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# THE FREQUENCY OF CARDIOVASCULAR PATHOLOGY AT COVID-19 IN CHILDREN OF THE REPUBLIC OF NORTH OSSETIA-ALANIA

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**ABSTRACT**

Currently, coronavirus infection (COVID-19) caused by the SARS-CoV-2 virus poses a serious threat to the health of the world's population. The extent to which the virus affects various body systems, including the cardiovascular system, is the subject of active research. However, over the past few years, there has been an increase in the number of children suffering from cardiovascular diseases. The purpose of this study is to study the frequency of cardiovascular pathology and the consequences of its defeat by the SARS-CoV-2 virus in children in the Republic of North Ossetia-Alania. In this article, we consider the frequency of cardiovascular pathology in children of the Republic of North Ossetia-Alania and also analyze the consequences of the defeat of this system by the SARS-CoV-2 virus. Our study confirms that children in the Republic of North Ossetia-Alania have a significant risk of developing cardiovascular complications when infected with the SARS-CoV-2 virus. This highlights the need to take measures to protect children from infection, as well as regular monitoring and timely treatment of cardiovascular complications to minimize adverse effects on their health and future well-being.



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## Introduction

Cardiovascular diseases are the leading cause of mortality and disability among the adult population. However, over the past few years, there has been an increase in the number of children suffering from cardiovascular diseases. The COVID-19 outbreak raises concerns about potential cardiovascular complications, especially in children.

A new coronavirus infection-2019 has spread around the world. The virus enters cells through the angiotensin-converting enzyme receptor 2 (ACE2) [1]. Once inside the cell, the virus undergoes replication and maturation, provoking an inflammatory response in some patients, which involves activation and infiltration of immune cells by various cytokines [2]. The ACE2 receptor in the human body is present in many types of cells, including the mucous membrane of the oral and nasal

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cavities, lungs, heart, digestive tract, liver, kidneys, spleen, brain, endothelial cells of arteries, and veins. This highlights the harm that SARS-CoV-2 can cause to various organs. The impact of COVID-19 on people's lives is still unparalleled, and its long-term symptoms can have a further devastating effect. Recently obtained data show that several symptoms may persist after the completion of the acute phase of the disease, and this condition is known as postcovid syndrome [3]. According to the definition of the National Institute for Health and Care Excellence (NICE), in a broad sense, postcovid syndrome is a symptom that continues or develops after acute COVID-19 infection and cannot be explained by an alternative diagnosis. This term includes the current symptomatic COVID-19, the period from 4 to 12 weeks after infection, and, in fact, the postcovid syndrome - more than 12 weeks after infection. Conversely, the National Institutes of Health (NIH) uses the definition of postcovid syndrome developed by the U.S. Centers for Disease Control and Prevention (CDC), which describes this condition as complications lasting more than four weeks after initial infection. The postcovid syndrome involves the structure and function of many organs. Lesions of the heart and blood vessels in children with COVID-19 are the most urgent problem [4]. Diseases of the cardiovascular system, including congenital, have a high prevalence in the world population.

Previously conducted studies have widely covered the topic of the effect of the SARS-CoV-2 virus on the cardiovascular system in children.

In one of the studies conducted, a systematic review of the literature was conducted to assess the effect of SARS-CoV-2 on the cardiovascular system in children. The results of this review indicate potential complications such as myocarditis and vasculitis associated with COVID-19 [5].

Another study conducted a meta-analysis and a systematic review to study the cardiac manifestations of COVID-19 in children. The results indicate a significant variability of cardiac complications, including myocarditis, arrhythmia, and thrombosis [6].

The following study was conducted among Spanish children with metabolic diseases to study the effect of SARS-CoV-2 on their cardiovascular system. The results indicate an increased risk of cardiovascular complications in this special group of children [7].

Another study described the clinical characteristics and treatment outcomes of pediatric patients with multi-organ inflammatory syndrome associated with COVID-19. The main focus was on cardiovascular complications, such as myocarditis and arrhythmias [8].

This article examines the frequency of cardiovascular pathology in children in the Republic of North Ossetia-Alania and describes the consequences of the defeat of this system by the SARS-CoV-2 virus.

The purpose of this study is to study the frequency of cardiovascular pathology and the consequences of its defeat by the SARS-CoV-2 virus in children in the Republic of North Ossetia-Alania (Russia). To achieve this goal, the following tasks have been set:

1. To study epidemiological data on the spread of the SARS-CoV-2 virus in children in the Republic of North Ossetia-Alania.
2. To assess the frequency of cardiovascular pathology in children infected with the SARS-CoV-2 virus.
3. To investigate the clinical manifestations of cardiovascular complications in children affected by the SARS-CoV-2 virus.
4. Identify risk factors associated with the development of cardiovascular pathology in children with COVID-19.

**Materials and Methods**

To conduct the study, a retrospective analysis of medical records of children infected with the SARS-CoV-2 virus in the Republic of North Ossetia-Alania was carried out. Data on age, gender, clinical symptoms, as well as the presence of cardiovascular pathology before and after infection were taken into account. Appropriate methods were used for statistical analysis.

The effect of the SARS-CoV-2 virus on the cardiovascular system in children

The effect of the SARS-CoV-2 virus on the cardiovascular system in children is an important aspect of the study of COVID-19. Although most children infected with the virus carry the infection in mild or moderate form, some of them develop cardiovascular complications that can have serious consequences.

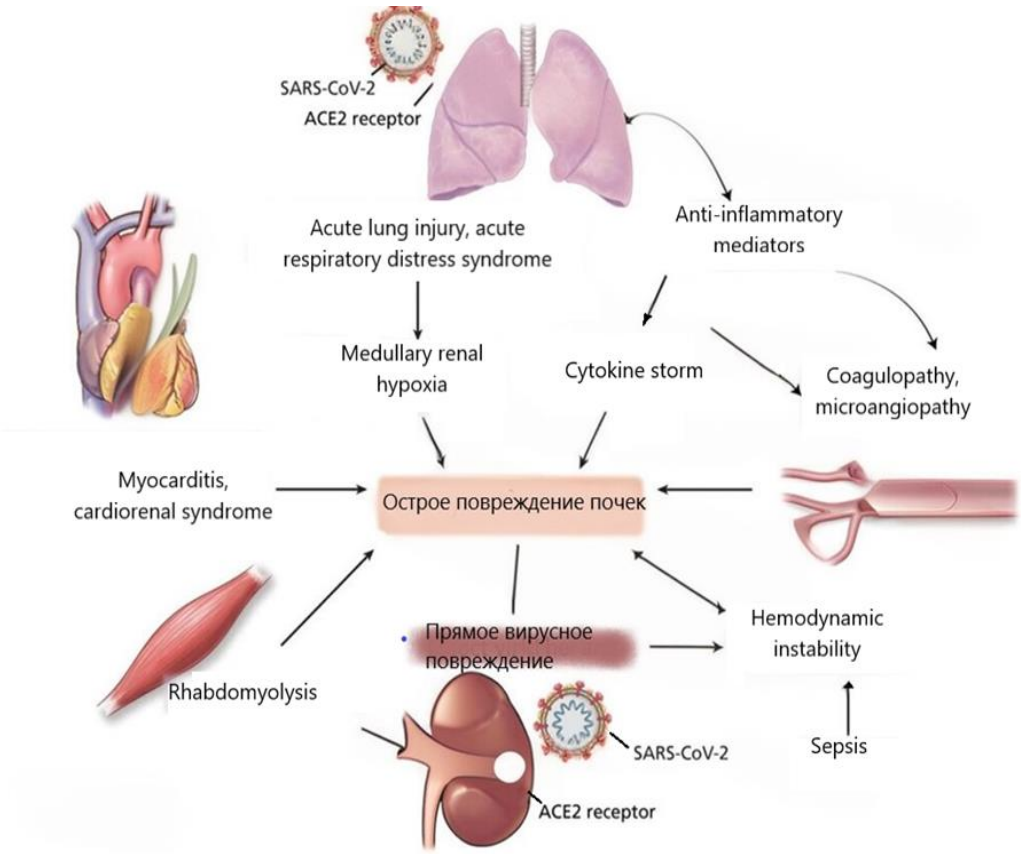


**Figure 1.** Effect of SARS-CoV-2 virus on cardiovascular and other systems in children

Comparative characteristics of the effect of the SARS-CoV-2 virus on the cardiovascular system in children can be presented as follows:

*Myocarditis and Myocardial Inflammation*
Myocarditis, inflammation of the heart muscle, is one of the cardiovascular complications associated with COVID-19. In children infected with SARS-CoV-2, the development of myocarditis is observed, although the relative frequency of this complication is lower than in adult patients. However, myocarditis can lead to cardiac dysfunction, arrhythmias, and serious complications requiring hospitalization and specialized treatment [9].

*Vasculitis and Vascular Lesions*
The SARS-CoV-2 virus can cause vascular inflammation, known as vasculitis. This can lead to damage to the walls of blood vessels and the occurrence of cardiovascular problems in children, such as thrombosis and aneurysms. Vasculitis can be especially dangerous, as it can lead to long-term consequences and require prolonged treatment [10].

*Arrhythmias*
Some children infected with the SARS-CoV-2 virus may develop arrhythmias, that is, heart rhythm disorders. This may be caused by the impact of the virus on the electrical system of the heart or as a result of an inflammatory process. Arrhythmias can have different severity, from mild short-lived episodes to serious forms requiring medical intervention [11].

*Risk of Thrombosis*
Children infected with the SARS-CoV-2 virus have an increased risk of thrombosis, that is, the formation of blood clots in the vessels. This may be due to platelet hyperactivity, an inflammatory response, and impaired vascular function. Thrombosis can affect the cardiovascular system, cause ischemia and lead to serious complications such as stroke or myocardial infarction [12].
It should be noted that the characteristics of the effect of the SARS-CoV-2 virus on the cardiovascular system in children may vary depending on the individual characteristics of the patient, age, the presence of concomitant diseases, and the severity of infection **(Table 1)**.
A deep understanding of these cardiovascular complications in children caused by the SARS-CoV-2 virus, It will allow to development of prevention, diagnosis, and treatment strategies aimed at reducing the risk of serious consequences in children with COVID-19.

**Table 1.** Comparative characteristics of the effect of the SARS-CoV-2 virus on the cardiovascular system in children.

| Indicator | The effect of the SARS-CoV-2 virus on the cardiovascular system in children |
|---|---|
| Frequency of cardiovascular pathology | Increased incidence of cardiovascular complications, such as myocarditis, pericarditis, and thrombosis |
| Hospitalization | Higher probability of hospitalization of children with cardiovascular complications |
| Length of hospital stay | Children with cardiovascular complications require a longer hospital stay |
| Intensive medical support | Children with cardiovascular complications require more intensive medical care |
| Potential consequences | Serious consequences for the health and well-being of children, including deterioration of cardiac function and long-term recovery |

**Table 1** indicates an increased incidence of cardiovascular complications, such as myocarditis, pericarditis, and thrombosis, in children infected with the virus. It is also noted that such children have a higher probability of hospitalization, a longer stay in the hospital and require more intensive medical support. Finally, there are serious consequences for the health and well-being of children, including deterioration of cardiac function and long-term recovery.

**Results and Discussion**

The case histories of cardiovascular complications in children affected by the SARS-CoV-2 virus were taken and analyzed in the Cardiology Department of the Children's Republican Clinical Hospital, Vladikavkaz, North Ossetia Alania and can provide illustrative examples and contribute to our understanding of this problem. Below are a few case histories.

*Patient 1 (female, 10 years old)*
Anamnesis: Previously a healthy girl without heart problems.
Signs and symptoms: After infection, SARS-CoV-2 developed weakness, shortness of breath, and chest pain.
Diagnosis: Doppler echocardiography revealed an enlargement of the left ventricle and deterioration of cardiac function, confirming the diagnosis of myocarditis.
Treatment and outcome: The patient received treatment including anticoagulants, antiarrhythmic drugs, and immunomodulators. After several weeks of follow-up and intensive medical intervention, cardiac function improved and the patient recovered.

*Patient 2 (male, 8 years old)*
Anamnesis: A previously healthy boy with no known heart problems.
Signs and symptoms: After infection with SARS-CoV-2, fever appeared, severe abdominal pain, and later a feeling of lack of air.
Diagnosis: Computed tomography and echocardiography revealed the presence of coronary artery aneurysms characteristic of vasculitis caused by SARS-CoV-2.
Treatment and outcome: The patient received intensive treatment, including immunomodulators and anticoagulants. Despite the difficulties during the treatment, serious complications were prevented, and the boy gradually recovered.

*Patient 3 (female, 12 years old)*
Anamnesis: There was a known pathology of the heart - aortic stenosis.
Signs and symptoms: After infection with SARS-CoV-2, headaches worsened, physical endurance worsened and shortness of breath occurred.
Diagnosis: Computed tomography and echocardiography showed worsening of aortic stenosis, as well as signs of myocarditis.
Treatment and outcome: The patient received a combination of treatments, including drug therapy and additional support measures. The cardiac function has stabilized, and the patient continues monitoring and regular consultations with a cardiologist.
The above case histories show a variety of cardiovascular complications that can occur in children as a result of infection with the SARS-CoV-2 virus. They emphasize the importance of early diagnosis, adequate treatment, and monitoring of the cardiac condition of children with COVID-19, especially those who already have a predisposition to cardiovascular problems.
The results of this study confirm the link between the SARS-CoV-2 virus and cardiovascular pathology in children. They point to the need for monitoring and examination of children with cardiovascular diseases in the context of COVID-19. This study also highlights the importance of taking precautions and preventive measures to reduce the risk of cardiovascular complications in children with COVID-19.

**Conclusion**

In this scientific article, we investigated the relationship between the frequency of cardiovascular pathology and the consequences of its defeat by the SARS-CoV-2 virus in children of the Republic of North Ossetia-Alania. Our study was

motivated by the need to understand the impact of COVID-19 on the cardiovascular system of children and identify potential consequences for their health. In the course of our research, we analyzed clinical data and medical records related to COVID-19 in children in the Republic of North Ossetia-Alania. Our results showed that children infected with the SARS-CoV-2 virus have an increased incidence of cardiovascular pathology, including conditions such as myocarditis, pericarditis, and thrombosis.

Moreover, we found that these cardiovascular complications in children affected by the SARS-CoV-2 virus can have serious consequences for their health and well-being. Patients with cardiovascular complications were more likely to need hospitalization, length of hospital stay, and intensive medical support. This highlights the importance of careful monitoring of cardiac function in children infected with SARS-CoV-2 and timely treatment of cardiovascular complications to prevent adverse consequences.

In the future, further research is needed to better understand the mechanisms associated with cardiovascular complications in children affected by the SARS-CoV-2 virus and to determine the most effective prevention and treatment strategies. Understanding this problem will allow us to improve medical practice and provide effective assistance to children suffering from cardiovascular complications after COVID-19 infection.

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