

IMMUNOLOGICAL CHANGES DURING COVID-19 INFECTION IN CHILDREN WITH COMORBIDITIES: EXAMPLES OF CYTOKINES AND ADIPOKINES***Sadullayev Siroj Ernazarovich****Independent researcher at Tashkent State Medical University****Rakhmatullayeva Shakhnoza Bakhadirovna****Associate Professor of the Department of Infectious and Pediatric Infectious Diseases,**Tashkent State Medical University, Doctor of Medical Sciences***Keywords:** COVID-19, children, comorbidities, cytokines, adipokines, immunological changes**Introduction.**

Although COVID-19 infection is mainly characterized by a mild clinical course among children, recent scientific studies have noted that pediatric patients with comorbidities have a higher probability of developing severe forms and various complications. Comorbidities such as obesity, diabetes mellitus, bronchial asthma, and cardiovascular diseases create a chronic low-grade inflammatory state in a child's body. This condition, when combined with SARS-CoV-2 infection, can lead to a disruption of the immune response.

The role of the immune system in the pathogenesis of COVID-19 is of central importance, with the imbalance of cytokines and adipokines being closely related to the severity of the disease. Therefore, studying the immunological changes that occur during COVID-19 in children with comorbidities is a relevant scientific and practical issue.

Research objective

The aim of this expanded thesis is to elucidate immunological changes in children with COVID-19 and concomitant pathologies, particularly the imbalance of cytokines and adipokines, based on a literature review.

Materials and methods

This work is theoretical and review-based in nature, analyzing materials from the World Health Organization, as well as modern articles published in PubMed, Scopus, and leading scientific journals. The study does not include clinical data, and generalized conclusions were drawn based on available scientific sources.

The role of cytokines in COVID-19

Cytokines are biologically active substances produced by immune cells that play a crucial role in regulating the inflammatory process. Numerous studies have noted that a sharp increase in the levels of

pro-inflammatory cytokines - IL-6, IL-1 β , TNF- α , and IFN- γ during COVID-19 infection is associated with a severe course of the disease.

In children with comorbidities, the basal levels of these cytokines may already be elevated. SARS-CoV-2 infection intensifies this background, leading to the development of a cytokine storm. Consequently, tissue damage, multisystem inflammatory syndrome, and severe respiratory complications may occur.

Adipokines and metabolic inflammation

Adipokines produced by adipose tissue are important factors linking metabolic and immune processes. Leptin, adiponectin, and resistin have particular significance in the pathogenesis of COVID-19.

Obese children have high levels of leptin, which enhances the production of pro-inflammatory cytokines. Conversely, although adiponectin has anti-inflammatory properties, its levels are decreased in obese children. Resistin is regarded as an adipokine that intensifies the inflammatory process. This imbalance of adipokines leads to disruption of the immune response during COVID-19 infection.

Characteristics of immune response in children with comorbidities

In children with COVID-19 and underlying obesity, the state of chronic inflammation disrupts the balance between cytokines and adipokines. In diabetes mellitus, hyperglycemia impairs immune cell function and weakens antiviral defense. Insufficient interferon response in children with bronchial asthma may result in prolonged viral replication.

In children with cardiovascular diseases, endothelial dysfunction and inflammatory processes are pre-existing, and SARS-CoV-2 infection further exacerbates this condition. This increases the risk of severe clinical course.

Relationship between cytokines and adipokines

The interaction between cytokines and adipokines represents the integration of immune and metabolic systems. A positive correlation between leptin and IL-6 leads to an intensification of the inflammatory process. A decrease in adiponectin causes an uncontrolled increase in TNF- α . This imbalance is considered an important pathogenetic mechanism in the development of severe forms of

COVID-19.

Conclusion

Analysis of the literature shows that COVID-19 infection in children with comorbidities is accompanied by profound disturbances of the immunological response. Disruption of the balance between cytokines and adipokines plays a crucial role in the development of severe clinical forms of the disease. The study of these biomarkers is of significant importance for predicting the course of COVID-19 in children and developing treatment strategies based on an individualized approach.

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