While most recover without sequelae, a significant proportion of those who recover may experience symptoms of Covid-19 after recovering from the infection, and others may even develop new symptoms (5). Interestingly, at the moment there is no relationship between the severity of acute covid-19 and the severity of the post-COVID state. The mechanism for the development of long-term covid is currently unknown, and its association with an autoimmune condition or hyperinflammatory conditions after resolution of acute Covid-19 is assumed (6). Which means we have yet to find out. For example, Tim Spector in The BMJ webinar notes that long-term covid is about twice as common in women as in men, and that the average age of those suffering from long-term symptoms is about 4 years older than those who have been acutely ill (7). Carole H. Sudre et al. believe that post-COVID syndrome develops more often in those patients who had symptoms such as fatigue, headache, shortness of breath, hoarseness, and myalgia during the acute period of the disease.

At the moment, there is no clearly defined definition of post-COVID syndrome. The World Health Organization has proposed to understand the post-COVID state as one that occurs in individuals with a history of probable or confirmed infection with the Sars-CoV-2 virus, usually within 3 months of the onset of Covid-19, and is characterized by the presence of symptoms for at least 2 months, as well as the impossibility of explaining them with an alternative diagnosis (8). At this stage, it is impossible to speak with confidence about the real prevalence of post-COVID syndrome due to the lack of large, multicenter studies involving a large number of patients. Also, the lack of clear criteria, the standard of laboratory, instrumental and clinical markers of long-term covid does not currently allow us to talk about a clear number of patients in need of assistance. However, already at this stage there are many works around the world, and their data are not comforting. For example, according to Sandra Lopez-Leon et al., about 80% of people diagnosed with Covid-19 had at least one persistent symptom of the disease two weeks after recovery. Most often they were fatigue, headache, decreased attention, hair loss and shortness of breath (9).

Scientists from Italy provided data that after 60 days from the onset of the first symptom of a coronavirus infection, in a group of patients of 143 people, none of them had a fever or other signs of an acute illness. However, only 13% of them had no symptoms and returned to their pre-illness condition. While 32% of the subjects had 1 or 2 persisting symptoms, and 55% had 3 or more. The most

common symptoms were fatigue, shortness of breath, joint pain, and chest pain (10). According to the U.S. Centers for Disease Control and Prevention (CDC), the five most common symptoms of long-term covid are:

- increased fatigue
- shortness of breath
- cough
- joint pain
- pain in the chest (11).

Olalekan Lee Aiyegbusi et al. in their review for SAGE journals provide the following data regarding the most common symptoms (12)

- fatigue 47%
- shortness of breath 32%
- myalgia 25%
- joint pain 20%
- headache 18%
- cough 18%
- chest pain 15%
- altered odor 14%
- altered taste 7%
- diarrhea 6%

As another confirmation of the above, we can cite the studies of Swiss scientists. In adults under 50 years of age, the effects of Covid-19 persisted from two weeks to three months, according to their systematic review. They were manifested by such symptoms as constant fatigue (39-73% of the assessed persons), shortness of breath (39-74%). 44-69% of the surveyed noted a decrease in the quality of life. There is also a high incidence of abnormal CT findings, including pulmonary fibrosis (39-83%), signs of peri-/perimio-/myocarditis (3-26%), changes in the microstructure and functional integrity of the brain with persistent neurological symptoms (55%), increased frequency of psychiatric diagnoses (5.8% versus 2.5-3.4% in the control group), incomplete recovery of olfactory and gustatory dysfunction (13).

Let us note the socio-economic consequences of the COVID-19 pandemic. China's stock exchanges suffered heavy losses, where the trading volume dropped sharply, but literally a week later it also affected European stock exchanges. Due to the shutdown of enterprises in China, and then throughout the world, the demand for oil and oil products fell significantly (14). There was also a sharp increase in demand for essential goods and everyday products. The situation dictated speculation in the market of certain products, including antiviral drugs, sanitary masks, and disinfectants. Sales of essential goods increased sharply, which led to a sharp jump in prices. During the pandemic, the demand for the delivery of food, medicines, and essential products has increased dramati-

ly. In the context of quarantine restrictions, business automation and digitalization is a key factor in minimizing production losses. Thus, companies that have carried out business transformation are now able to provide an acceptable level of production and maintain their position in the market (15). The only solution is a sharp jump in development can give progress (16). The COVID-19 pandemic has changed the socio-economic space in Russia, a fact that no one questions: the state and society are already in a new reality (17). It should be clear that the Chinese economy can afford to respond quickly to emerging emergencies (18).

The COVID-19 outbreak is also a global public health crisis. COVID-19 has shown that scientific collaboration is key to addressing the global public health challenge. This shows us the need for continuing education when so many children today cannot go to school. This is a vivid reminder of the importance of high-quality, reliable information. The pandemic shows the power of culture and knowledge for public health and solidarity at a time when countless people around the world have had to maintain social distancing and stay at home. UNESCO is fully committed to supporting governments in distance learning, open science, knowledge sharing and culture as a fundamental means to stand together and strengthen our society (19). Analysis of the current situation points to the significant and persistent negative impact of this pandemic on the global economy, and no country has escaped it without consequences. China and "developing Asia" will fare better in the near future. Sweden, however, serves as a warning that no economy is immune to the negative effects of Covid-19 in an interconnected global economy. Non-Asian emerging markets are especially vulnerable. These findings highlight the importance of a comprehensive and coordinated interstate policy response to this pandemic. This includes global efforts to ensure the rapid deployment of medical resources (including vaccines when available), policies that can restore the normal functioning of financial markets, and other measures that can support firms and households. Finally, a risk-management approach to policy development will require increased efforts to buy insurance against tail events, which are represented by a distribution of likely outcomes. These efforts are likely to limit the number of problems (20). In each country, mitigating conditions were provided that helped with less problems and understanding of such a complex socio-economic crisis. With regards to medicine, in the process of treatment, people faced new problems. People with chronic diseases could not cope with this disease, especially diseased kidneys susceptible to the COVID virus, therefore, the treatment and the method of finding a cure are changing.

#### 4. Discussion

Thus, the presence of long-term symptoms in such a wide population is a topical public health problem throughout the world, which should not be neglected in a pandemic. Since the post-COVID syndrome is still unknown in its essence, scientists have yet to under-

stand the causes, mechanisms of development and ways to prevent the post-COVID state. Also over the course of almost two years, Covid-19 has become more virulent, undergoing frequent mutations, making it difficult to link a specific strain to disease severity. Therefore, it is necessary to conduct large-scale studies in order to establish a relationship between the strain of the virus and the duration of post-COVID manifestations of the disease. The pandemic has exposed the fragility of the health care system around the world, and has shown the need for a more reliable and highly effective science, technology and innovation system. The lack of test kits and other personal protective equipment (PPE), insufficient training of healthcare workers, the lack of adequate supplies to treat patients infected with COVID-19 - all these factors have led to a rethinking of priorities, in particular to increase investment in science, technology and innovation. Different vaccines have been created to provide a choice, but the economy needs about five years to get up to speed. The results of the analysis show that the global recession will be prolonged, and no country will escape its consequences, regardless of its mitigation strategy.

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