 10.15789/2220-7619-TIO-17560

THE IMPACT OF CONCOMITANT DISEASES DURING SARS-COV-2 INFECTION IN RESIDENTS OF KAZAKHSTAN

Ashirova M.Z.,

Abuova G.N.,

Seytkhanova B.T.

South Kazakhstan Medical Academy, Shymkent, Kazakhstan

 ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

 10.15789/2220-7619-TIO-17560

ВЛИЯНИЕ СОПУТСТВУЮЩИХ ЗАБОЛЕВАНИЙ ПРИ ИНФЕКЦИИ SARS-COV-2 У ЖИТЕЛЕЙ КАЗАХСТАНА

Аширова М.З.,

Абуова Г.Н.,

Сейтханова Б.Т.

Южно-Казахстанская медицинская академия, Шымкент, Казахстан

 ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

Abstract

Background . Since the onset of the COVID -19 pandemic, interindividual variability in the course of the disease has been reported , indicating a wide range of factors influencing it. Factors most commonly associated with increased severity of COVID -19 disease include older age, obesity, and diabetes. The impact of the cytokine storm is complex, reflecting the complexity of the immunological processes triggered by SARS - CoV -2 infection. A modern problem such as a worldwide pandemic requires modern solutions, which in this case involve the use of machine learning to analyze differences in the clinical properties of populations affected by the disease and then assess its significance, which in turn leads to the creation of a tool that applicable to assess the individual risk of infection with SARS - CoV -2.

Methods . Values of biochemical and morphological parameters of 781 patients (Kazakhstan, Shymkent) were collected and used for static analysis. The Spearman rank correlation coefficient formula was used to estimate the correlations between each of the traits in the population .

Results . The highest correlation coefficients were shown by such parameters as , patient's age and sex , serum glucose, while the highest inverse correlation coefficient was estimated for serum red blood cell count.

Conclusion . The current analysis indicates a range of parameters available for routine screening in clinical settings. A tool based on these parameters is also presented, useful for assessing the individual risk of developing COVID -19 in patients. A limitation of the study is the demographics of the study population, which may limit its general applicability.

Keywords: SARS - CoV -2, blood biomarkers, COVID -19, comorbid pathology, arterial hypertension.

Резюме

История вопроса. С начала пандемии COVID-19 сообщалось о межиндивидуальных особенностях течения заболевания, что указывает на широкий спектр факторов, влияющих на него. Факторы, наиболее часто связанные с повышенной тяжестью заболевания COVID-19 включают пожилой возраст, ожирение и диабет. Цитокиновый шторм оказывает разные эффекты, что отражает сложность иммунологических процессов, запускаемых инфекцией SARS-CoV-2. Вызовы современности, такие как глобальные пандемии, требуют новых решений, которые могут включать использование машинного обучения для анализа различий в клинических свойствах популяций пациентов и последующей оценки его значимости, что, в свою очередь, приводит к созданию инструмента для оценки индивидуального риска заражения SARS-CoV-2.

Методы. Значения биохимических и морфологических параметров 781 пациента (Казахстан, Шымкент) были собраны и использованы для статического анализа. Формула коэффициента ранговой корреляции Спирмена использовалась для оценки корреляций между каждым из признаков в популяции.

Результаты. Самые высокие коэффициенты корреляции были показаны для таких параметров, как возраст и пол пациента, уровень глюкозы в сыворотке, в то время как самый высокий коэффициент обратной корреляции был обнаружен для содержания эритроцитов в сыворотке крови.

Заключение. Представленный анализ указывает на ряд параметров, доступных для рутинного скрининга в клинических условиях. Также представлен подход, основанный на изученных параметрах, применимый для оценки индивидуального риска развития COVID-19 у пациентов. Ограничением исследования является демографическая характеристика исследуемой популяции, что может влиять на его общую применимость.

Ключевые слова: SARS-CoV-2, биомаркеры крови, COVID-19, коморбидная патология, артериальная гипертензия.

1 Introduction

Pandemic new coronavirus infection (COVID-19), which is spread by the SARSCoV-2 virus , is challenge systems health everyone countries peace . Most frequent manifestation of COVID-19 is defeat respiratory systems _ Maintaining patient with COVID-19 implies Not only treatment pneumonia And respiratory insufficiency , but And timely recognition And treatment defeats others target organs . _ Analysis factors from all countries associated With heavy with the current And unfavorable COVID-19 forecast , indicates on important role comorbid pathologies such as cardiovascular _ diseases (CVD) (arterial hypertension (AH), ischemic disease heart (CHD), sugar diabetes (DM), chronic obstructive disease lungs (COPD), chronic blood diseases (anemia), autoimmune diseases, cancer, etc. [8]. The course of SARS-CoV-2 infection can be influenced by several factors, including the presence of concomitant diseases in patients [2]. Comorbidities such as type 2 diabetes affect the host immune response, which may be associated with severe SARS-CoV-2 infection. In the context of type 2 diabetes, there is an increased release of pro-inflammatory cytokines, which can lead to cytokine storms in patients with SARS-CoV-2(+) . The occurrence of a cytokine storm correlates with a worse course of the infection [6]. Moreover, patients with SARS-CoV-2(+) exhibit some changes in blood parameters, which may further influence the severity of the infection. For example, changes in inflammatory markers in patients with SARS-CoV-2 (+) may indicate a complex mechanism of infection and its long-term consequences [5].

Given the wide variation in the course of SARS-CoV-2 infection among patients and the need to identify effective therapy, the main goal of our study was to determine the physiological characteristics of patients infected with the SARS-CoV-2 virus, and the presence of comorbidities. The secondary objective of this study was to elucidate the underlying mechanisms influencing multiorgan dysfunction during COVD-19 infection. Contributing physiological parameters were ranked in terms of their importance to the predictive model using machine learning. This means that _

preventive measures V period the COVID-19 pandemic should fold How from events By prevention infection , yes And activities aimed at on optimal control comorbid states _ Target _ of this study - definition features of the management of patients with COVID -19 infected with the SARS-CoV-2 virus, with the presence of concomitant diseases (Table 2) and provide important information that _ Maybe be useful at conducting Total spectrum comorbid patients V conditions COVID-19 pandemic - How uninfected , yes And carrying COVID-19.

Materials and methods:

3696 patients were studied, of which 781 patients had a comorbid condition. The analyzed data set consisted of the test results of 781 patients hospitalized in the city infectious diseases hospital in Shymkent, Kazakhstan. Three hundred ninety-five of them were women (*n* = 395 ; 50.58%) and three hundred eighty-six men (*n* = 386 ; 49.42%) (Table 1). Ages 2 0 – 80 and older years, mean = 51.6 years, median = 50 years) hospitalized due to severe infection. acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Table 2). About two hundred blood test results belonged to the control group (women, *n* = 60 ; 30%; men, *n* = 140 ; 70%; age 20–65 years , median = 42.5 years) without SARS-CoV-2 in PCR analysis. The resulting data set included in this study consisted of anthropometric parameters: age, gender; serum biochemical parameters: glucose , morphological indicators: number of red blood cells (RBC Count);

Criteria inclusions: laboratory confirmed diagnosis of COVID -19; Patients With established concomitant diseases, having at least 6 months. dispensary observation for this disease; age of patients (18 and older);

Exclusion criteria: patient age (under 18 years); lack of laboratory confirmation of the diagnosis of COVID-19; presence of pregnancy;

Results and discussion.

Data from this study suggest that the course of SARS-CoV-2 infection may depend on multiple factors. The present study examined and examined the influence of gender, age and changes in blood parameters of patients with COVID -19.

Floor . In the presented analysis of the effect of patient gender on the course of SARS-CoV-2, a significant correlation was observed between poor prognosis and female gender, in contrast to the results of a previous report that reported higher mortality among men [7]. This may be explained by the fact that men have higher expression of angiotensin-converting enzyme 2 (ACE2), which may facilitate the entry of the virus into the host cell [3].

In patients with COVID-19 with concomitant diseases, a comparative analysis of clinical manifestations revealed significant differences in the form of age; among patients, people over 60 years of age predominated in the group of severe and extremely severe cases and SpO2 (histogram 2). As can be seen from histogram 3, in patients of the main group the infection proceeded mainly in severe and critical form , when in the comparison group the moderate-severe course of the infection prevailed.

Hyperglycemia. Survey results patients indicate that perglycemia correlates with severe SARS-CoV-2 disease (Table 2). As can be seen in the table, 207 (26.50%) patients had diabetes mellitus. This was reported in an Italian study [4]. Blood sugar levels were elevated in more than 30% of patients in the control group and in more than 86% of patients in the SARS-CoV-2(+) group. Another study also reported that 51.5 and 57.4% of severely and critically ill patients were diagnosed with diabetes [1]. A high concentration of glucose directly affects the course of the infection, and also affects this process indirectly through the development of further complications, such as diabetic ketoacidosis and concomitant vascular diseases (atherosclerosis, peripheral atherosclerosis) [9,10].

Comorbid background in patients with COVID -19. The most common pathology was hypertension, which was recorded in 715 (91.55%) patients with COVID-19, in 2nd place were neurological diseases (39.44%), and in 3rd place was

coronary artery disease (32.14%). Diabetes mellitus was observed in 207 (26.50%) patients (Table 2).

Based on the results of this analysis of all complications that developed against the background of COVID-19, significant differences were identified in the study groups. In patients of the main group, more severe complications were more often observed (stage 3 DN - 94.49%; ARDS - 55.31%; PE - 56.85%; OSHF - 59.28%) (histogram 5). A DN I Art. and DN II Art. were recorded significantly more often in the control group (histogram 6).

Morphological parameters . One study found that low red blood cell concentration was associated with SARS-CoV-2 severity . Patients who had a worse prognosis were found to have decreased red blood cell counts. This report also suggests a relationship between red blood cell count and hemoglobin concentration [9,10]. The results presented in this study indicate that low red blood cell counts in the study groups correlate with a higher percentage of hospitalized patients and more severe infection. This is because red blood cells provide an important function in the respiratory and central nervous systems. Pearson's correlation coefficient was used to statistically analyze the correlation of intervariables. The relationships between cohort parameters for different severity levels of COVID-19 disease are presented (Table 2). Hemoglobin levels were positively associated with red blood cells ($r = 0.456$; $p < 0.001$) and PCV ($r = 0.5\ 66$; $p < 0.001$). RBC and PCV levels were positively correlated with each other in the SCP group ($r = 0.5\ 89$; $p < 0.001$).

In patients with COVID-19 with concomitant diseases, a comparative analysis of laboratory parameters in patients with severe and extremely severe severity of COVID-19 showed a significantly significant increase in markers of inflammation and D- dimer (ferritin in severe cases is more than 2.5 norms, in extremely severe cases during the course is more than 4 norms, CRP is more than 7 norms, LDH in severe cases is 1.5 r more than the norm, in extremely severe cases it is twice the norm, IL-6 in severe cases is more than 9 norms, with extremely severe is more than

19 norms, D- dimer is more than 6 norms in extremely severe cases and 2 norms in severe cases) (Histogram 3).

In patients of moderate severity, according to CT of the lungs, the damage to the pulmonary parenchyma is the smallest ($p<0.5$) CT1 28%, CT 3 10% versus 48% in severe and 90% in extremely severe cases, when in severe infection the lungs are affected often corresponded to CT3 and CT4. During a critical course of infection in patients with a comorbid background, damage to the pulmonary parenchyma is significantly more common than CT level 4 ($p < 0.01$). In patients with an extremely severe course, complications developed in 100% of cases and death in 90.2% ($p < 0.001$). With moderate severity, complications developed in only 43.7%, recovery was 10.1 ($p < 0.01$), no deaths were recorded. In patients with COVID-19 without CVD with extremely severe cases, complications developed in 100% of cases and lethal outcome in 53% ($p<0.001$). With moderate severity, complications developed in 18%, recovery was observed in 17.6%, improvement in 82%. Lethal outcomes were recorded only in cases of extremely severe infection (Table 3).

Conclusion .

Assessing the impact of pre-existing comorbidities and changes in biochemical and morphological parameters observed in patients with SARS-CoV-2 over the course of the disease may contribute to a better understanding of the impact of each of these individual factors on pathology. Consequently, this may subsequently influence the selection of appropriate therapy and the reduction of possible complications . It was found that in patients with COVID-19 with a comorbid background , the most common pathology was arterial hypertension (91.55 %) , coronary heart disease (32.14 %) and various neuropathies were also identified. In patients COVID-19 with concomitant diseases, severe forms of infection prevailed, affecting the lungs 75–80% (according to CT data), which were accompanied by the development of stage 2–3 respiratory failure. (in 60% of cases) and an increase in inflammatory markers (IL-6 , ferritin , D-dimer). Patients with COVID-19 over the age of 70 years with concomitant hypertension in combination

with other chronic diseases constitute a risk group for developing a severe form of infection with an unfavorable prognosis and require timely hospitalization, dynamic observation in a hospital, as well as rehabilitation after a coronavirus infection. It is necessary to increase the efficiency of further clinical observation of patients in this category.

ТАБЛИЦЫ

Table 1. Some laboratory data of patients with COVID-19

Parameter	SCP	(n = 200)	NSCP	(n = 200)
Hb and WBC	**r0.456 _ _**	**p with**	**r 0.589**	**p 0.353**
Hb and WBC	**0.566**	**<0.001**	**-0.37**	**0.4 76**

r = correlation coefficient; p = significance; Negative values indicate the opposite correlation. The correlation is significant at the 0.05 level (2-sided). SCP—patients with severe COVID-19; NSCP - patients with non-severe COVID-19; Hb hemoglobin; ERT red blood cells;

Table 2. Outcomes at various degrees severity of COVID-19

Degree gravity	Average (%)	Heavy (%)	Extremely heavy (%)	p
Improvement	97.44%	0.5	0	**<0.01**
Lethal Exodus	2.56%	0.5	90.2	**<0.001**
Complications	**43.7%**	**55.5**	**100**	**<0.01**

ISSN 2220-7619 (Print)
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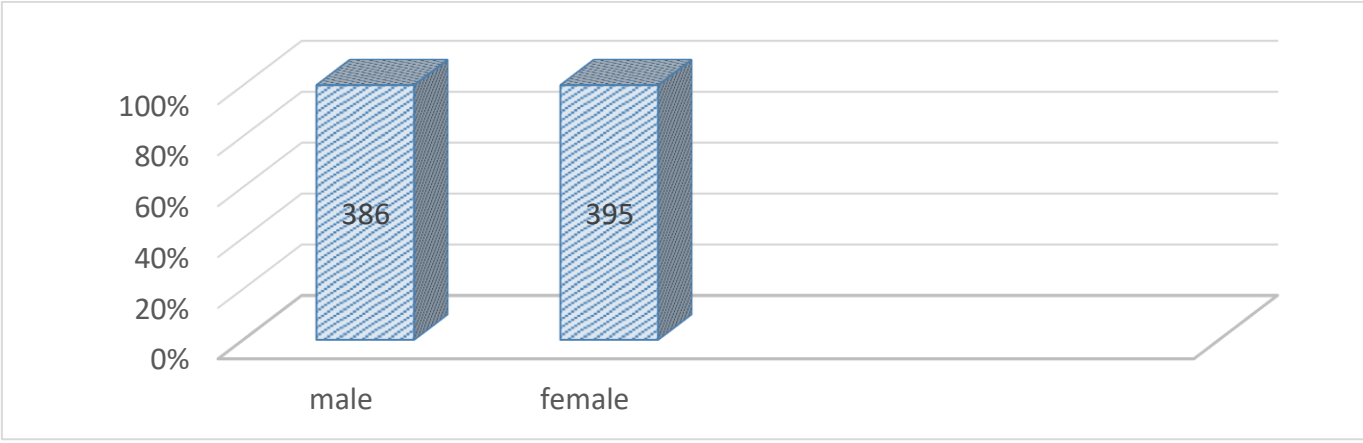
 10.15789/2220-7619-TIO-17560

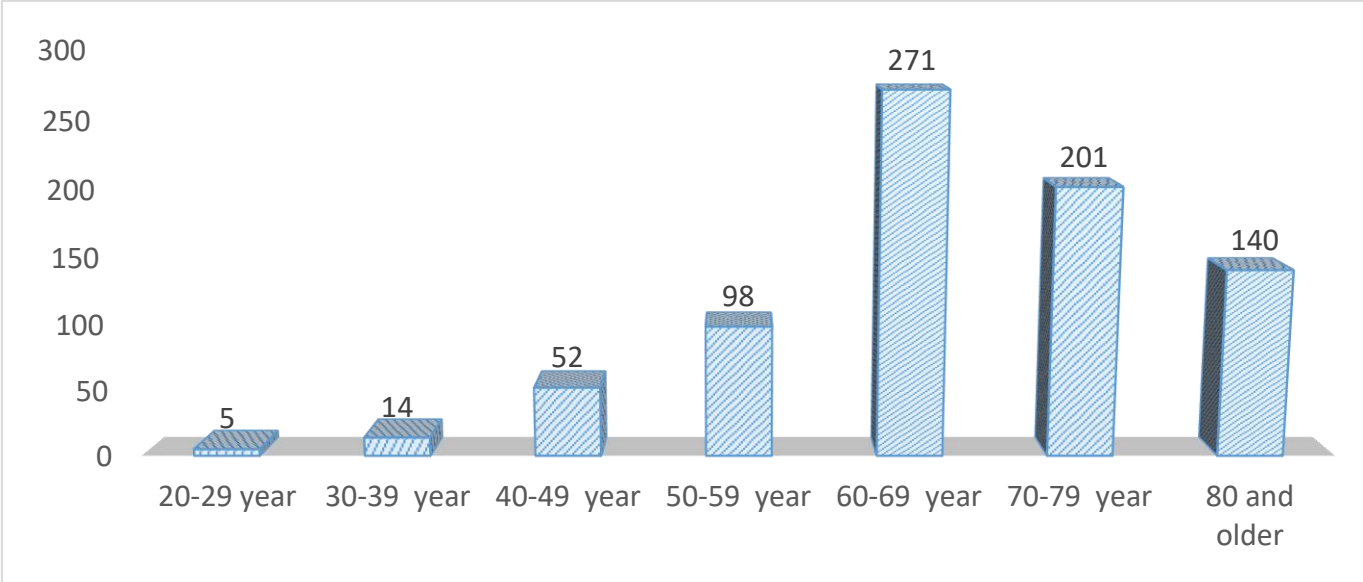
РИСУНКИ

Histogram 1. Gender of patients with COVID-19 .



In patients with COVID-19 with concomitant diseases, a comparative analysis of clinical manifestations revealed significant differences in the form of age; among patients, people over 60 years of age predominated in the group of severe and extremely severe cases and SpO2 (histogram 2). As can be seen from histogram 3, in patients of the main group the infection proceeded mainly in severe and critical form , when in the comparison group the moderate-severe course of the infection prevailed.

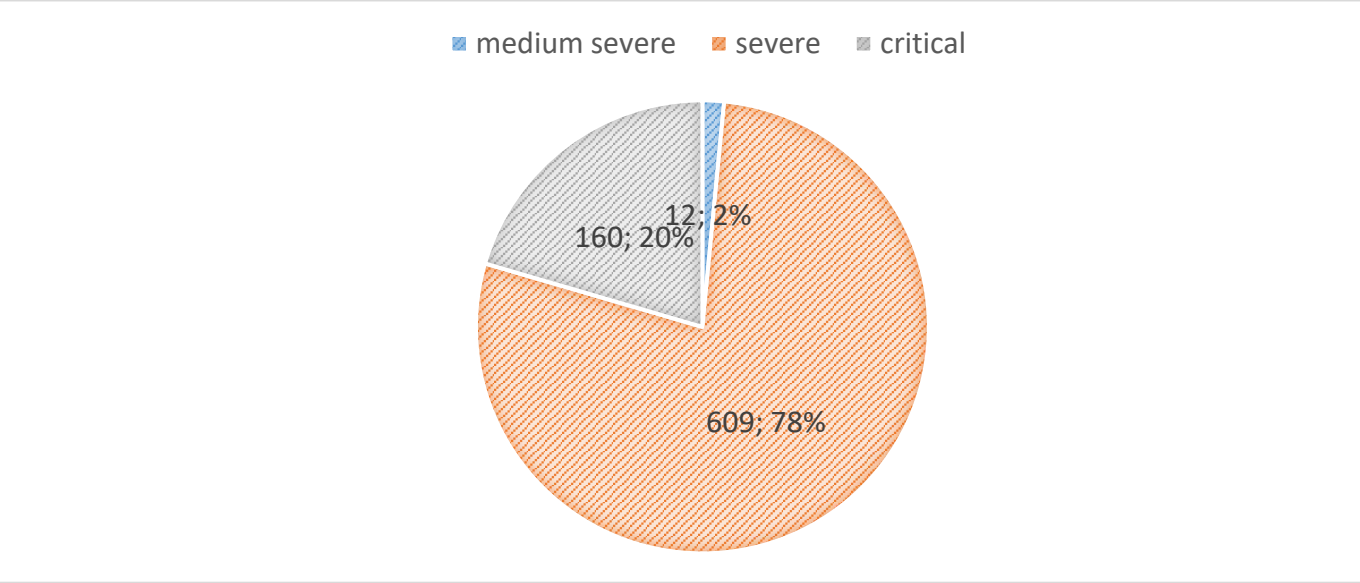
Histogram 2. Age structure of patients with COVID -19



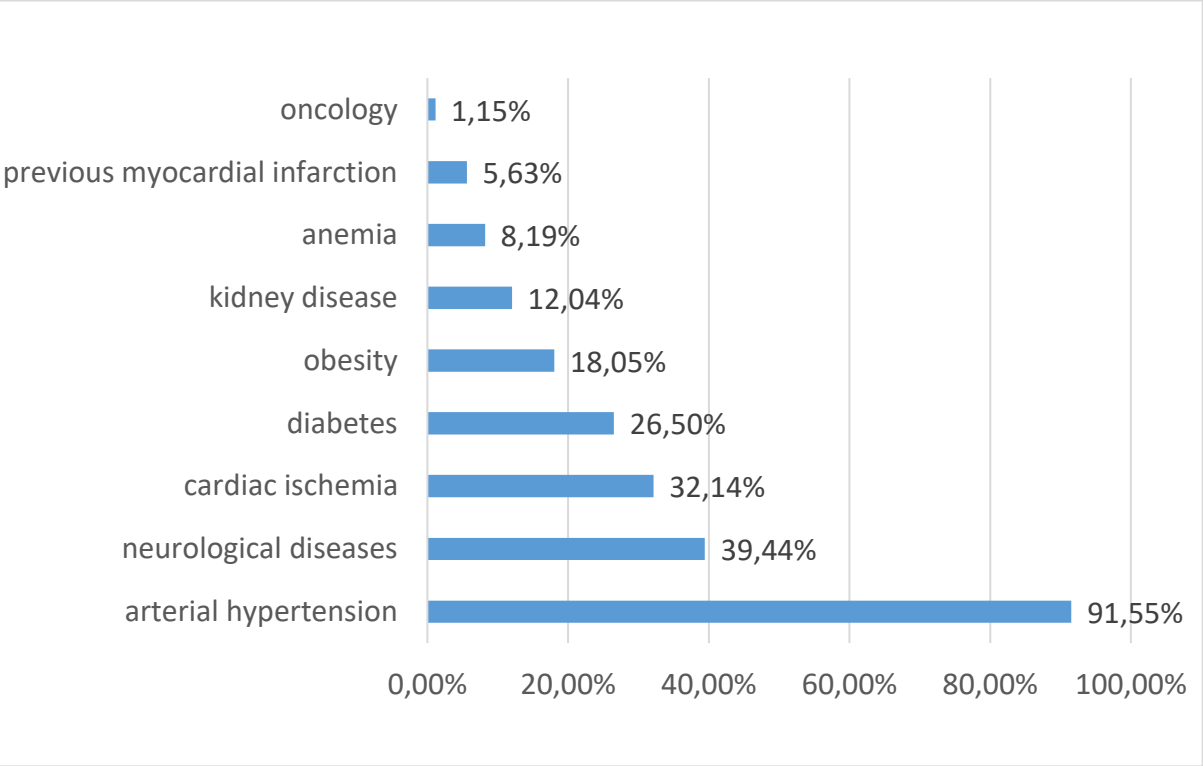
 ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

 10.15789/2220-7619-TIO-17560

Histogram 3. COVID-19 severity in patients

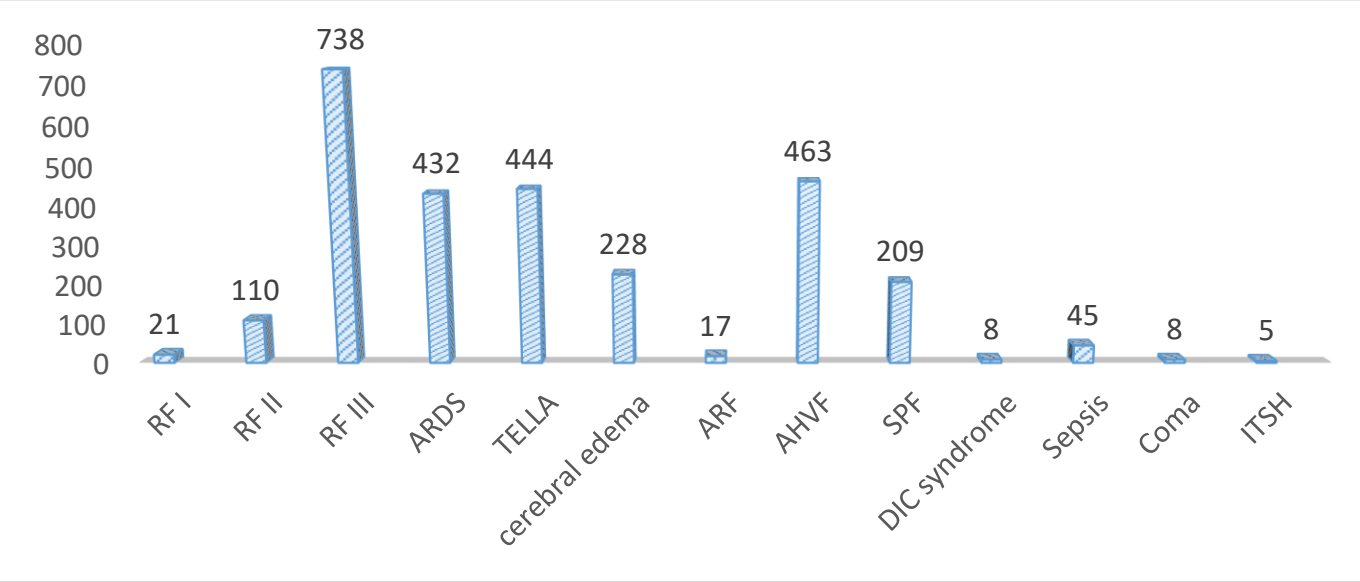


Histogram 4. Structure of CVD among patients with coronavirus infection COVID-19

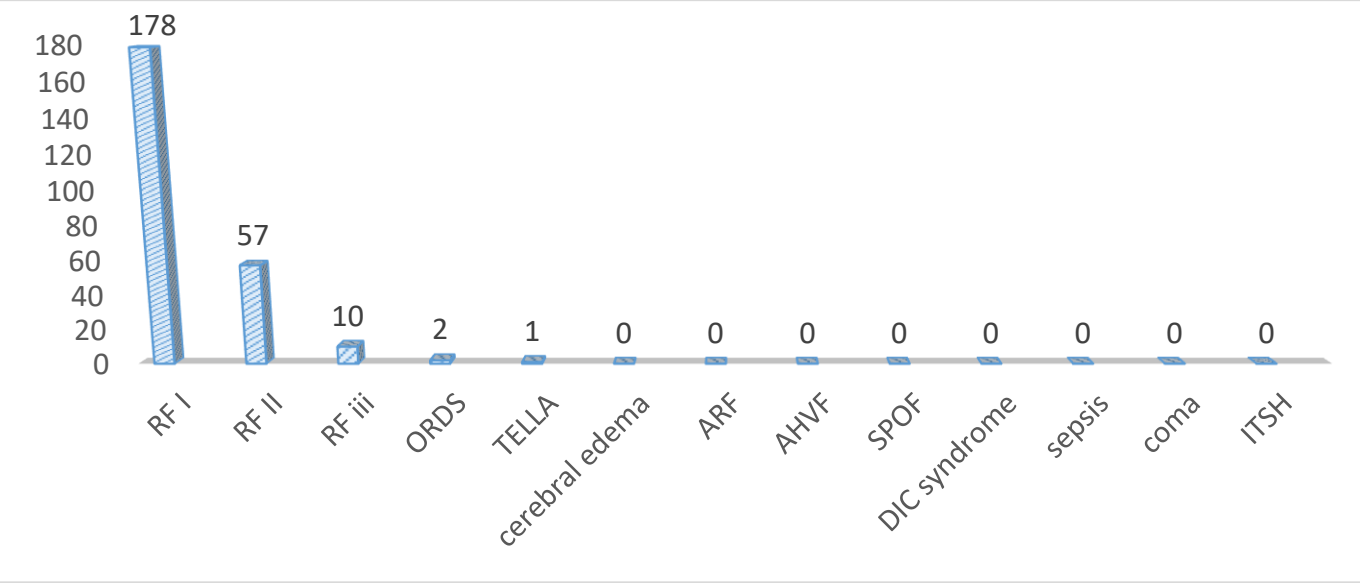


ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

Histogram 5. Structure and frequency of COVID-19 complications in the study groups (main group).



Histogram 6. Structure and frequency of COVID-19 complications in the study groups (control group).

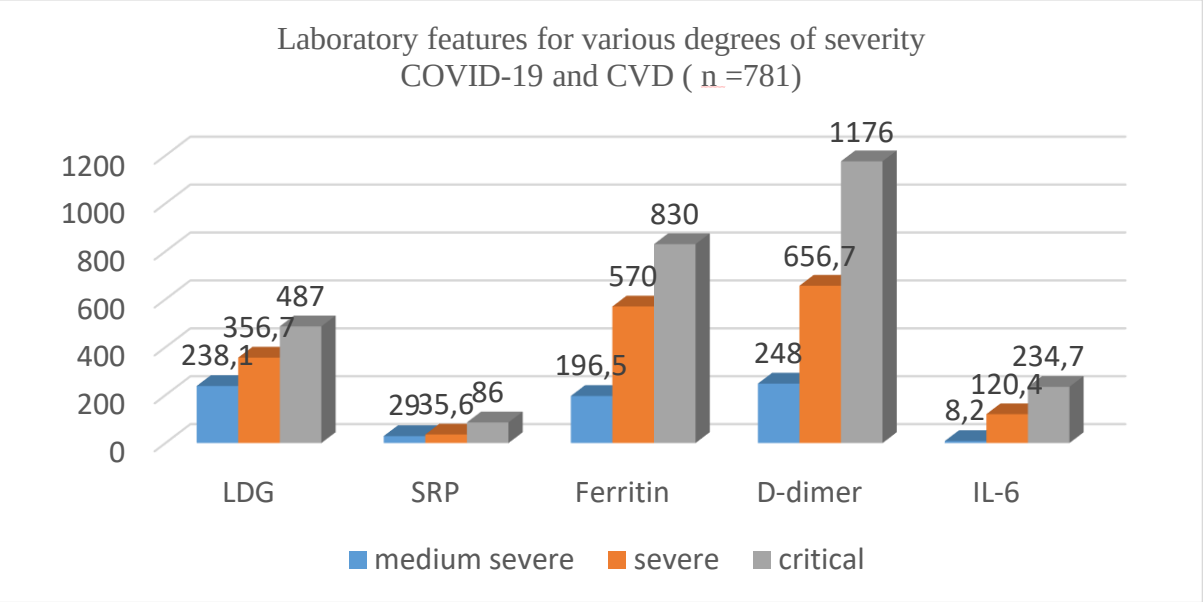


ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

 10.15789/2220-7619-TIO-17560

Histogram 7. Laboratory features for various degrees of severity

COVID-19 and CVD (n =781)



 ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)

ТИТУЛЬНЫЙ ЛИСТ_МЕТАДАННЫЕ

Блок 1. Информация об авторе ответственном за переписку

Ashirova Mayra Zangarovna – 3rd year doctoral student, assistant at the Department of Infectious Diseases and Dermatovenereology of South Kazakhstan Medical Academy, Shymkent, Kazakhstan.

Email: mayra.ashirova@list.ru

Аширова Майра Зангаровна – докторант 3 курса, ассистент кафедры инфекционных болезней и дерматовенерологии Южно-Казахстанской медицинской академии, г. Шымкент, Казахстан.

Email: mayra.ashirova@list.ru

Блок 2. Информация об авторах

Abuova Gulzhan Narkenovna, candidate of medical sciences, professor, head of the department of infectious diseases and dermatovenereology, South Kazakhstan Medical Academy, Shymkent, Kazakhstan, dr.abuova@gmail.com

http://orcid.org/0000-0002-1210-2018

Абуова Гульжан Наркеновна, кандидат медицинских наук, профессор, заведующая кафедрой инфекционных болезней и дерматовенерологии Южно-Казахстанской медицинской академии, г. Шымкент, Казахстан, dr.abuova@gmail.com

http://orcid.org/0000-0002-1210-2018

Seytkhanova Bibigul Toelegenovna - Candidate of Medical Sciences, Head of the Department of Microbiology, South Kazakhstan Medical Academy, Shymkent, Kazakhstan, d.m.n._bibigul@mail.ru

Сейтханова Бибигуль Тоелегеновна - кандидат медицинских наук, заведующая кафедрой микробиологии Южно-Казахстанской медицинской академии, г. Шымкент, Казахстан, d.m.n._bibigul@mail.ru

Блок 3. Метаданные статьи

THE IMPACT OF CONCOMITANT DISEASES DURING SARS-COV-2 INFECTION IN RESIDENTS OF KAZAKHSTAN

ВЛИЯНИЕ СОПУТСТВУЮЩИХ ЗАБОЛЕВАНИЙ ПРИ ИНФЕКЦИИ SARS-COV-2 У ЖИТЕЛЕЙ КАЗАХСТАНА

Сокращенное название статьи для верхнего колонтитула:

Impact of comorbidities in COVID-19

Влияние сопутствующих заболеваний при COVID-19

Ключевые слова: SARS-CoV-2, биомаркеры крови, COVID-19, коморбидная патология, артериальная гипертензия

Keywords: SARS - CoV -2, blood biomarkers, COVID -19, comorbid pathology, arterial hypertension.

Оригинальные статьи.

Количество страниц текста – 6, количество таблиц – 2, количество рисунков – 7.

22.12.2023

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ISSN 2220-7619 (Print)
ISSN 2313-7398 (Online)