An-Najah National University

Faculty of Graduate Studies

CLINICAL CHARACTERISTICS AND OUTCOMES OF HOSPITALIZED PATIENTS WITH CORONAVIRUS DISEASE 2019: A SINGLE-CENTER, RETROSPECTIVE STUDY FROM PALESTINE

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Dedication

This work is dedicated to my family for their endless love, support, encouragement, which gave me the strength to face all challenges and bring this research to reality.

Acknowledgment

I would like to thank everyone who helped me accomplish my mission of pursuing master's degree in clinical pharmacy.

I genuinely owe my deepest gratitude to my supervisor Dr. Rowa Al Ramahi, for guiding me and her efforts and patience in following up on my data collection and reviewing my thesis. She showed great support and help.

I am highly indebted to the An-Najah National University for giving me the opportunity and resources to carry out this study.

My thanks go to all the people who have supported me, directly or indirectly, to accomplish this research work.

Muhamad Mamoon Amer

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

CLINICAL CHARACTERISTICS AND OUTCOMES OF HOSPITALIZED PATIENTS WITH CORONAVIRUS DISEASE 2019: A SINGLE-CENTER, RETROSPECTIVE STUDY FROM PALESTINE

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, workot been submitted elsewhere for any other degree or qualification.

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Date: 4/18/2022

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CLINICAL CHARACTERISTICS AND OUTCOMES OF HOSPITALIZED PATIENTS WITH CORONAVIRUS DISEASE 2019: A SINGLE-CENTER, RETROSPECTIVE STUDY FROM PALESTINE

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Abstract

Background: This study reports routine laboratory analysis related to coronavirus disease 2019 (COVID-19) severity evaluated at admission and follows up the lab result until the disease outcome either discharge or death. This study combines test results with data on the severity of the disease. It can provide differences between patients with mild, moderate, and severe COVID-19 observed in a particular laboratory analysis. Therefore, this study contributes to a better understanding of the use of laboratory analysis in the evaluation of COVID-19 patients.

Methodology: A cross-sectional retrospective study using medical records at An-Najah National University Hospital to abstract data about patients diagnosed with COVID-19 in Palestine. The IBM Statistical Package for Social Sciences was used to conduct the statistical analysis (SPSS version 21).

Results: The study included 106 patients with COVID-19, most of the patients were males (70.8%, n=75) and females (29.2%, n=31) with a ratio of 2.4:1. There were 18 patients who died during the follow-up of this study. Most of the symptoms were resolved at the time of discharge. The vast majority of the patients suffered from tiredness (91.51%) at the time of admission, while this symptom has reduced to (51.14%) at the time of discharge. Females had the highest percentage of *severe* COVID-19 among all participants (53.77%). In terms of age, geriatric females (30 patients) had severe COVID-19; this age group had the highest severity, which was not statistically significant (p=0.09). The current study analyzed the patients with COVID-19 based on disease severity and lab results, only neutrophils, lymphocytes, Lactate dehydrogenase, and c-reactive protien had statistically significant differences between severity of COVID-19 ($p<0.05$). D-dimer had very high levels with a mean of 2.96 in severe cases compared to a mean of 0.67±0.5 in mild cases.

Conclusions: Latest research indicates, individuals with a severe COVID-19 illness history have a unique laboratory pattern upon admission that can be used for triaging and treatment decisions. Patients with a severe COVID-19 illness history are expected to exhibit a different pattern in terms of the results of regular laboratory testing, based on the current data. Instead of employing a single special biomarker, a systematic approach utilising multiple relevant regular tests is preferable. There is a need for more investigation into the use of laboratory testing as predictive indicators of COVID-19 disease severity and outcome.

Keywords: Corona; COVID-19; Lab Results; Outcomes; Palestine.

Chpter One

Introduction

1.1 Overview

Severe Acute Respiratory Syndrome- Corona Virus-2 (SARS-CoV-2) is a new coronavirus that has quickly spread over the world, causing considerable global health and economic hardship. The current primary treatment is still symptomatic and supportive due to a lack of full knowledge of the mechanisms to severe reaction or complication, risk factors, and groups with pre-existing conditions (Sanders, Monogue, Jodlowski, & Cutrell, 2020). Many clinical studies from several companies worldwide have been working to discover effective treatments and vaccines (Lythgoe & Middleton, 2020). Recently, several vaccines showed promising efficacy and were approved for emergency usage. However, efficacy against new variants of the virus that evolve fast, lack of global availability of the vaccines, and poor compliance are reasons that forced us to deal with COVID19 for a long time to reach global herd immunity. With the widespread Coronavirus disease COVID-19, scientific communities worldwide have shown renewed interest in searching for novel immune-stimulating or antiviral agents for either treatment or prevention.

COVID-19 signs and symptoms are classified by the World Health Organization (WHO) to different categories; fever, dry cough, and tiredness are considered the most abundant signs. Aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of taste or smell, a rash on the skin, or discolorations of fingers or toes are considered fewer common signs. While Breathing problems or shortness of breath, chest discomfort or pressure, and trouble speaking or moving are considered severe symptoms (Sohrabi et al., 2020).

A limited minority of persons with severe COVID-19 may develop hyper-inflammatory cytokine storm syndrome, and respiratory failure from acute respiratory distress syndrome (ARDS) which is the major cause of death. Secondary haemophagocytic lymphohistiocytosis (sHLH) is an inflammatory disorder marked by a fatal hypercytokinaemia (coagulopathy and reduced fibrinolysis –endothelial cells activation clot formation and pulmonary embolism with multiorgan failure and is associated with severe COVID-19 patients. Cardinal characteristics of sHLH involve unremitting fever,

hyperferritinemia, pulmonary involvement (including ARDS), elevated interleukin IL-2, IL-7, and cytopenias (Huang et al., 2020).

While the majority of persons get COVID-19 in moderate or simple forms, it is predicted that 14% develop a severe acute respiratory infection that requires hospitalization and oxygen assistance, and 5% require admission to an intensive care unit (ICU) (WHO, 2020). In addition, a small fraction of COVID-19 patients may develop a hyper-inflammatory cytokine storm syndrome, and respiratory failure from ARDS is the major cause of death (Ruan, Yang, Wang, Jiang, & Song, 2020).

In Palestine, The Palestinian Authority (PA) has responded promptly and successfully to the COVID-19 outbreak, coordinating international and national efforts to keep the virus from spreading outside its boundaries. To halt the COVID-19 pandemic, the Palestinian Ministry of Health devised ways to decrease and stop transmission, offer optimal patient care, and reduce the epidemic's impact on health systems, social services, and economic activity (Hejaz, 2020).

1.2 Objectives

1.2.1 General Objective

The current study aims to identify the clinical characteristics and outcomes of hospitalized patients with coronavirus disease-2019 (COVID-19) in Palestine.

1.2.2 Specific objectives

- To determine the complications that develop among COVID-19 patients in Palestine.
- To assess the blood tests made to Palestinian patients with COVID-19 and their adherence to the global guidelines.
- To find an association between specific markers, especially lipid profile, sugar profile, coagulation tests, liver and kidney tests, and the development of COVID-19 complications and outcomes.

1.3 Significance of the study

This study benefits patients with COVID-19 and clinicians who manage the disease. This study reports routine laboratory analysis related to patients' disease severity evaluated at admission and follows up the lab result until the patients' disease outcome either discharge or death. This study combines test results with data on the severity of the disease. It can differentiate individuals with mild, moderate, and severe COVID-19

observed in particular laboratory analysis. Therefore, this study contributes to a better understanding of the utilization of laboratory analysis in the evaluation of COVID-19 patients.

1.4 Literature Review

1.4.1 Overview

The current study's research goal, strategy, and methodological approach were designed after a thorough review of the literature. This section looked at past research and data that was directly related to the study's goals. COVID-19 in Palestine, COVID-19 therapy, COVID-19 problems, COVID-19 laboratory tests, and information gaps relevant to the research goals are all discussed.

1.4.2 COVID-19

In December 2019, a number of acute atypical respiratory ailment cases were recorded in Wuhan, China. This swiftly swept throughout China from Wuhan. It wasn't long before a novel coronavirus was identified as the culprit. The severe acute respiratory syndrome coronavirus-2 was named by its remarkable resemblance (80%) to SARS-CoV, which caused acute respiratory distress syndrome (ARDS) and considerable mortality in 2002–2003.

A zoonotic transmission associated to a seafood market in Wuhan, China, was assumed to be the source of the SARS-CoV-2 outbreak. Human-to-human transmission was eventually discovered to have a key role in the subsequent epidemic. This virus caused Coronavirus Disease 19 (COVID-19), which the World Health Organization (WHO) declared a pandemic. COVID-19 has afflicted a large number of people all across the world, with instances reported in more than 200 countries and territories. As of April 2020, around 1,400,000 cases had been reported worldwide (Li et al., 2020; J. Zhang et al., 2020).

SARS-CoV-2 is a virus that mostly affects the respiratory system, although it can potentially impact other organ systems. Fever, dry cough, and dyspnea were among the symptoms of lower respiratory tract infection in the first case series from Wuhan, China. Headaches, dizziness, generalized weakness, vomiting, and diarrhea were also reported. COVID-19 respiratory symptoms are now well recognized to be highly varied, ranging

from modest symptoms to severe hypoxia in ARDS patients (Shi et al., 2020; Wu, Wang, & Liu, 2020).

Table 1.1 summarizes the definitions of asymptomatic, mild, moderate, severe, and critical severities of COVID-19 (COVID-19 Treatment Guidelines Panel, 2021).

Table 1.1

COVID-19 severity

Severity	**COVID definitions**
	COVID PCR test positive.
Asymptomatic	No clinical symptoms and signs
	Normal chest imaging
Mild	fever, fatigue, myalgia, cough, sore throat, runny nose, sneezing, nausea, vomiting, abdominal pain, diarrhea.
	Pneumonia (frequent fever, cough)
Moderate	No hypoxia
	Lesions in chest CT
Severe	Pneumonia with hypoxia ($SpO_2 < 92\%$)
Critical	Acute respiratory distress syndrome (ARDS), shock, encephalopathy, myocardial injury, heart failure, coagulation dysfunction and acute kidney injury.

1.4.3 Diagnosis of COVID-19

COVID-19 should be evaluated for everyone who has a new-onset fever and/or respiratory symptoms. Although cough and dyspnea are the most frequent COVID-19 respiratory symptoms, other symptoms such as sore throat, rhinorrhea, and nasal congestion are also common. Odor or taste difficulties, myalgias, and diarrhea are all common symptoms. Individuals with severe lower respiratory tract illness for no obvious reason should be tested for COVID-19.

Because SARS-CoV-2 is so common over the world, doctors should suspect COVID-19 with a low threshold. The level of suspicion should be elevated if the person is exposed to SARS-CoV-2 in an epidemic context, has lived in or visited locations with high rates of community transmission, or has had close contact with someone who has the suspicion level should be raised (Nouvellet et al., 2021).

Due to a lack of specific clinical features, COVID-19 cannot be recognized from other viral respiratory infections. Certain traits, however, may warrant a higher level of clinical suspicion. According to various studies, the most strongly connected symptom to a positive SARS-CoV-2 test is loss of taste or smell (Cherry et al., 2020). COVID-19 can also be detected by the onset of dyspnea many days after the onset of early symptoms. None of these data, however, can definitively identify COVID-19 without microbiologic testing.

COVID-19 should be investigated in individuals who have extrapulmonary issues such heart damage, ischemic stroke, and other thromboembolic events, as well as inflammatory illnesses connected to SARS-CoV-2 infection (ex., the multisystem inflammatory syndrome in children).

COVID-19 patients that do not require immediate medical attention should be urged to contact before going to a health care institution for examination. Many patients can be assessed over the phone to see if they require testing. As soon as COVID-19 is suspected in patients in a health care facility, infection control measures should be implemented.

To detect SARS-CoV-2 RNA from the upper respiratory tract, nucleic acid amplification testing (NAAT), most often using a reverse-transcription polymerase chain reaction (RT-PCR) assay, is the preferred first diagnostic test for COVID-19. Fast RT-PCR assays tend to be equivalent to typical laboratory-based NAAT, however rapid isothermal testing may be less sensitive (Lai & Lam, 2021).

1.4.4 COVID-19 in Palestine

The first case of COVID-19 was detected in Palestine on March 5th, 2020. On March 22nd, the Palestinian Authority declared a state of emergency and launched rapid containment measures, including a lockdown in Bethlehem, followed by lockdowns in other West Bank governorates, restricting mobility and closing all non-essential facilities.

As of June 2020, there had been 630 confirmed coronavirus cases and five fatalities throughout the Gaza Strip and the West Bank, including East Jerusalem, with 527 of them fully recovered. According to the Palestinian Ministry of Health, this figure may be underestimated because the Israeli Occupation Authorities refuse to provide statistics regarding the number of Palestinian cases in Jerusalem with the Palestinian Authority. Medical missions, preventive treatments, and equipment were all disrupted by Israeli Occupation Authorities in Jerusalem, accounting for about one third of all cases in Palestine. Compared to other nations in the area, the number of illnesses and deaths in Palestine is comparatively low (AlKhaldi, Kaloti, Shella, Al Basuoni, & Meghari, 2020).

The humanitarian and political situation in Palestine is complicated, and it has a big impact on the health system's capacity to deal with epidemics like COVID-19. The catastrophic humanitarian situation hampers Palestine's capacity to prepare for and respond to COVID19 in the country, including poor socio-economic and living circumstances and a damaged health system. The continued political unrest in Gaza and the physical separation between the Gaza Strip and the West Bank are important contributors to these difficulties, causing worsening humanitarian situations during the COVID-19 epidemic. These long-term humanitarian requirements, along with the high frequency of NCDs among Palestinians, raise the possibility of COVID-19 spreading and increasing the disease burden.

1.4.5 The treatment of COVID-19

The pathogenesis of COVID-19 is assumed to be driven by two primary mechanisms. First, the replication of SARS-CoV-2 drives the illness early on in the clinical stage. The illness seems to be caused later in the clinical course by a dysfunctional immune/inflammatory reaction to SARS-CoV-2, which results in cellular destruction. On the basis of this knowledge, it is expected medicines targeting SARS-CoV-2 directly would have the most impact early in the disease's progress., whereas immunosuppressive/anti-inflammatory medications will be more useful later in the disease's course (National Institute of Health, 2022b).

1.4.5.1 General management of non-hospitalized patients with acute COVID-19

Supportive care, consideration of COVID-19-specific therapy for patients with a high risk of disease progression, taking steps to reduce the risk of SARS-CoV-2 transmission

(including isolating the patient) and advising patients on when to contact a health care provider and seek an in-person evaluation should all be part of the management of non-hospitalized patients with acute COVID-19.

Patients with COVID-19 symptoms should be assessed by telehealth appointments whenever feasible to identify if they need a particular COVID-19 treatment and in-person healthcare.

Patients with dyspnea should be referred to a health care provider for an in-person assessment, and they should be closely followed for deteriorating respiratory status in the days following the onset of dyspnea.

When designing a management plan, take into account the patient's vital signs, physical exam findings, risk factors for severe disease progression, and the availability of healthcare resources.

1.4.5.2 Therapeutic Management of Non-hospitalized Adults with COVID-19

Antipyretics, analgesics, and antitussives can all be used to treat fever, headache, myalgias, and cough. Patients with dyspnea may prefer to sleep in the prone position rather than the supine position. Because extreme breathlessness can induce worry, health care professionals should teach patients how to breathe properly. Patients should be urged to drink water on a regular basis to avoid dehydration. Rest is recommended during the acute phase of COVID-19, and ambulation and other forms of activity should be increased according to the patient's tolerance. Patients should be informed about the varying lengths of time for symptoms to resolve and complete recovery.

In people with mild to severe SARS-CoV-2 infection, two anti-SARS-CoV-2 monoclonal antibody (mAb) combinations (bamlanivimab plus etesevimab and casirivimab plus imdevimab) and a single mAb (sotrovimab) have been demonstrated to lower the risk of hospitalization and mortality. In patients with mild to severe COVID-19 symptoms and specific risk factors for disease development, Symptoms of COVID-19 and certain risk factors for disease development. As a result, the FDA has given these drugs Emergency Use Authorizations (EUAs) for the treatment of COVID-19 in these individuals as well as those with other risk factors for progression identified in population-based studies.

However, there are no comparable data available to evaluate if these medications vary in clinical effectiveness or safety (National Institute of Health, 2022a).

- Dexamethasone

  Dexamethasone or other systemic glucocorticoids should not be used to treat individuals with mild to moderate COVID-19 who do not require hospitalization or supplemental oxygen, according to the Panel. There is currently no information on the safety and efficacy of these drugs, and systemic glucocorticoids may have an impact on these people. Patients taking dexamethasone or another corticosteroid for another reason should follow their doctor's instructions and maintain treatment for their underlying problems.
- Remdesivir

  Remdesivir is the only medicine licensed by the FDA for the treatment of COVID-19 at this time. It is indicated for usage in patients who require supplementary oxygen while in the hospital. The safety and effectiveness of remdesivir were investigated in clinical studies after patients were discharged from the hospital. The Panel advises against continuing remdesivir treatment in COVID-19 patients who are sufficiently stable to be discharged and don't need supplementary oxygen.
- Baricitinib

  Patients with COVID-19 were recruited in the key safety and effectiveness studies for baricitinib, and therapy was ceased at the time of hospital discharge.

  The Panel (NIH) advises against continuing baricitinib treatment in COVID-19 patients who are sufficiently stable to be discharged and don't need supplementary oxygen.
- Other COVID-19 agents that have been explored or evaluated for usage in outpatients
- The panel advises against utilizing chloroquine or hydroxychloroquine with or without azithromycin for COVID-19 outpatient treatment, as well as lopinavir/ritonavir and other HIV protease inhibitors.

In the absence of additional reason, the panel advises against using antimicrobial medication (e.g., azithromycin, doxycycline) for COVID-19 outpatient treatment.

In the outpatient context, several agents have been investigated or are presently being investigated:

1. Ivermectin and nitazoxanide, for example, are antiviral drugs.
2. Plasma from a patient who is recovering
3. Supplements, such as vitamin C, vitamin D, and zinc Immunomodulators, such as colchicine and fluvoxamine

Anticoagulants and antiplatelet medication should not be started in the outpatient environment to prevent venous thromboembolism or arterial thrombosis unless the patient has additional grounds or is enrolled in a clinical study.

For patients taking immunomodulating medicine, the prescribing doctor should discuss the pros and cons of temporarily reducing or stopping the medication; these pros and cons will vary depending on the indication of the drug and how serious the underlying condition is.

Patients with obstructive sleep apnea who use a continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP) device may continue to use it. However, patients should be told that, like nebulizers, they should only use the device when they are alone.

1.4.5.3 Therapeutic Management of Hospitalized Adults with COVID-19

The COVID-19 Therapy Guidelines Panel advises against using dexamethasone or other corticosteroids for COVID-19 therapy in patients who don't need more oxygen. However, patients with COVID-19 taking a corticosteroid such as dexamethasone for an underlying illness should keep taking it as prescribed by their doctor.

There isn't inadequate proof to support remdesivir for COVID-19 therapy in patients admitted to hospital who don't need supplementary oxygen, although it may be useful in individuals at elevated risk for condition worsening.

A diverse group of patients needs supplementary oxygen but not high-flow oxygen, non-invasive ventilation, or mechanical ventilation. Some of these patients may have a modest disease that will recover in a brief amount of time with or without remdesivir, dexamethasone, or both; others will develop condition exacerbation despite therapy and

will need more acute healthcare. Unfortunately, no agreement on whether laboratory or clinical indicators provide meaningful risk classification to drive treatment and detect which subgroups of individuals will develop progressive lung damage and hypoxia.

- Dexamethasone 6 mg PO/IV daily for ten days (or until discharge if sooner) is recommended.
- Tocilizumab
- It is recommended for patients who are taking dexamethasone (or a dose-equivalent corticosteroid) at prescribed dosages and are within 14 days of hospital admission (or within 14 days of a new COVID-19 diagnosis if the infection was nosocomially acquired). In medication scarcity conditions, a single dose of tocilizumab 400 mg IV or sarilumab 400 mg IV should be given to all eligible patients. No patient should get a second dose of tocilizumab or sarilumab.
- Baricitinib

  In patients who are on prescribed dosages of dexamethasone (or a dose-equivalent corticosteroid) but have a contraindication to corticosteroid treatment, a dose of 4 mg PO/NG daily for 14 days (or until discharge if sooner) may be explored. Due to a lack of safety and effectiveness evidence, the panel does not suggest combining baricitinib and IL-6 inhibitors.

Low molecular weight or unfractionated heparin is indicated as a prophylactic dosage.
Patients who are critically unwell should not get therapeutic dosage anticoagulation unless they have a distinct reason.
Remdesivir should not be used in individuals who are on mechanical ventilation.
In patients who require high-flow oxygen, Remdesivir 200 mg IV on day 1 followed by 100 mg IV daily for four days may be explored (i.e., oxygen by mask, oxygen by high-flow nasal cannula, or non-invasive mechanical ventilation).
Antibodies that neutralize SARS-CoV-2 are not indicated for severely unwell individuals.

At the time of presentation, bacterial co-infection is infrequent in COVID-19 pneumonia. If a bacterial infection is firmly suspected, do not add empiric medicines for bacterial pneumonia. Continue empiric antibiotics for 5 days and then de-escalate based on microbiological results and clinical assessment.

1.4.6 Complications of COVID 19

While most young and healthy populations are asymptomatic or show very mild symptoms after testing positive to COVID-19, many show moderate symptoms that require hospitalization; among those, some develop severe medical complications that can lead to death. Significant scientific efforts, including clinical, basic, and genetic studies, focus on understanding the mechanisms that underline the variability in disease complications and outcomes, risk factors, and biomarkers to predict risk groups and prioritize being treated or vaccinated that correlate with the severity of COVID-19 (Shah, Hillman, Playford, & Hishmeh, 2021).

COVID-19 puts older persons and people with pre-existing medical issues at a higher risk of becoming extremely sick. Pneumonia and breathing difficulties, organ failure in many organs, cardiovascular illnesses, severe lung problems (ARDS), venous thrombosis, acute kidney damage, and further viral and bacterial infections are all possible consequences. Although most patients diagnosed with COVID-19 recover entirely within a few weeks, some people, even patients with mild disease, keep experiencing symptoms after their initial recovery (Carfì, Bernabei, & Landi, 2020; Shah et al., 2021).

COVID-19 symptoms last the longest in older persons and people with a variety of serious medical issues, but even young, otherwise healthy people might feel ill for weeks to months following infection. Symptoms such as exhaustion, shortness of breath, cough, joint pain, chest discomfort, muscular pain, or headache, tachycardia, loss of smell or taste, memory, concentration, or sleep issues, rash, or hair loss may persist.

Although COVID-19 is considered a disease that mainly hits the lungs, it can also affect several organs (e.g., the heart, lungs, and brain). Even in patients who just had modest COVID-19 symptoms, damage to the heart muscle has been shown during imaging follow-up after recovery from COVID-19, hence, increasing the risk of heart complications such as heart failure or thrombosis. COVID-19 causes pneumonia that leads to enduring damage to the alveoli in the lungs, hence, breathing problems. Moreover, COVID-19 has the potential to induce strokes or seizures. COVID-19 may potentially raise the risk of Parkinson's and Alzheimer's disease. In endemic locations, neurologists are working hard to figure out how COVID-19 affects the nerve system. Numerous articles have investigated the neurological characteristics of COVID-19, but

there is inadequate evidence to illuminate the whole picture. A total of 43 clinical cases were detailed, including history, examination, and comprehensive investigations. Kabbani et al. case study for example, illustrates the possible range of neurological symptoms (Kabbani & Olds, 2020; Xiong et al., 2020).

Furthermore, blood cells are affected by COVID-19, in which blood cells tend to clump up and form clots. These clots cause heart attacks and strokes. Thus, most cardiovascular disorders triggered by COVID-19 came from the tiny clots that emerged and blocked the capillaries in the myocardium. Besides, blood clots may affect other organs such as the lungs, legs, liver, and kidneys. Therefore, cardiovascular disorders can also affect the liver and kidneys (Llitjos et al., 2020).

Some patients with COVID-19 may experience serious kidney problems via acute kidney injury, proteinuria, hematuria, increased blood urea nitrogen, and/or creatinine. Kidney damage may be caused directly by an infection from SARS-Cov-2 or indirectly as an immune reaction from the body. Pieces of evidence show that sepsis is one of the main mechanisms of kidney damage in patients with COVID-19. Hypoxia as a result of pneumonia seen in severe cases and intrarenal vascular obstruction secondary to blood clot formation after virus infection is considered an indirect cause of kidney injury by COVID-19 (Jadali, 2020).

According to a comprehensive study, people with COVID-19 should engage in a 20–60-minute aerobic exercise program on a regular basis. This program should be completed by cycling or walking at an intensity of 55 percent to 80 percent VO2max or 60 percent to 80 percent of maximum heart rate. This program should be completed three times a week, twice a week. These components can be employed to improve immune function without making the patient tired (Alawna, Amro, & Mohamed, 2020).

Patients with severe symptoms of COVID-19 mostly need to be treated in an intensive care setting and might need mechanical ventilators to breathe. Upon discharge and surviving such a harsh experience, patients may develop psychological symptoms, especially post-traumatic stress syndrome, depression, and anxiety (Jain & Yuan, 2020).

The long-term effects of COVID-19 are currently unclear. Researchers advise clinicians to keep a careful eye on those who have undergone COVID-19 to evaluate how their

organs perform after they have recovered. With the varied complications of COVID-19, research must predict the complications to prevent them effectively (Thompson et al., 2020). This goal can be achieved by studying the patients in detail and orientation. Hence, the current study aimed to investigate the relationship between COVID-19 complications and blood tests to develop a predictive tool that can identify the complications that might happen and their severity.

It is imperative to remember that most patients who had COVID-19 recovered quickly. However, the long-lasting complications from COVID-19 warrant the development of preventive measures such as predicting complications and their severity (Muhammad, Islam, Usman, & Ayon, 2020).

1.4.7 Laboratory testing for COVID-19 patients

COVID-19 is severe; the patients will encounter mostly acute respiratory distress syndrome, sepsis, and multiorgan failure. Therefore, lab results are an essential tool in diagnosing SARS-CoV-2 and their vital role in managing patients with COVID-19.

COVID-19 patients get biochemical laboratory testing to help with illness staging, prognosis, and treatment intervention monitoring. Inflammation (including cytokine storm) and coagulation may be present in COVID-19 patients who require hospitalization, as evidenced by changes in cytokines and coagulation markers. (Del Valle et al., 2020). There are numarous biochemical tests that need to bu investigated to properly diagnose, treat, and monitor the patients. This section will review the main biochemical tests, explain them briefly and present their role in COVID-19. This understanding of the biochemical test will allow the researcher to critically investigate the lab results and link them with the clinical aspects of the patients.

C-reactive protein (CRP) is an acute inflammatory protein produced at the sites of infection or inflammation and can rise up to 1,000-fold there (Sproston & Ashworth, 2018). In addition to smooth muscle cells, macrophages, endothelial cells, lymphocytes, and adipocytes, the liver's hepatocytes are the main producers of CRP. The complement pathway, apoptosis, phagocytosis, the release of nitric oxide (NO), and the production of cytokines, particularly interleukin-6 and tumor necrosis factor, are just a few of the processes that CRP plays a significant role in during inflammatory processes and host responses to infection. Inflammatory illnesses include rheumatoid arthritis, several

cardiovascular diseases, and infections show higher expression of C-reactive protein (Du Clos & Mold, 2004).

Tumor necrosis factor-alpha, Initially discovered as a cytokine that contributes to the necrosis of tumors, tumor necrosis factor alpha (TNF-) has more recently been shown to perform crucial additional roles as a pathogenic component of autoimmune disorders. Two distinct receptors that TNF- hits to start signal transduction cascades. These pathways result in a range of biological responses, such as cell proliferation, differentiation, and survival. However, TNF- signaling that is inappropriately or excessively activated is linked to chronic inflammation and may eventually result in the emergence of clinical consequences including autoimmune disorders. TNF-inhibitors and other potent therapeutics have been created as a result of increased knowledge of the TNF-signaling mechanism's role in the treatment of immunological disorders (Jang et al., 2021). Tumor necrosis factor-alpha (TNF-alpha) is a proinflammatory cytokine involved in a number of crucial physiological processes. TNF-alpha antagonists are useful in the management of inflammatory disorders. This cytokine has a pathogenic function in various illnesses (Rychly & DiPiro, 2005).

Small proteins known as cytokines are secreted by a variety of cells, including immune system's white blood cells. Inflammation and immune system response regulation are aided by cytokines. The storm occurs when the body's organs are damaged by hyperinflammation as a result of cytokine production that goes into an unchecked overdrive. This inflammation in the lungs leads to fluid buildup in the airspaces, which subsequently results in ARDS.

Interleukin-6 (IL-6) is the cytokine that has drawn the greatest media attention out of all the others. Patients with COVID-19 have higher levels of IL-6 in their blood, with critically sick patients having the highest levels. Increased IL-6 levels have been shown to be strongly linked to unfavorable clinical outcomes, such as ICU hospitalization, ARDS, and mortality.

C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-α), interleukin-1 (IL-1), and interleukin 6 (IL-6) levels may all be raised as a result of systemic inflammation. IL-6 and CRP levels have been demonstrated to have a strong predictive value for severe COVID-19 that necessitates mechanical breathing (Aziz, Fatima, & Assaly, 2020).

Associated with bacterial superinfection include neutrophilia, leukocytosis, and increased procalcitonin levels (Frater, Zini, d'Onofrio, & Rogers, 2020).

D-dimer is a crosslinked fibrin fragment that forms when fibrin clots are broken up by plasmin, making it an indirect biomarker of the activation of the hemostatic system. Several studies published in the early stages of the coronavirus disease 2019 (COVID-19) pandemic identified coagulation abnormalities in infected patients, including elevated D-dimer levels. As a result, D-dimer has been extensively utilized for indications that are not yet licensed. The primary use of D-dimer is to rule out pulmonary embolism and deep vein thrombosis in individuals with low or moderate clinical suspicion. D-dimer is incorporated into the ISTH algorithm for the diagnosis of disseminated intravascular coagulation and is also used to calculate the likelihood of venous thromboembolism recurrence. Finally, several studies have found that individuals with COVID-19 who are hospitalized have high D-dimer levels have a bad prognosis (Auditeau et al., 2022).

In 10-25 percent of COVID-19 patients who require hospitalization, abnormalities in coagulation lead to venous and thromboembolic problems. D-dimer levels are often elevated in patients with COVID-19 coagulopathies. Prolongation of the prothrombin time (PT) and a slight reduction in platelets are two less noticeable alterations. Furthermore, depending on their stage in the disease's course, fibrinogen concentrations may be elevated or lowered (Y. Zhang et al., 2020).

Lactate dehydrogenase (LDH), alanine aminotransferase (ALT), and aspartate aminotransferase (AST) enzyme levels may be elevated in the lung, liver, and systemic injury, respectively. Increases in serum bilirubin and decreases in serum albumin with liver dysfunction (Cai et al., 2020). COVID-19 patients have a greater risk of acute renal damage. Serum creatinine and serum urea nitrogen are linked to a significant risk of death in COVID-19 individuals and should be monitored.

One well-known indicator of myocardial damage is cardiac troponin. Recent investigations have shown a correlation between the severity of COVID-19 and myocardial damage, which is defined by increased cardiac troponins (García de Guadiana-Romualdo et al., 2021). In COVID-19 individuals, cardiac damage is a frequent problem. Troponin levels have also been shown to be prevalent in COVID-19 individuals who have been hospitalized (Gaze, 2020).

Hence, biochemical testing is a critical tool that aids in decisions of patients' admission, transfer to ICU, therapeutic regimen, or discharge.

COVID-19 is still a disease that requires further research. Hence, lab results and their link to the complications caused by COVID-19 are still unclear. Therefore, specific testing and their proper interpretation are crucial to providing valuable and accurate decisions in managing COVID-19 to solve this pandemic.

In COVID-19, ferritin is a recognized indicator of inflammation. However, a variety of variables and co-morbidities may confuse the serum ferritin level. The serum ferritin level is assessed in this most recent metaanalysis for various COVID-19 severity levels. studies assessing the serum ferritin level in various clinical settings (COVID-19 vs. control, mild to moderate vs. severe to critical, non-survivor vs. survivor, organ involvement, ICU and mechanical ventilation requirement). As a "acute phase reactant," serum ferritin reflects the intensity of both chronic and acute inflammatory responses within the body. Hyperferritinaemia may be a cause or a mediator of inflammation, however this is unclear. The monocyte-macrophage system is triggered when ferritin levels are greater.

1.4.8 Diagnosing COVID-19 by lab tests

The preferred method for diagnosing an active COVID-19 infection is Nucleic acid amplification test NAAT. The ideal first diagnostic test is the real-time polymerase chain reaction (RT-PCR) assay for detecting SARS-CoV-2 RNA from the upper respiratory tract.

The RT-PCR assays' cycle threshold (Ct) measures the number of cycles required to amplify viral RNA to a detectable level. The relative viral RNA level in a specimen and the Ct value are negatively correlated. To quantify viral concentration and across RT-PCR systems, Ct values are not standardized. When attempting to utilize the CT value as a guide for clinical care, especially when various diagnostic platforms or tests are employed, clinicians should be aware of these limitations.

On respiratory sample, SARS-CoV-2 viral proteins are found by antigen detection testing. The majority of commercially available tests call for samples from the nasal cavity or nasopharynx, however saliva has sometimes been used as a substitute sample.

In epidemiological studies, when the attack rate in a given population may be calculated, non-quantitative antibody detection is very helpful. Contrarily, although not generally regarded as the test of preference for acute infection, semi-quantitative or quantitative tests that can quantify the quantity of antibody production can identify a change in antibody titre can play a role in the diagnosis of acute infection.

The antibodies being evaluated by these tests might be total immunoglobulin, immunoglobulin G (IgG), immunoglobulin M (IgM), immunoglobulin A (IgA), or any combination of these. IgG antibody or total immunoglobulin tests are often more accurate than testing for IgM, IgA, or IgM/IgG antibodies.

Point-of-care testing are simple-to-use tools that may be utilized outside of a lab. The majority of commercially available POCTs rely on host antibodies or SARS-CoV-2 antigen detection. Antigen-detecting quick diagnostic tests and antibody-detecting rapid diagnostic tests are not advised for use in patient care as of April 2020, according to WHO. Additionally, users of these POCTs should be aware that these tests might not be as sensitive as laboratory-based testing.

The clinical management of SARS-CoV-2 infection and the halting of the continuing epidemic depend heavily on the COVID-19 diagnosis. The viral identification by NAAT in respiratory specimens is still the current gold standard for identifying active COVID-19, although this method may not be easily accessible in less resourceful areas or be in short supply in many locations. The limits of antigen, antibody, and POCT users should be understood. Before the development and distribution of efficient vaccinations, new diagnostic technologies with low hardware requirements, quick turnaround times, and high performance are eagerly anticipated to aid in the management of the pandemic or the transition from mitigation to the new norm.

1.4.9 COVID-19 Specimens

The respiratory tract is the major target of the viral illness COVID-19. The testing setting, clinical characteristics, and illness stage all affect the specimen selection. As the primary method of diagnosing a current clinical illness, viral detection of samples from the upper and lower respiratory tracts has been recommended. Serum and feces had also been mentioned as additional specimen kinds.

- Upper respiratory samples

Clinical samples are taken from the upper respiratory tract using nasopharyngeal swabs, nasopharyngeal aspirates, oropharyngeal (throat), anterior nasal, mid-turbinate, or a combination of these methods. Healthcare practitioners are needed to accurately collect upper tract specimens, with the exception of anterior nasal swabs and mid-turbinate swabs that can be collected by patients.

For making a clinical diagnosis of active illness in symptomatic individuals, early-stage infections, or asymptomatic people, upper respiratory specimens are advised. Since they provide the best yield in viral detection, such as in influenza A, nasopharyngeal specimens, especially nasopharyngeal aspirates, have long been thought of as the specimen of choice for making a diagnosis of respiratory viral infections.

In comparison to oropharyngeal swabs, nasopharyngeal swabs are an excellent substitute for NPA. Combining nasopharyngeal and oropharyngeal swabs has become one of the most used specimen types for the identification of COVID-19 active infection in order to increase diagnostic yield.

Self-collection of saliva, mid-turbinate, and nasal swabs has the benefit of avoiding the need for medical personnel to collect them, particularly when PPE is in limited supply. A lot of research has been done on the usage of deep-throat saliva, which is the self-collection of the posterior oropharyngeal secretion. Comparable to nasopharyngeal swab specimens in terms of sensitivity.

- Lower respiratory tracts Samples

In comparison to upper respiratory tract specimens, lower respiratory tract specimens contain larger viral loads and are more likely to result in positive testing. When COVID-19 illness is advanced or when a patient has a high clinical suspicion but their upper respiratory results came back negative, lower respiratory specimens are advised.

If generated spontaneously, sputum is the lower tract specimen that may be collected the simplest. It has been demonstrated to provide a larger yield in COVID-19 than upper respiratory specimens. Due to the possibility of aerosol created during the process, putting the safety of the medical staff at risk, induced sputum is not advised.

Patients with severe illness who are receiving closed-loop mechanical ventilation and strictly adhering to infection control guidelines can have their endotracheal aspirates and brochoalveolar lavages taken in the proper conditions (e.g. well-ventilated negative pressure rooms).

- Blood samples

Although the SARS-CoV-2 virus can occasionally be found in plasma and is thought to be a signal for severe to critical illness, its contribution to assisting clinical diagnosis is minimal. Pairs of serum samples taken 2-4 weeks apart can be used to search for a four-fold increase in antibody titres in the presence of acute clinical illness. Serology, however, cannot be employed as a sole diagnostic method for SARS-CoV-2 infection. Blood has the highest diagnostic value when used to estimate seroprevalence at the population level.

- Fecal samples

A substantial percentage of COVID-19 patients have been discovered to have SARS-CoV-2, with the likelihood being greater in more seriously sick patients [32,33] and from the second week on. Anal swabs have been discovered to be independently related with admission to intensive care and can be used as a warning sign for serious illness. When respiratory tract specimens are negative despite a high clinical suspicion in a patient, feces might also be taken into consideration.

Chapter Two

Methodology

The methods used to attain the research goals are described in this section.

2.1 Study Design

A cross-sectional retrospective study was conducted in Palestine, utilizing medical records (chart reviews) to extract data on COVID-19 patients.

2.2 Population

Patients diagnosed with COVID-19 in Palestine require hospitalization.

2.2.1 Inclusion Criteria

Patients above 18 years old who are diagnosed with COVID-19 in the medical records of Najah University Hospital in the period of (January 1st, 2020 to December 31st, 2020).

2.2.2 Exclusion criteria

COVID-19 patients that were not admitted to a hospital.

2.3 Sample Size

A substantial number of patient records is necessary for retrospective research to have appropriate power.

To provide 80% power to detect a difference, a two-sided significance level of $\alpha=0.05$ is needed. The sample size was estimated based on the number of patients in MOH hospitals. According to WHO, COVID-19 cases in 10th March 2021 in the West Bank were as in Table 2.1.

Table 2.1

COVID-19 cases in Palestine[*]

Confirmed Cases	Active Cases	Recovered Cases	Death Cases	West Bank Population
162700	19067	141858	1775	2,747,943

*(WHO, 2021).

Based on the above, the prevalence of COVID-19 in the West Bank is 5.9%

The equation (1) by Cochran (1963:75) is recommended for obtaining a representative sample for a specified fraction. P is the predicted prevalence or proportion, while d is the margin of error. Z is a constant for the specified confidence level. (Sathian, 2010)

$$n_0 = \frac{Z^2 P(1-P)}{d^2} \quad (1)$$

By applying equation (1) to the study design, Z equals 1.96, P is 5.9%, and d is 5%.

$$n_0 = \frac{1.96^2 0.06(1-0.06)}{0.05^2} = 87$$

Hence, 87 Medical records must be randomly picked from patients to be abstracted as a minimum requirement. To compensate for any missing or insufficient information, 20% of medical records were added. As a result, 110 recordings had to be chosen at random.

The current study found 106 records and included them in the research.

2.4 Outcome measures (clinical and laboratory tests)

Upon admission of patients with COVID-19, nasal or throat swab tests are conducted to confirm that the patients have positive COVID-19. Then the outcomes of COVID-19 are assessed based on the case of each patient. The outcomes were developing sepsis, kidney dysfunction, ICU admission, acute respiratory distress syndrome (ARDS), or death. In addition, the following tests are recommended to be monitored by global guidelines.

A. Medical imaging: x-ray
B. Blood pressure
C. Heart rate
D. ECG
E. Respiratory Indices: oxygen saturation (SaO_2), the fraction of inspired oxygen (FiO_2)
F. Lab tests: RT-PCR, PCR Ct, CBC, LFT, KFT, PPT, aPPT, interleukine (IL-6, IL-10), CRP, ESR, Nitric Oxide, Ferretin, D-dimer.
G. Lipid profile (LDL, HDL, tChol, TG)
H. Kidney function test (Creatinine, BUN, Na, Mg, K, PO_4)
I. Liver function test (AST, ALT, GGT, ALP, Bilirubin)

The tests need to be collected from the medical records to analyze them and link the association between them and the complications of the COVID-19 mentioned earlier.

2.5 Data collection

2.5.1 Data collection tool

Case Report Form (CRF) was designed for optimal collection of data following the study protocol compliance. ; The form included sociodemographic, medical history, lab testing, symptomatic follow-up (Appendix 1).

The CRF consisted of the following:

A. Sociodemographic information
B. Medical History
C. COVID-19 severity
D. Medication History
E. Temperature
F. Lab Results
G. Symptoms

2.5.2 Validation of data abstraction tool

Face validity and pilot testing were used to validate the abstraction form. In addition, the items were assessed by specialists and physicians to ensure that they could provide findings that met the study's goals.

A pilot study is a small-scale replica of a larger research project that is used to examine study design and methods. It cannot be utilized for statistical analysis or addressing any research questions.

As a result, a formal pilot study was conducted to determine the viability of the project, the NNUH medical record office's method for delivering medical files, the time period, and the availability of information in medical records. As a result, it is regarded a validation step for data abstraction forms, as it allows for editing, removal, and addition of elements.

The pilot research should have a sample size of up to 10% of the total sample size. Hence, ten medical records were randomly selected.

2.5.3 Data collection procedure

The medical record office/NNUH requested to provide the list of patients with COVID-19 to do the random sampling step. Next, a further request to access the selected patients' records for data abstraction.

It is not a basis for exclusion if a patient is admitted as a referral from another hospital to be handled at NNUH. Despite writing pharmaceuticals using the brand name, medications were written using the scientific name.

Lab results were collected for each patient for three intervals; however, if the patient had the test once or twice, it was written as it is; otherwise, there were three intervals for each lab test.

Complications were written either happened or not based on the symptoms; hence, it might not be written clearly in the medical record that the patient has a particular complication. However, it might be inferred from the symptoms that the patient had developed a particular complication. Hence, symptoms need to be filled with caution, symptoms at admission, and clinical case at discharge, in addition to the clinical case during admission.

2.6 Statistical analysis

The IBM Statistical Package for Social Sciences was used to conduct the statistical analysis (SPSS version 21). Continuous variables were reported as median with interquartile range (IQR), and mean standard deviation was calculated using the normality test. For categorical variables, frequencies and percentages were determined. To find statistically significant differences, the Chi-square test was performed. The 5% threshold was used to define the significance level.

2.7 Ethical Considerations

An-Najah National University Institutional Review Boards (IRB) authorized the study protocol before initiating this study (Appendix 2). Authorization from Najah National University Hospital was obtained to conduct the study at the institution using NNUH medical records and resources. Maintaining high-level objectivity in discussion and analysis throughout the research was assured.

Chapter Three

Results

3.1 Overview

The study abstracted data from medical records of 106 patients diagnosed with COVID-19 at Najah National University Hospital. The data were filled into a google form and then reconciled and cleaned in order to be analyzed. The data was analyzed using SPSS according to the research objectives and presented in the below sections.

3.2 Sociodemographic of participants

The study included 106 patients with COVID-19, most of the patients were males with a ratio of 2.4:1. Most of the patients were from Nablus (55.7%), followed by Jenin (15.1%). The patients had hypertension and diabetes mellitus as chronic diseases (50%, and 48.1%, respectively). Most of the patients were not smokers, 69.8%. Table 3.1 and Figures 3.1-3.3 present sociodemographic and clinical data of the patients who participated in the current study.

Table 3.1

Sociodemographic and clinical data

Variable		Frequency (%)
Age	18-29	2 (1.9)
	30-50	26 (24.5)
	50-64	37 (34.9)
	65 and more	41 (38.7)
Gender	Male	75 (70.8)
	Female	31 (29.2)
Residency	Jenin	16 (15.1)
	Nablus	59 (55.7)
	Qalqilya	5 (4.7)
	Ramallah	5 (4.7)
	Salfit	4 (3.8)
	Tubas	2 (1.9)
	Tulkarem	15 (14.2)
Chronic Diseases	DM	53 (50)
	HTN	51 (48.1)
	IHD	18 (17)
	HF	5 (4.7)
	Respiratory Disease	3 (2.8)
	Dyslipidemia	4 (3.8)
	Stroke	6 (5.7)
	Rheumatoid Arthritis	5 (4.7)
	Other diseases	22 (20.8)
Severity	Mild	8 (7.5)
	Moderate	21 (19.8)
	Severe	77 (72.6)
Drugs	Tocilizumab	38 (35.8)
	Remdesvir	26 (24.5)
	Both	10 (9.4)
Allergy	Yes	6 (5.7)
	No	100 (94.3)
Chronic Diseases	Yes	77 (72.6)
	No	29 (27.4)
Smoking	Yes	18 (17)
	No	74 (69.8)
	Ex-smoker	14 (13.2)

DM: Diabetes Mellitus, HTN: Hypertension, IHD: Ischemic heart disease, HF: Heart failure

Figure 3.1

Age distribution among participants

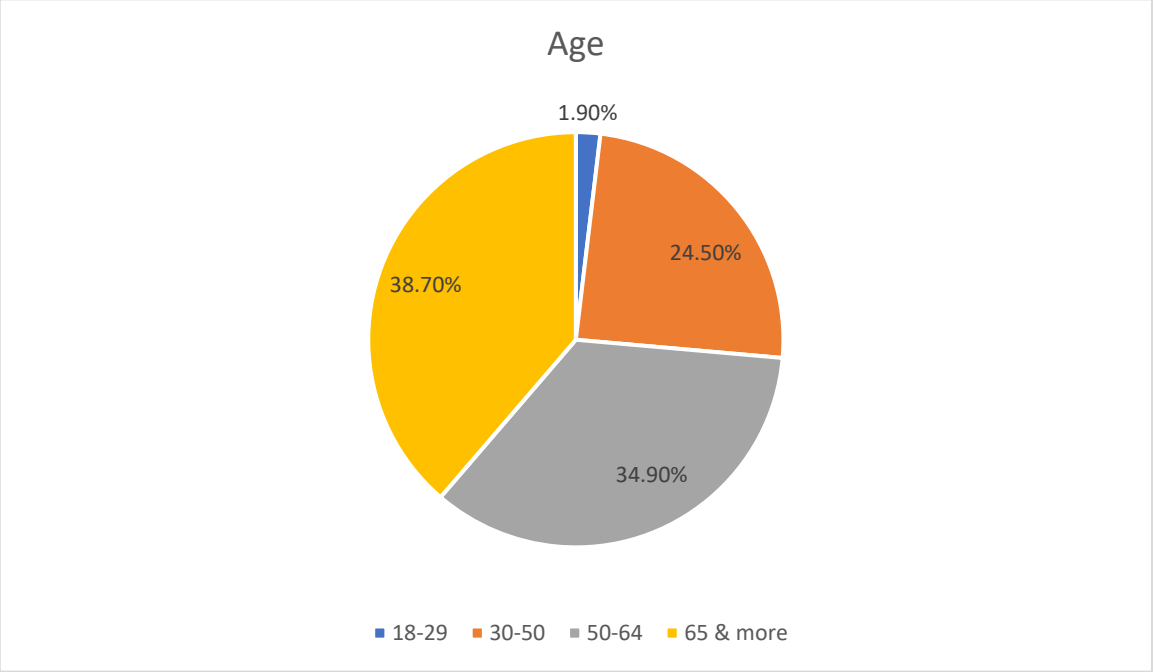


Figure 3.2

Chronic diseases among participants

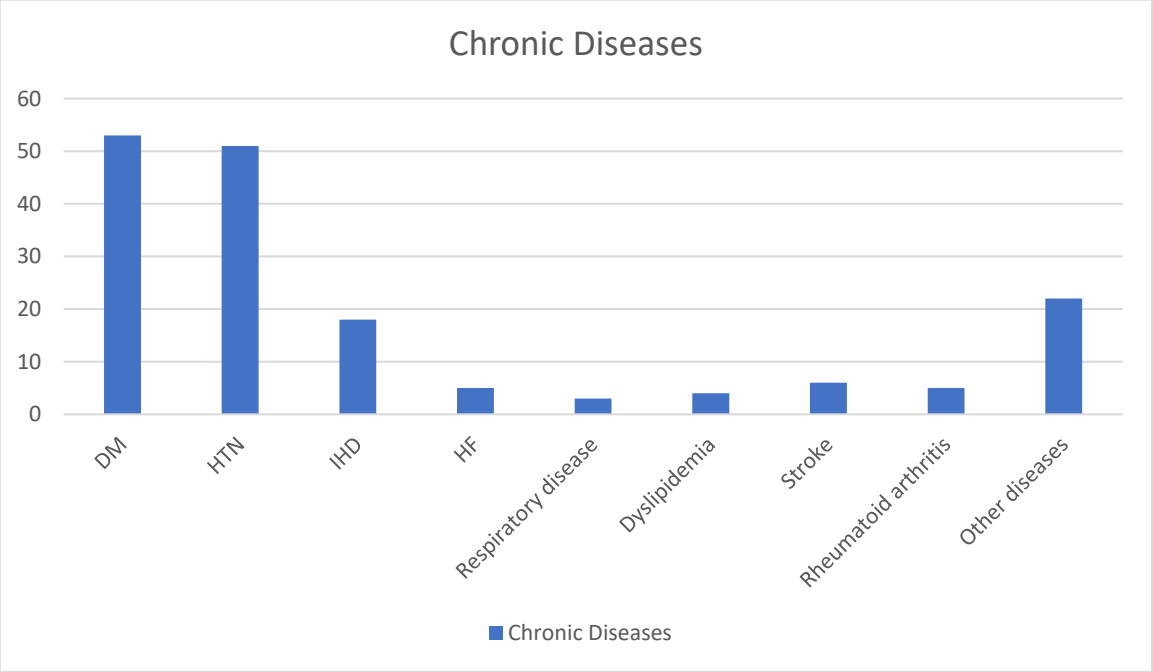
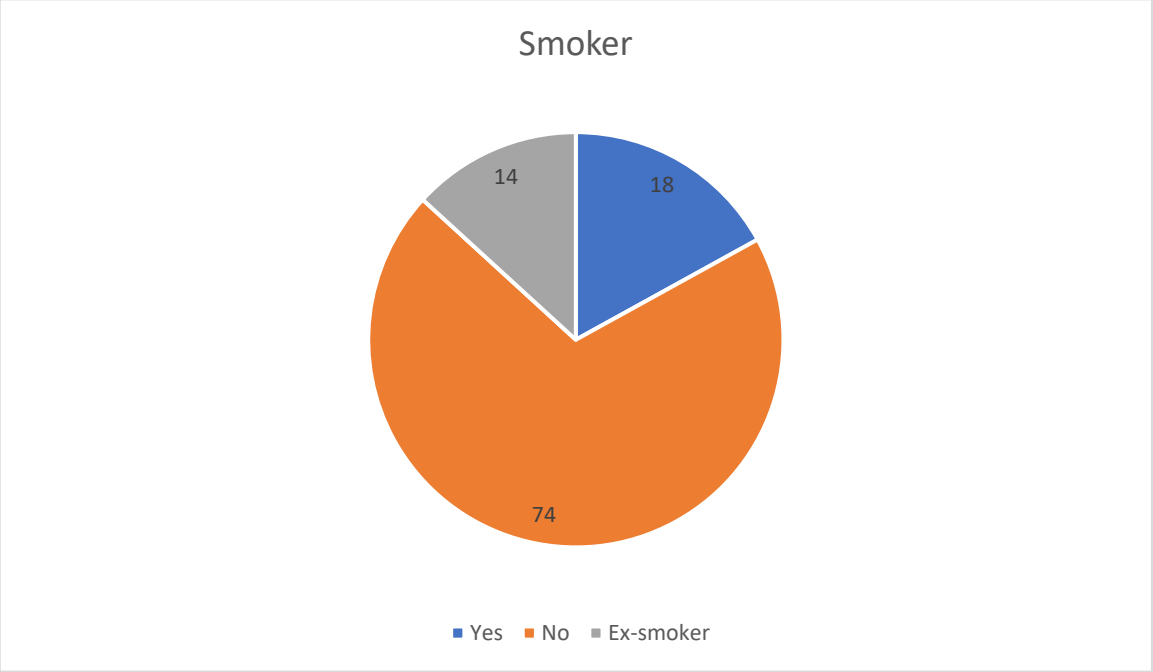


Figure 3.3

Smoking status among participants



3.3 Symptoms of COVID-19

The patients were followed up at admission and discharge regarding the symptoms of COVID-19 that they suffered from. Table 3.2 presents the symptoms of the patients who participated in the current study. There were 18 patients who died during the follow-up of this study. Most of the symptoms were resolved at discharge. The vast majority of the patients suffered from tiredness (91.51%) at admission, while this symptom has reduced to (51.14%) at discharge. The fever has been totally resolved, and all patients at discharge did not suffer from it. However, aches and pain remained high at discharge, and the patients complained of it (59.05%).

Table 3.2

Symptoms presence on admission and at discharge

At Admission (n = 106)	Yes	(%)	No	(%)
Aches and Pain	63	59.43	43	40.57
Chest Pain	39	36.79	67	63.21
Conjunctivitis	3	2.83	103	97.17
Diarrhea	11	10.38	95	89.62
Dry Cough	77	72.64	29	27.36
Fever	44	41.51	62	58.49
Headache	31	29.25	75	70.75
Loss of Taste	28	26.42	78	73.58
Mucus Secretion	10	9.43	96	90.57
Nasal Congestion	4	3.77	102	96.23
Productive Cough	20	18.87	86	81.13
Shortness of Breath	78	73.58	28	26.42
Skin Rash	1	0.94	105	99.06
Sore throat	21	19.81	85	80.19
Tiredness	97	91.51	9	8.49
At discharge (n = 88)	Yes	(%)	No	(%)
Aches and Pain	52	59.09	36	40.91
Chest Pain	12	13.64	76	86.36
Conjunctivitis	0	0	88	100
Diarrhea	3	3.41	85	96.59
Dry Cough	29	32.95	59	67.05
Fever	0	0	88	100
Headache	8	9.09	80	90.91
Loss of Taste	23	26.14	65	73.86
Mucous Secretion	1	1.14	87	98.86
Nasal Congestion	1	1.14	87	98.86
Productive Cough	6	6.82	82	93.18
Shortness of Breath	33	37.5	55	62.5
Skin Rash	0	0	88	100
Sore throat	0	0	88	100
Tiredness	45	51.14	43	48.86

Figure 3.4

Symptoms of patients at admission

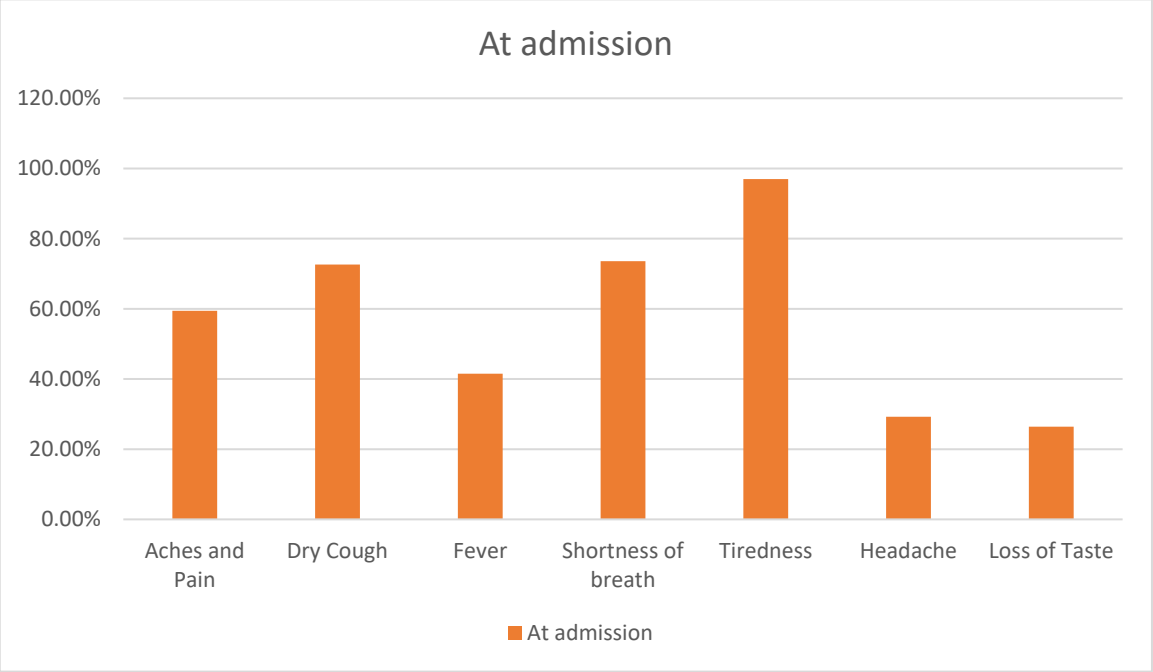
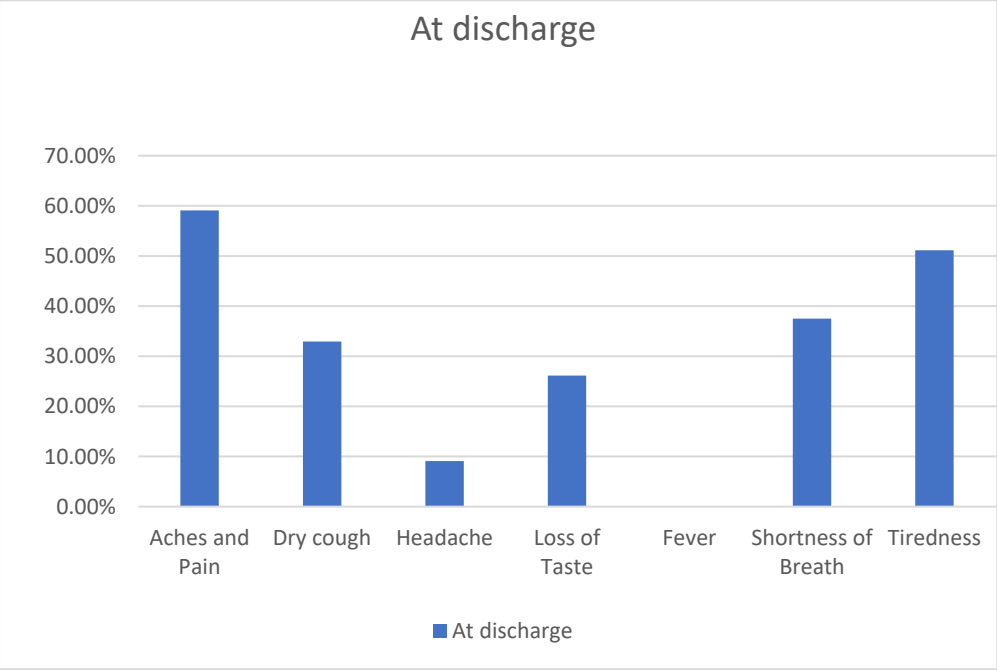


Figure 3.5

Symptoms of patients at discharge



3.4 The severity of COVID-19 of the participants

At the admission time, patients with COVID-19 positive were classified according to the severity of disease (or symptoms), these including the sociodemographic data of the patients are shown in Table 3.3. Females had the highest percentage of severe COVID-19 among all participants (53.77%). In terms of age, geriatric females (30 patients) had severe COVID-19; this age group had the highest severity, which was statistically not significant (p=0.09). BMI was not a statistically significant variable (p=0.45) and had no relation with disease severity. Similarly, smoking was not statistically significant despite most of the patients being non-smokers. None of the chronic diseases studied had impact on the COVID-19 severity. The more the severity, the more the mortality; this was a significant finding from the patients in this study ($p<0.05$). ICU admission was totally correlated with the disease severity, in which the patients who had mild to moderate disease states had fewer ICU admissions ($p<0.05$).

Table 3.3

Association between variables on admission and severity

	Mild Frq. (%)		Moderate Frq. (%)		Severe Frq. (%)		P value
Gender							
Male	4	(3.77)	7	(6.60)	20	(18.86)	0.372
Female	4	(3.77)	14	(13.20)	57	(53.77)	
Age							
<30	1	(0.94)	0	(0)	1	(0.94)	0.09
30-49	4	(3.77)	4	(3.77)	18	(16.98)	
50-64	0	(0)	9	(8.49)	28	(26.41)	
>65	3	(2.83)	8	(7.54)	30	(28.30)	
BMI							
< 18.5	0	(0)	0	(0)	0	(0)	0.45
18.5 - 24.9	2	(1.88)	3	(2.83)	5	(4.71)	
25 – 29.9	2	(1.88)	7	(6.60)	28	(26.41)	
30 and more	4	(3.77)	11	(10.37)	44	(41.51)	
Smoking				()			
Ex-smoker	1	(0.94)	2	(1.88)	11	(10.37)	0.409
No	7	(6.60)	17	(16.03)	50	(47.16)	
Yes	0	(0)	2	(1.88)	16	(15.09)	
Residency							
Jenin	1	(0.94)	5	(4.71)	10	(9.43)	0.886
Nablus	6	(5.66)	11	(10.37)	42	(39.62)	
Qalqilya	0	(0)	2	(1.88)	3	(2.83)	
Ramallah	0	(0)	1	(0.94)	4	(3.77)	
Salfit	0	(0)	0	(0)	4	(3.77)	
Tubas	0	(0)	0	(0)	2	(1.88)	
Tulkarem	1	(0.94)	2	(1.88)	12	(11.32)	
Allergy							
Yes	0	(0)	20	(18.86)	5	(4.71)	0.736
No	8	(7.54)	1	(0.94)	72	(67.92)	
HTN							
Yes	3	(2.83)	9	(8.49)	34	(32.07)	0.4
No	5	(4.71)	12	(11.32)	43	(40.56)	
DM							
Yes	6	(5.66)	13	(12.26)	38	(35.84)	0.2
No	2	(1.88)	8	(7.54)	39	(36.79)	
Respiratory disease							
Yes	7	(6.60)	0	(0)	2	(1.88)	0.188
No	1	(0.94)	21	(19.81)	75	(70.75)	
Tocilizumab							
Yes	0	(0)	17	(16.03)	34	(32.07)	0.009
No	8	(7.54)	4	(3.77)	43	(40.56)	
Remdesvir							
Yes	8	(7.54)	18	(16.98)	21	(19.81)	0.471
No	2	(1.88)	3	(2.83)	56	(52.83)	
Outcome (Alive)							
Yes	1	(0.94)	0	(0)	17	(16.037)	0.05
No	7	(6.60)	21	(19.81)	60	(56.60)	
ICU Admission							
Yes	7	(6.60)	17	(16.03)	51	(48.11)	0.00
No	1	(0.94)	4	(3.77)	26	(24.52)	
Multi-organ Failure							
Yes	0	(0)	0	(0)	12	(11.32)	0.05
No	8	(7.54)	21	(19.81)	65	(61.32)	-
AKI							
Yes	7	(6.60)	0	(0)	17	(16.03)	0.05
No	1	(0.94)	21	(19.81)	60	(56.60)	-
Liver Injury							
Yes	0	(0)	0	(0)	25	(23.58)	0.002
No	8	(7.54)	21	(19.81)	52	(49.05)	-
ARDS							
Yes	7	(6.60)	20	(18.86)	25	(23.58)	0.024
No	1	(0.94)	1	(0.94)	52	(49.05)	-
Sepsis							
Yes	7	(6.60)	20	(18.86)	17	(16.03)	0.171
No	1	(0.94)	1	(0.94)	60	(56.603)	
Secondary Bacterial Infection							
Yes	0	(0)	0	(0)	12	(11.32)	0.078
No	8	(7.54)	21	(19.81)	65	(61.32)	

DM: Diabetes Mellitus, ARDS: Acute respiratory distress syndrome, AKI: Acute kidney injury, HTN: Hypertension, ICU: Intensive care unit

3.5 Association between lab results and severity of the COVID-19 case

The current study analyzed the patients with different COVID-19 severity and the lab results are shown in Table 3.4. There has been an elevation on the lab tests results. However, the difference was significant among some of them. In other words, only neutrophils, lymphocytes, LDH, and CRP had statistically significant differences between severity of COVID-19. D-dimer had very high levels with a mean of 2.96 in severe cases compared to a mean of 0.67 in mild cases. However, this difference was not statistically significant.

Table 3.4

Laboratory findings of 106 patients with COVID-19

Variable	Normal range	Mild N = 8	Moderate N = 21	Severe N = 77	P-value
WBCs	4.50 - 11.00 $\times 10^9$/L	6.87 ±2.2	16.22 ±36.58	8.2 ±3.93	0.307
Neutrophils	45.00 - 75.00%	70.11 ±17.24	77.12 ±16.24	82.56 ±11.63	0.021
Lymphocytes	25.00 - 40.00%	20.84 ±15.04	16.25 ±16.83	10.46 ±7.0	0.011
Basophils	0.00 - 1.00 %	0.61 ±0.38	0.33 ±0.25	0.38 ±0.29	0.07
Eosinophils	0.00 - 4.00%	6.34 ±3.3	5.22 ±2.67	4.9 ±2.46	0.501
Monocytes	0.00 - 7.00%	2.11 ±2.57	0.8 ±0.43	0.67 ±0.47	0.116
RBCs	4.2 - 6.1 $\times 10^{12}$/L	4.62 ±0.64	4.63 ±0.77	4.81 ±0.7	0.656
Hemoglobin	Male: 13.7 - 17.2 g/dL Female: 11.6 - 15.6 g/dL	12.9 ±2.2	13.28 ±2.27	13.32 ±1.97	0.79
Platelets	150 - 450 $\times 10^9$/L	197.26 ±59.98	292.69 ±117.87	241.36 ±86.51	0.07
CRP	> 2.0 mg/L	48.33 ±49.87	83.78 ±63.58	132.42 109.42	0.01
D-Dimer	≤ 0.5 mcg/mL	0.67 ±0.5	1.8 ±0.2	2.96 ±1.04	0.79
LDH	50 - 150 u/L	277.13 ±90.17	294.62 ±93.57	376.88 ±132.52	0.007
Ferritin	Male 24-336 mcg/L Female 11 - 307 mcg/L	490.88 ±386.56	668.77 ±378.53	798.96 ±554.98	0.165
PT	11 - 14 sec	13.8 ±0.65	13.8 ±1.14	15.12 ±5.35	0.252
aPTT	25 - 35 sec	27.69 ±2.48	26.41 ±1.76	28.7 ±11.76	0.612
AST	< 42 u/L	27.5 ±13.46	20.66 ±7.02	44.37 ±65.4	0.009
ALT	< 50 u/L	20.15 ±11.26	22.88 ±8.64	36.83 ±38.34	0.109
Creatinine	0.4 - 1.2 mg/dL	0.86 ±0.34	0.85 ±0.16	1.09 ±1.04	0.991

RBC: Red blood cells, WBC: White blood cells, LDH: Lactate dehydrogenase, ALT: Alanine transferase, AST: Aspartate transferase, PT: Prothrombin time, aPTT: activated partial thromboplastin time, CRP: c reactive protein,

3.6 Association between lab results on admission and COVID-19 complications

3.6.1 Association between lab results and mortality

Comparing the patients' lab results at admission and the patients who died during the follow-up of this study revealed the data shown in Table 3.5. The lab results between alive and dead patients were mostly not statistically significant ($p>0.05$). However, CRP, ferritin, LDH, lymphocytes, neutrophils, and INR had statistically significant differences between alive and dead patients ($p<0.05$).

Table 3.5

The association between patients' lab results on admission and mortality

Variable	Alive	N	Mean Rank	Median	[Q1-Q3]	P-value
WBC	Yes	88	53.59	8.04	[5.56-11.18]	0.95
	No	18	53.08	7.76	[5.48-12.91]	
Lymphocytes	Yes	88	56.32	9.8	[6.81-17.02]	**0.037**
	No	18	39.72	7.25	[4.27-10.64]	
BAS	Yes	88	54.1	0.34	[0.24-0.55]	0.65
	No	18	50.58	0.27	[0.23-0.56]	
EOS	Yes	88	53.36	0.69	[0.39-0.9]	0.916
	No	18	54.19	0.61	[0.48-0.97]	
D-Dimer	Yes	88	52.8	0.46	[0.26-0.82]	0.576
	No	18	56.92	0.63	[0.21-1.77]	
PT	Yes	88	51.01	14	[13.2-14.9]	0.065
	No	18	65.67	14.45	[13.9-15.55]	
PTT	Yes	88	47.89	26.1	[25-27.9]	<0.05
	No	18	80.94	30.45	[28.5-31.33]	
INR	Yes	88	50.41	1.05	[0.98-1.13]	0.022
	No	18	68.61	1.12	[1.07-1.17]	
AST	Yes	88	48.7	22.85	[15.93-33.85]	<0.05
	No	18	76.97	34.75	[30.13-79.48]	
ALT	Yes	88	52.57	22.95	[16.93-35.38]	0.493
	No	18	58.03	26.8	[16.6-42.85]	
CR	Yes	88	48.27	0.81	[0.70-0.93]	<0.05
	No	18	79.08	1.2	[0.88-01.49]	
Neutrophils	Yes	88	50.92	79.7	14.16	0.05
	No	18	66.11	84.65	8.59	
Monocytes	Yes	88	54.34	5.13	2.54	0.533
	No	18	49.39	4.77	2.79	
RBCs	Yes	88	55.53	4.81	0.66	0.133
	No	18	43.58	4.48	0.79	
Hemoglobin	Yes	88	55.26	13.41	1.94	0.194
	No	18	44.92	12.65	2.2	
Platelets	Yes	88	55.3	254.88	97.05	0.182
	No	18	44.69	215.56	74.9	
CRP	Yes	88	49.53	97.97	74.91	0.003
	No	18	72.89	206.72	157.65	
LDH	Yes	88	50.11	341.26	128.57	0.012
	No	18	70.08	410.72	113.22	
Ferritin	Yes	88	49.3	670.92	451.57	0.002
	No	18	74.06	1136.11	647.45	

3.6.2 Association between lab results and acute kidney injury

Among the 106 patients, 18 patients (17%) developed acute kidney injury during follow-up. Investigating the lab results and their correlation with acute kidney injury is presented in Table 3.6.

It was found that PT, PTT, and INR had a statistically significant difference between patients with AKI and those who did not. In addition, hemoglobin levels were lower in patients with AKI (p=0.001), while platelets were higher in patients without kidney injury (p=0.036).

Table 3.6

The Association between lab results on admission and the Acute Kidney Injury

Variable	AKI	N	Mean Rank	Median	[Q1-Q3]	P-value
WBC	Yes	18	54.75	7.53	[5.74-12.91]	0.85
	No	88	53.24	8.04	[5.47-11.18]	
NEU	Yes	18	67.11	88.48	[78.61-91.26]	0.039
	No	88	50.72	83.01	[76.76-87.31]	
LYM	Yes	18	38.89	7.11	[4.27-10.64]	0.027
	No	88	56.49	9.9	[6.81-17.02]	
BAS	Yes	18	49.25	0.27	[.18-.67]	0.52
	No	88	54.37	0.34	[.25-.53]	
EOS	Yes	18	51.42	0.605	[.47-.82]	0.752
	No	88	53.93	0.69	[.4-.923]	
D-Dimer	Yes	18	59	0.63	[.24-1.77]	0.136
	No	88	52.38	0.46	[.26-.82]	
PT	Yes	18	70.86	14.55	[13.9-16.95]	0.033
	No	88	49.95	14	[13.13-14.9]	
PTT	Yes	18	71.28	29.75	[25.53-30.93]	0.025
	No	88	49.86	26.3	[25-28.1]	
INR	Yes	18	69.94	1.12	[1.07-1.17]	0.008
	No	88	50.14	1.05	[0.98-1.14]	
AST	Yes	18	75.72	34	[28.48-79.48]	0.007
	No	88	48.95	22.85	[15.45-34.83]	
ALT	Yes	18	55.94	24.7	[14.9-42.85]	0.013
	No	88	53	22.95	[17.25-35.38]	
CR	Yes	18	79.08	1.2	[0.88-1.67]	0.001
	No	88	48.27	0.805	[0.70-0.93]	
MONO	Yes	18	49.33	4.76	2.94	0.528
	No	88	54.35	5.13	2.5	
PLT	Yes	18	43.67	212.7	77.41	0.036
	No	88	55.51	255.46	86.41	
RBC	Yes	18	39.64	4.407	0.82	0.711
	No	88	56.34	4.828	0.67	
HGB	Yes	18	43.97	12.52	2.35	0.001
	No	88	55.45	13.44	1.89	
CRP	Yes	18	71.39	204.25	159.78	0.149
	No	88	49.84	98.48	74.75	
LDH	Yes	18	67.58	402.06	119.06	0.007
	No	88	50.62	343.03	128.44	
Ferritin	Yes	18	68.33	1000.22	586.15	0.405
	No	88	50.47	698.72	491.08	

LDH: Lactate dehydrogenase, HGB: haemoglobin, CRP: C-reactive protein, PTT: prothrombin time, AST: aspartate transferase, ALT: Alanine transferase, WBC: white blood cells, LYM: lymphocyte, INR: international normalized ratio.

3.6.3 Association between lab results and liver dysfunction

Liver injury was more prevalent than acute kidney injury (25 patients, 23.5%). Studying the lab results on admission and liver injury is presented in Table 3.7. Liver markers (ALT, AST, LDH, PT, PTT, INR) were found to be statistically different between patients with liver dysfunction and patients who did not develop a liver injury, except PTT was not statistically significant ($p>0.05$).

Other markers like CRP (which is an acute phase reactant) were found to be higher in patients with liver dysfunction ($p>0.05$).

Table 3.7

The Association between lab results on admission and liver injury

Variable	Liver Injury	N	Mean Rank	Median	[Q1-Q3]	P-value
NEU	Yes	25	61.74	88.56	[78.69-91.3]	0.125
	No	81	50.96	82.65	[76.85-87.11]	
LYM	Yes	25	39.54	5.28	[4.42-11.56]	0.009
	No	81	57.81	10.4	[7.07-16.82]	
BAS	Yes	25	44.72	0.27	[.17-.52]	0.102
	No	81	56.21	0.38	[.39-.93]	
LDH	Yes	25	74.8	439	[316.5-526.5]	0.00
	No	81	46.93	305	[246.5-397.5]	
Ferritin	Yes	25	68.42	885	[611-1324.5]	0.006
	No	81	48.9	582	[319-872]	
PT	Yes	25	68.8	14.6	[13.9-15.4]	0.004
	No	81	48.78	14	[13.1-14.9]	
PTT	Yes	25	63.22	28.3	[25-30.55]	0.07
	No	81	48.77	26.5	[25-28.2]	
INR	Yes	25	68.82	1.11	[1.07-1.18]	0.004
	No	81	48.77	1.05	[.97-1.12]	
AST	Yes	25	79.58	38.8	[29.85-88.95]	0.00
	No	81	45.45	22	[15.25-31.85]	
ALT	Yes	25	69.16	35	[20.75-74.35]	0.004
	No	81	48.67	157.23	[16.55-28]	
WBC	Yes	25	58.34	9.73	4.62	0.368
	No	81	52.01	10.43	18.85	
MONO	Yes	25	53.14	5.13	2.65	0.947
	No	81	53.61	5.05	2.56	
EOS	Yes	25	50.14	0.74	0.61	0.532
	No	81	54.54	0.82	0.95	
RBC	Yes	25	52.22	4.77	0.72	0.823
	No	81	53.9	4.75	0.71	
HGB	Yes	25	58.62	13.56	2.09	0.341
	No	81	51.92	13.19	1.97	
PLT	Yes	25	46.08	211.8	68.66	0.167
	No	81	55.79	259.43	98.83	
CRP	Yes	25	65.12	159.5	133.64	0.031
	No	81	49.91	103.15	86.46	
D-Dimer	Yes	25	59.88	4.76	14.09	0.235
	No	81	51.53	1.88	7.71	
CR	Yes	25	54.98	1.19	1.16	0.783
	No	81	53.04	0.98	0.81	

3.6.4 Association between lab results and respiratory distress syndrome

Acute respiratory distress syndrome has been developed in 27 patients out of 106 patients with COVID-19 who participated in the study, the results are presented in Table 3.8. CRP was found to be significantly higher in patients with ARDS than those who did not develop ARDS ($p=0.001$). Similarly, LDH was statistically different between the two groups ($p=0.002$). WBC elevation was not statistically significant between the patients who participated in the study ($p>0.05$). Ferritin levels were high in both groups, with and without ARDS, but the levels between groups were statistically different ($p=0.001$).

Table 3.8

The association between lab results on admission ARDS

Variable	ARDS	N	Mean Rank	Median	[Q1-Q3]	P-value
NEU	Yes	27	57.84	87.01	[76.37-91.39]	0.394
	No	79	52.01	83.14	[77.36-87.36]	
LYM	Yes	27	44.74	7.6	[4.41-17.21]	0.086
	No	79	56.49	9.96	[7.0-15.87]	
BAS	Yes	27	46.81	0.27	[.19-.53]	0.19
	No	79	55.78	0.3	[.25-.55]	
EOS	Yes	27	50.65	0.58	[0.41-0.85]	0.576
	No	79	54.47	0.7	[0.4-0.93]	
CRP	Yes	27	70.56	153.5	[56.43-289.1]	0.001
	No	79	47.67	73.21	[42.7-126.3]	
D-Dimer	Yes	27	63.04	0.75	[0.29-2.18]	0.062
	No	79	50.24	0.44	[0.26-0.78]	
PT	Yes	27	59.26	14.4	[13.1-15.2]	0.259
	No	79	51.49	14	[13.2-14.9]	
PTT	Yes	27	65.93	28.5	[25.9-30.6]	0.015
	No	79	49.25	26.1	[25-28.1]	
INR	Yes	27	65.13	1.11	[1.07-1.18]	0.023
	No	79	49.53	1.05	[.97-1.11]	
AST	Yes	27	64.96	31.5	[22.5-56.8]	0.025
	No	79	49.58	24	[15.3-35]	
ALT	Yes	27	54.22	24.4	[15.7-34.3]	0.888
	No	79	53.25	23	[17-35.8]	
CR	Yes	27	61.87	0.94	[0.73-1.2]	0.101
	No	79	50.64	0.81	[0.71-0.97]	
WBC	Yes	27	61.39	15.89	32.12	0.122
	No	79	50.8	8.34	3.51	
MONO	Yes	27	48.5	4.75	3.1	0.328
	No	79	55.21	5.18	2.38	
RBC	Yes	27	51.85	4.65	0.83	0.747
	No	79	54.06	4.79	0.66	
HGB	Yes	27	53.17	13.16	2.21	0.948
	No	79	53.61	13.32	1.93	
PLT	Yes	27	49.3	229.43	79.72	0.411
	No	79	54.94	254.62	98.7	
LDH	Yes	27	69.35	415.59	127.08	0.002
	No	79	48.08	331.68	122.3	
Ferritin	Yes	27	69.94	999.56	545.7	0.001
	No	79	47.88	664.6	482.77	

3.6.5 Association between lab results and sepsis

Sepsis is a common complication in patients admitted to the hospital; however, in the current study, patients who developed sepsis were 19 patients (17.9%). Elevated WBC was evident in the patients with sepsis and COVID-19, with a mean of 17.66 $x10^9$/L. However, this difference was not statistically significant. On the other hand, D-dimer levels were higher in sepsis patients, which was statistically significant ($p=0.028$). Platelets were at normal levels among both groups. Also, LDH, ferritin, and CRP levels were higher in the group of patients with COVID-19 and who developed sepsis ($p>0.05$). Table 3.9 in appendix D shows the results related to sepsis and COVID-19.

3.6.6 Association between lab results and ICU admission

More than half of the patients in the current study were admitted to the ICU (52.8%). Therefore, there have been numerous lab tests with results out of the normal range taking into account ICU admission. Namely, neutrophils, lymphocytes, d-dimer, ferritin, LDH, and CRP with all significant differences between groups ($p>0.05$) as shown in Table 3.10 in appendix D.

Chapter Four

Discussion

4.1 Overview

The current study aimed to determine the complications that develop among COVID-19 patients in Palestine. Moreover, to assess the blood tests made to Palestinian patients with COVID-19 and their adherence to the global guidelines.

In addition, to find an association between specific markers, especially, coagulation tests, liver and kidney tests, and the development of COVID-19 complications and outcomes.

The study included 106 patients from An-Najah National University Hospital in Nablus, Palestine, and used a retrospective examination of medical records to acquire the data needed to meet the study's goals.

The study generates much knowledge about COVID-19 patients regarding complications and their relation to blood testing. The expected results for the symptoms and lab testing for COVID-19 patients according to literature are shown in Table 4-1 (Caterino et al., 2021; Chen et al., 2020; T. Liu et al., 2020; Mardani et al., 2020; McElvaney et al., 2020; Pozdnyakova et al., 2021; Vespa et al., 2020; L. Zhang et al., 2020).

The findings of the current study were consistent with the expected hypothesis revealed from the literature review. The sections below discuss these findings.

4.2 The severity of the disease course in COVID-19

The severity of the disease course in COVID-19 has been a topic of great interest for medical professionals and researchers. As the pandemic continues to affect millions of people around the world, understanding the factors that contribute to the severity of the disease is crucial for developing effective treatment options.

Laboratory tests have been used to evaluate the severity of COVID-19 in patients. The study mentioned in the paragraph provides valuable insights into how laboratory analysis can be used to evaluate COVID-19 patients and identify those at a higher risk of developing severe illness.

One factor that has been consistently associated with severe COVID-19 illness is elevated levels of CRP. CRP is an inflammatory marker that is produced by the liver in response to infection or inflammation. Elevated levels of CRP indicate that the body is experiencing an inflammatory response, which can contribute to the severity of the disease. Other laboratory tests, such as D-dimer, LDH, and AST, have also been associated with severe COVID-19 illness.

In addition to laboratory tests, other factors have been found to contribute to the severity of the disease course in COVID-19. Older age, male sex, and the presence of underlying medical conditions, such as diabetes and cardiovascular disease, have all been identified as risk factors for severe illness. These factors can help medical professionals identify patients at a higher risk of developing severe illness and prioritize their treatment accordingly.

The severity of the disease course in COVID-19 can also have long-term implications for patients. Some patients may experience ongoing symptoms, such as fatigue, shortness of breath, and cognitive difficulties, even after their initial infection has resolved. This condition, known as long COVID, has been the subject of ongoing research and highlights the importance of developing effective treatments and support for patients with COVID-19.

Overall, the severity of the disease course in COVID-19 is a complex and multifactorial issue. Laboratory tests, along with other clinical and demographic factors, can be used to identify patients at a higher risk of developing severe illness and guide treatment decisions. Continued research in this area is crucial for developing effective treatments and support for patients with COVID-19 and preventing the long-term health consequences of the disease (Ruuskanen, Lahti, Jennings, & Murdoch, 2011).

4.3 Association between laboratory variables and clinical outcome

The specific cause of mortality in COVID-19 individuals is yet unknown. However, hypoxia and multiorgan dysfunction are suspected to be the culprits. Many individuals with serious COVID-19 disease have been documented to have organ dysfunction, particularly acute renal damage (Mokhtari et al., 2020). This research found no link between renal function indicators (creatinine at admission) and illness severity during hospitalization. Similarly, there was a minimal link between liver function indicators (ALT, AST, and prothrombin time) at admission and the severity of the illness. While

this might be attributable to an incorrect categorization of severe disease, it could also represent that deterioration often happens during disease exacerbation. Zhou et al. 2020, reported that there was dramatically increasing in D-dimer and LDH in non-survivors over time shown in this study.

According to a study conducted early during the pandemic, 91 cases were discharged (26.8%), 183 cases stayed in hospital (54.0%) and 65 cases (19.2%) were dead. These findings are in line with our results, as the mortality rate was 17% among our sample (Wang et al., 2020).

Severe illness was linked to increased white blood cell count, neutrophil count, C-reactive protein, lactate dehydrogenase, and D-dimer, which all shown statistically significant. Compared to the study by Alnor et al. (2020), which found low lymphocyte count, platelet count, and hemoglobin that were linked to severe disease, the results of the current study did not find any of these tests to be low in severe cases (Alnor, Sandberg, Gils, & Vinholt, 2020).

There were 45 studies total, and 21 of those were used in the meta-analysis. Although studies varied in terms of patient selection and reference standard, there was no worry over applicability and little risk of bias. Higher white blood cell (1.28 $x10^9$/L), neutrophil (1.49 $x10^9$/L), C-reactive protein (49.2 mg/L), lactate dehydrogenase (196 U/L), D-dimer (0.58), and aspartate aminotransferase (8.5 U/L) counts were all related with severe illness; all $p<0.001$. Furthermore, low hemoglobin (4.1 g/L), platelet count (22.4 $x10^9$/L), and lymphocyte (0.32 $x10^9$/L) counts were all significantly ($p< 0.001$) related with severe illness. In conclusion, the severity of the disease in COVID-19 is correlated with a number of common laboratory tests.

The neutrophil count was greater in severe cases than in non-severe cases ($p = 0.021$). In this aspect, however, there is a significant discrepancy between studies. According to certain research, more than 25% of patients had a high neutrophil count (Y. Liu et al., 2020).

Clinical laboratory data determinations provide important diagnostic information for individuals with severe COVID-19. In a recent study, the findings of the blood routine, blood biochemistry, coagulation function, and infection-related biomarkers of adult COVID-19 patients were presented. The study examined the laboratory results of both severe and mild cases of COVID-19 to determine if there were significant differences in the various measures.

Interestingly, the counts of WBC, LYM, NEU, and MONO were found to not be substantially different between the severe and mild groups. This contrasts with a study by Huang et al. (2020), which showed that most patients had low lymphocyte and WBC levels. However, the present study did find that in several patients, WBC (the severe group 8.2 ± 3.9 109/L and the moderate group 16.2 109/L) and LYM (the severe group 10.46 109/L and the mild group 20.84 109/L) were towards the bottom of the normal range.

Hence, the present study highlights the importance of examining laboratory data in COVID-19 patients, particularly those with severe cases. While the results of this study were not conclusive, they do suggest that certain laboratory markers may be useful in predicting COVID-19 severity. Further research is needed to confirm these findings and to identify other markers that may be useful in predicting COVID-19 outcomes. By identifying factors that predict poor outcomes, clinicians can improve patient care and allocate resources more effectively. (Huang et al., 2020)

According to this study, the severe group and the mild group had substantially different coagulation functions. These findings are agreed with the study results by Gao et al. (2020).

Gao et al. (2020) conducted research to identify warning indices in patients with severe COVID-19 and to determine how clinical laboratory data are used in the differential diagnosis of its severe variants. The study included 43 adult patients with COVID-19 who were divided into two groups: moderate and severe. Hematological data showed that IL-6, d-dimer, hyperglycemia, thrombin time, fibrinogen, and C-reactive protein were all significantly different between the mild and severe groups ($P<0.05$). The sensitivity of IL-6 and d-dimer by parallel testing in severe COVID-19 was 96.4%, while the specificity of predicting the severity of COVID-19 during IL-6 and d-dimer tandem testing was up to 93.3%. The prevalence of severe COVID-19 in adult patients was strongly correlated with IL-6 and d-dimer, and their combination detection had the best specificity and sensitivity for early COVID-19 patient severity prediction, which has significant therapeutic relevance. The study's findings suggest that measuring IL-6 and d-dimer levels in patients with COVID-19 can be used as an effective screening tool for predicting the severity of the disease and could be crucial for providing timely interventions to improve patient outcomes. (Gao et al., 2020).

4.4 Limitations of the study

The current study aimed to investigate the laboratory findings of patients with SARS-CoV-2 infection upon admission. The research populations had diverse age and comorbidities. While the study provides valuable insights into laboratory markers as a tool for risk assessment in COVID-19 patients, the absence of estimates of prognostic influence, such as hazard ratios and risk ratios, is a limitation. Additionally, the retrospective nature of the study limited the follow-up factor, and the researcher had to work with the available data. The small sample size and the study's single-hospital design also limit the generalizability of the findings.

It is worth noting that the study did not explore molecular and serologic testing. However, a comprehensive evaluation of both types of testing in terms of COVID-19 disease severity is necessary to enhance our understanding of COVID-19 disease processes and the use of these tests as prognostic indicators. The identification of factors that predict COVID-19 disease progression is critical in guiding clinical care and allocating limited resources.

Future research should focus on the standardization of laboratory tests and the establishment of uniform definitions of illness severity. This will allow for better comparisons of laboratory findings and more accurate assessments of disease severity. Large-scale studies that involve multiple hospitals and geographic locations would provide a more comprehensive understanding of COVID-19 disease progression and improve the generalizability of the findings.

While the current study provides valuable insights into laboratory findings as a tool for risk assessment in COVID-19 patients, the limitations must be taken into consideration. The identification of prognostic indicators that accurately predict COVID-19 disease progression remains an ongoing research area. Standardized laboratory tests, uniform definitions of illness severity, and large-scale studies involving multiple hospitals and geographic locations are needed to improve our understanding of COVID-19 disease processes and enhance clinical care.

4.5 Conclusions

In conclusion, the severity of the disease course in COVID-19 is a critical issue that requires further investigation. Laboratory tests, along with other clinical and demographic factors, have been identified as important predictors of severe illness in COVID-19 patients. The study mentioned in the generated paragraph provides valuable insights into how laboratory analysis can be used to evaluate COVID-19 patients and identify those at a higher risk of developing severe illness.

Although current research indicates that individuals with severe COVID-19 illness exhibit a unique laboratory pattern upon admission, there is a need for a systematic approach using multiple relevant regular tests rather than relying on a single unique biomarker. Additionally, a uniform definition of illness severity and corrected prognostic effect estimations must be evaluated to ensure accurate assessments of disease severity.

It is crucial to continue research in this area to develop effective treatments and support for patients with COVID-19 and prevent the long-term health consequences of the disease. As the pandemic continues to affect millions of people around the world, understanding the factors that contribute to the severity of the disease is crucial for developing effective treatment options.

Overall, laboratory testing has emerged as an essential tool for evaluating the severity of COVID-19 illness, and it is hoped that further research will continue to shed light on the best ways to use laboratory analysis to guide treatment decisions and improve patient outcomes.

4.6 Recommendations

Based on the research and information presented, it is recommended that healthcare professionals consider using laboratory markers such as D-dimer, CRP, and LDH to predict COVID-19 prognosis. Elevated levels of these markers have been consistently linked to poorer outcomes in COVID-19 patients, and therefore, can be used to guide clinical care and improve patient outcomes.

It is important to note, however, that the involvement of these markers in the SARS-CoV-2 causative pathway is still uncertain. Therefore, further research is needed to confirm the predictive value of these and other markers in COVID-19 disease development.

In addition to laboratory markers, age, comorbidities, immunological response, radiographic abnormalities, signs of organ failure, and other clinical factors can also be used to predict poor outcomes in COVID-19 patients. Healthcare professionals should consider using a combination of these factors to develop a more comprehensive picture of a patient's illness severity and prognosis.

The fact that SARS-CoV-2 can be pathogenic in multiple organs makes estimating COVID-19 disease severity even more challenging. Therefore, it is crucial to identify and confirm factors that can accurately anticipate COVID-19 issues. This information can help guide clinical care, improve patient outcomes, and allocate limited resources in a more effective manner.

Furthermore, it is recommended that there be a uniform definition of illness severity and corrected prognostic effect estimations to ensure accurate assessments of disease severity. This will ensure that healthcare professionals are using consistent criteria to evaluate and predict COVID-19 disease severity across different patient populations.

Therefore, healthcare professionals should consider using laboratory markers, clinical factors, and a uniform definition of illness severity to predict COVID-19 disease development and allocate resources effectively. Further research is needed to confirm the predictive value of these factors and identify additional markers that can accurately anticipate COVID-19 issues. By taking a comprehensive and multidisciplinary approach to COVID-19 disease prediction, healthcare professionals can improve patient outcomes and ultimately mitigate the impact of the pandemic.

List of Abbreviations

Abbreviation	Meaning
AKI	Acute Kidney Injury
ALT	Alanine Transferase
aPTT	Activated Partial Thromboplastin Time
ARDS	Acute Respiratory Distress Syndrome
AST	Aspartate Transferase
BiPAP	Bilevel Positive Airway Pressure
BMI	Body Mass Index
COVID-19	Corona Virus Disease 2019
CPAP	Continuous Positive Airway Pressure
CRF	Case Report Form
CRP	C Reactive Protein
Ct	Cycle threshold
DM	Diabetes Mellitus
FDA	Food and Drug Administration
HF	Heart Failure
HIV	Human Immunodeficiency Virus
HTN	Hypertension
ICU	Intensive Care Unit
IHD	Ischemic Heart Disease
IL	Interleukin
INR	International Normalized Ratio
IQR	Interquartile Range

IRB	Institutional Review Board
IV	Intravenous
LDH	Lactate Dehydrogenase
MOH	Ministry of Health
NIH	National Institute of Health
NNUH	Najah National University Hospital
PA	Palestinian Authority
PO	Oral Route
PT	Prothrombin Time
RT-PCR	Real time polymerase chain reaction
SARS-CoV-2	Severe Acute Respiratory Syndrome Corona Virus 2
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

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Appendices

Appendix A

Data Collection Form

DATE ____ / ____ / _____	**CASE RECORD FORM**	**# ( )**
A: Patient Information		
Medical Record Number		
Date of Birth	____ / _____ / _____ AGE: _____	
Gender	○ Male ○ Female	
Marital Status	○ Single ○ Married ○ Divorced ○ Widowed	
Height	_____ **cm**	
Weight	_____ **Kg**	
BMI	_____ **Kg/m^2**	
Smoking	○ No ○ Yes ○ Ex	
Blood group		
City		
Village		

B: Medical History					
ALLERGY	○ None		○ Allergic to _____		
DISEASE HISTORY	○ None	☐ Diabetes	☐Hypertension	☐Dyslipidemia	☐ BPH
	☐ Asthma	☐COPD	☐L. Cirrhosis	☐ IBS	☐IHD
	☐ R. Arthritis	☐ Osteoarthritis	☐ Gout	☐Osteoporosis	
	☐Others: _____				

C: COVID-19 Severity	○ Mild	○ Moderate	○ Severe	○ Asymptomatic

D: Medication History
Home Medications (Drug, Dose, Route, Frequency)
Hospital Medications (Drug, Dose, Route, Frequency)

E: Temperature							
Day							
Temp (ºC)							

F: Patient Symptoms				
#	Symptoms	Upon Admission	During admission	Upon Discharge
1	Fever	○Yes ○ No	○Yes ○ No	○Yes ○ No
2	Tiredness	○Yes ○ No	○Yes ○ No	○Yes ○ No
3	Productive cough	○Yes ○ No	○Yes ○ No	○Yes ○ No
4	Loss of taste or smell	○Yes ○ No	○Yes ○ No	○Yes ○ No
5	Respiratory mucus secretion	○Yes ○ No	○Yes ○ No	○Yes ○ No
6	Nasal congestion	○Yes ○ No	○Yes ○ No	○Yes ○ No
7	Sore throat	○Yes ○ No	○Yes ○ No	○Yes ○ No
8	Headache	○Yes ○ No	○Yes ○ No	○Yes ○ No
9	Diarrhea	○Yes ○ No	○Yes ○ No	○Yes ○ No
10	Skin rash	○Yes ○ No	○Yes ○ No	○Yes ○ No
11	Conjunctivitis	○Yes ○ No	○Yes ○ No	○Yes ○ No
12	Aches and pains	○Yes ○ No	○Yes ○ No	○Yes ○ No
13	Chest pain	○Yes ○ No	○Yes ○ No	○Yes ○ No
14	Loss of speech	○Yes ○ No	○Yes ○ No	○Yes ○ No
15	Shortness of breath	○Yes ○ No	○Yes ○ No	○Yes ○ No

G: COVID-19 complications	
Complications	**Status**
Pneumonia	○Yes ○ No
Hypoxemic respiratory failure/acute respiratory distress syndrome (ARDS)	○Yes ○ No
Diffuse alveolar damage	○Yes ○ No
Secondary bacterial infections	○Yes ○ No
Sepsis and septic shock	○Yes ○ No
Cardiac injury	○Yes ○ No
Cardiomyopathy	○Yes ○ No
Arrhythmia	○Yes ○ No
Sudden cardiac death	○Yes ○ No
Acute kidney injury	○Yes ○ No
Liver dysfunction	○Yes ○ No
Multiorgan failure	○Yes ○ No
Thromboembolism	○Yes ○ No
Gastrointestinal bleeding	○Yes ○ No
Critical illness polyneuropathy/myopathy	○Yes ○ No

H: Lab Results					
#	Test	Reference Range			
1.	WBCs	4.50 - 11.00 $\times 10^9$/L			
2.	Neutrophils	45.00 - 75.00%			
3.	Lymphocytes	25.00 - 40.00%			
4.	Monocytes	0.00 - 7.00%			
5.	Eosinophils	0.00 - 4.00%			
6.	Basophils	0.00 - 1.00 %			
7.	RBCs	4.2 - 6.1 $\times 10^{12}$/L			
8.	Hemoglobin	Male: 13.7 - 17.2 g/dL Female: 11.6 - 15.6 g/dL			
9.	Platelets	150 - 450 $\times 10^9$/L			
10.	CRP	> 2.0 mg/L			
11.	ESR	Male: <15 mm/hr Female: <20 mm/hr			
12.	IL-6	≤1.8 pg/ml			
13.	IL - 10	≤3.0 pg/mL			
14.	Nitric Oxide	Kit dependent			
15.	PT	11 - 14 sec			
16.	aPTT	25 - 35 sec			
17.	Creatinine	0.4 - 1.2 mg/dL			
18.	AST	< 42 u/L			
19.	ALT	< 50 u/L			
20.	LDH	50 - 150 u/L			
21.	Ferritin	Male 24-336 mcg/L Female 11 - 307 mcg/L			
22.	D-Dimer	≤ 500 ng/mL			

Need of ICU Yes No if yes, days in ICU_____
Outcomes of hospitalization: Discharge or Death
Length of hospital stay: _____

Appendix B

Ethical Approval

An-Najah National University
Faculty of medicine Sciences Health
Institutional Review Board

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref: Pharm May 2021/17

IRB Approval Letter

Study Title:

Clinical characteristics and outcomes of hospitalized patients with Coronavirus disease 2019: A single-center, retrospective study from Palestine.

Submitted:
Muhamad Mamoon Amer.

Supervisor:
Rowa Al Ramahi

Date Approved:
25 th May 2021

Your Study **" Clinical characteristics and outcomes of hospitalized patients with Coronavirus disease 2019: A single-center, retrospective study from Palestine"** viewed by An-Najah National University IRB committee and was approved on 25h May 2021.

Hasan Fitian, MD

IRB

IRB Committee Chairman

An-Najah National University

نابلس - ص.ب 7 أو 707 || هاتف 2342902/4/7/8/14 (09) (970) || فاكسميل 2342910 (09) (970)

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910 | E-mail : hgs@najah.edu

Appendix C

An-Najah National University Hospital approval

An-Najah
National University
aculty of Graduate Studies
Dean's Office

جامعة
النجـــاح الوطنية
كليـة الدراســات العليـا
مكتب العميد

تسهيل مهمة طالب

التاريخ: 2/6/2021

حضرة د. بلال رحال المحترم،
رئيس قسم الدراسات العليا للعلوم الطبية و الصحية المحترم

الموضوع: تسهيل مهمة طالب الماجستير محمد عامر

تحية طيبة وبعد،

أرجو من حضرتكم التكرم بالموافقة ومخاطبة حضرة الدكتور عبد الكريم البرقاوي المحترم / المدير الطبي - مستشفى النجاح الوطني الجامعي

لتسهيل إجراء البحث المخصص للطالب محمد عامر من كلية الطب وعلوم الصحة في جامعة النجاح الوطنية/ برنامج ماجستير الصيدلة السريرية. مؤكدين لكم بأن كافة المعلومات التي سوف يتم جمعها هي لأغراض البحث العلمي فقط، وسوف يتم الحفاظ على السرية التامة وعدم استخدام هذه المعلومات لأغراض أخرى.

Title of Research: Clinical characteristics and outcomes of hospitalized patients with Coronavirus disease 2019: A single-center, retrospective study from Palestine

العنوان باللغة العربية: الخصائص والنتائج السريرية للمرضى المقيمين في المستشفى المصابين بمرض فيروس كورونا 2019: دراسة بأثر رجعي من مركز واحد من فلسطين

المشرف : د رواء الرمحي.

المستشفيات المطلوبة للعمل البحثي : مستشفى النجاح الوطني الجامعي

المطلوب : الاطلاع على سجلات المرضى الطبية و ادويتهم عن طريق النظام المحوسب

المرفقات: موافقة لجنة الاخلاقيات IRB + ملخص البحث

وتفضلوا بقبول فائق الاحترام والتقدير

منسقة برنامج ماجستير الصيدلة السريرية

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Appendix D

Tables

Table 3.1

The association between patients' lab results on admission and sepsis

Variable	Sepsis	N	Mean Rank	Median	[Q1-Q3]	P-value
NEU	Yes	19	55.37	85.27	[76.53-91.35]	0.77
	No	87	53.09	83.23	[77.10-88.01]	
LYM	Yes	19	45.63	8.63	[4.46-11.11]	0.218
	No	87	55.22	9.8	[6.12-16.36]	
BAS	Yes	19	46.13	0.27	[0.17-0.6]	0.249
	No	87	55.11	0.34	[0.25-0.53]	
EOS	Yes	19	52.97	0.6	[0.26-1.12]	0.934
	No	87	53.61	0.69	[0.41-0.91]	
D-Dimer	Yes	19	67.53	0.77	[0.31-3.1]	0.028
	No	87	50.44	0.44	[0.26-0.8]	
PTT	Yes	19	62.45	28.5	[24.90-30.75]	0.161
	No	87	51.55	26.3	[25-28.23]	
AST	Yes	19	66.32	31.4	[22.83-44.95]	0.045
	No	87	50.7	24.15	[15.28-35.1]	
ALT	Yes	19	50.05	21.8	[12.93-29.58]	0.589
	No	87	54.25	23.45	[18-36.35]	
WBC	Yes	19	58.68	17.66	37.35	0.417
	No	87	52.37	8.54	3.56	
MONO	Yes	19	46.26	4.78	3.43	0.257
	No	87	55.08	5.14	2.35	
RBC	Yes	19	52.79	4.66	0.85	0.911
	No	87	53.66	4.78	0.68	
HGB	Yes	19	54.26	13.14	2.06	0.905
	No	87	53.66	13.31	1.99	
PLT	Yes	19	54.74	238.45	85.42	0.847
	No	87	53.23	250.45	96.82	
CRP	Yes	19	69.11	183.62	146.21	0.015
	No	87	50.09	100.82	81.89	
LDH	Yes	19	71.05	420.85	130.69	0.006
	No	87	49.67	337.29	123.22	
Ferritin	Yes	19	68.74	908.25	507.09	0.017
	No	87	50.17	713.1	515.51	
PT	Yes	19	56.42	14.49	1.61	0.647
	No	87	52.86	14.82	25.8	
INR	Yes	19	65.45	1.13	0.13	0.061
	No	87	50.89	2.55	13.58	
CR	Yes	19	55.53	0.91	0.3	0.751
	No	87	53.06	0.84	0.99	

Table 3.2

The association between patients' lab results on admission and ICU admission

Variable	ICU Admission	N	Mean Rank	Median	[Q1-Q3]	P-value
NEU	Yes	56	59.23	85.89	[78.03-90.92]	0.042
	No	50	47.08	82.75	[75.67-86.82]	
LYM	Yes	56	45.47	8.36	[4.48-12.74]	0.004
	No	50	62.49	11.78	[7.08-18.13]	
BAS	Yes	56	49.96	0.29	[0.23-0.53]	0.21
	No	50	57.46	0.4	[0.26-0.61]	
EOS	Yes	56	51.49	0.62	[0.4-.89]	0.58
	No	50	55.25	0.71	[0.44-0.95]	
PLT	Yes	56	54.31	242.25	[178.73-290]	0.773
	No	50	52.59	228.2	[186.90-282.40]	
CRP	Yes	56	61.57	113.67	[58.18-209.13]	0.004
	No	50	44.46	67.335	[39.99-127.13]	
D-Dimer	Yes	56	59.09	0.56	[0.27-1.48]	0.048
	No	50	47.24	0.37	[0.26-0.75]	
Ferritin	Yes	56	60.34	665.5	[454.25-1216.25]	0.015
	No	50	45.84	576	[303.25-828]	
PT	Yes	56	56.49	14.25	[13.2-15]	0.289
	No	50	50.15	14	[13.2-14.8]	
PTT	Yes	56	54.75	26.65	[24.93-30]	0.658
	No	50	52.1	26.8	[25-28.1]	
INR	Yes	56	60.46	1.09	[1.01-1.16]	0.014
	No	50	45.7	1.045	[0.94-1.09]	
AST	Yes	56	61.19	29.15	[20.98-43.60]	0.006
	No	50	44.89	20.8	[15.00-32.35]	
ALT	Yes	56	56.26	387.5	[305-454.50]	0.328
	No	50	50.41	272	[224.25-354.25]	
WBC	Yes	56	58.7	12.32	22.53	0.066
	No	50	47.68	7.96	3.24	
MONO	Yes	56	51.4	4.85	2.61	0.457
	No	50	55.85	5.32	2.54	
RBC	Yes	56	52.12	4.7	0.81	0.624
	No	50	55.05	4.82	0.59	
HGB	Yes	56	52.32	13.17	2.16	0.676
	No	50	54.82	13.41	1.8	
LDH	Yes	56	64.95	401.34	131.26	0.001
	No	50	40.68	298.98	101.41	
CR	Yes	56	57.55	1.2	1.19	0.151
	No	50	48.96	0.84	0.23	

Table 4.3

Lab results hypothesis

#	Variable	During treatment of COVID-19	Upon complications development
1.1	Fever	The number of symptoms reduced rapidly	The number of symptoms increase, and the severity will worsen
1.2	Tiredness		
1.3	Productive cough		
1.4	Loss of taste or smell		
1.5	Respiratory Mucus secretion		
1.6	Nasal congestion		
1.7	Sore throat		
1.8	Headache		
1.9	Diarrhea		
1.10	Skin rash		
1.11	Conjunctivitis		
1.12	Aches and pains		
1.13	Chest pain		
1.14	Loss of speech		
1.15	Shortness of breath		
2.	RT-PCR	Conversion to negative results will take a shorter time	Conversion to negative results will take a longer time
3.	Ct values	Ct values will be increased rapidly	Ct values will be increased slowly
4.	WBCs	Will reach up to normal levels rapidly	Will be elevated up or reach normal levels slowly
5.	Neutrophils	Elevated up to normal rapidly	Elevated up to normal slowly
6.	Lymphocytes	will be reduced up to normal rapidly	will be reduced up to normal slowly
7.	CRP	Will be reduced up to normal rapidly	Elevated or will be reduced to normal slowly

8.	ESR	Will be reduced up to normal rapidly	Elevated or will be reduced to normal slowly
9.	IL-6	Will be reduced to normal rapidly	Will be reduced up to normal slowly
10.	IL - 10	Will be increased up to normal rapidly	It Will be increased up to normal slowly
11.	Nitric Oxide	Will be reduced up to normal rapidly	Will be reduced up to normal slowly
12.	Monocytes	Normal	Normal
13.	Eosinophils	Normal	Normal
14.	Basophils	Normal	Normal
15.	RBCs	Normal	Normal
16.	Hemoglobin	Normal	Normal
17.	Platelets	Normal	Reduced
18.	PT	Normal	Elevated
19.	aPTT	Normal	Elevated
20.	INR	Normal	Elevated
21.	Fasting Blood Sugar	Normal	Normal
22.	Creatinine	Normal	Elevated
23.	AST	Normal	Elevated
24.	ALT	Normal	Elevated
25.	LDH	Normal	Elevated
26.	Ferretin	Normal	Normal
27.	D-Dimer	Normal	Normal
28.	LDL	Normal	Elevated
29.	HDL	Normal	Reduced
30.	TG	Normal	Elevated

جـامعـــة النجاح الوطنية

كليـــة الدراســـات العليـــا

الخصائص والنتائج السريرية للمرضى المقيمين في المستشفى المصابين بمرض فيروس كورونا 2019: دراسة بأثر رجعي من مركز واحد من فلسطين

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الملخص

مقدمة: تفيد هذه الدراسة مرضى COVID-19 والأطباء الذين يعالجون المرض. تشير هذه الدراسة إلى ارتباط نتائج تحاليل المختبر عند دخول المريض بشدة المرض ومتابعة نتائج المختبر حتى نتيجة المرض إما الخروج أو الوفاة. تجمع هذه الدراسة الرجعية بين نتائج المختبر والبيانات المتوفرة عن شدة المرض. لذلك، تساهم هذه الدراسة في فهم أفضل لاستخدام التحاليل المخبرية في تقييم مرضى COVID-19.

المنهجية: دراسة رجعية أحادية المركز باستخدام السجلات الطبية من مستشفى جامعة النجاح الوطنية لاستخراج البيانات حول المرضى الذين تم تشخيص إصابتهم بـ COVID-19 في فلسطين. تم إجراء التحليل الإحصائي باستخدام SPSS (الإصدار 21).

النتائج: اشتملت الدراسة على 106 مرضى مصابين بـ COVID-19، وكان معظم المرضى من الذكور بنسبة 2.4:1. توفي 18 مريضا أثناء متابعة هذه الدراسة. معظم الأعراض اختفت عند خروج المرضى. الغالبية العظمى من المرضى كانوا يعانون من التعب (91.51٪) عند الدخول، بينما انخفضت هذه الأعراض إلى (51.14٪) عند الخروج. سجلت الإناث أعلى نسبة إصابة بفيروس COVID-19 الحاد بين جميع المشاركين (53.77٪). من حيث العمر، أصيبت الإناث المسنات (30 مريضا) بفيروس COVID-19 الشديد؛ كانت هذه الفئة العمرية الأكثر خطورة وكانت ذات دلالة إحصائية (P = 0.09). الدراسة الحالية

حللت مرضى COVID-19 من حيث شدة المرض ونتائج المختبر فقط neutrophils والخلايا الليمفاوية وLDH و CRP كانت لها فروق ذات دلالة إحصائية بين شدة COVID-19. كان لـ D-dimer مستويات عالية جدا بمتوسط 2.96 mcg/L في الحالات الشديدة مقارنة بمتوسط 0.67 في الحالات الخفيفة. ومع ذلك، كان هذا الفرق لا يعتد به إحصائيا.

الاستنتاجات: إن الأفراد الذين يعانون من تاريخ مرضي شديد لـ COVID-19 لديهم نمط مختبري فريد عند الدخول يمكن استخدامه لقرارات الفرز والعلاج. من المتوقع أن يظهر المرضى الذين يعانون من تاريخ مرض COVID-19 الحاد نمطًا مختلفًا من حيث نتائج المختبر بناء على البيانات الحالية. بدلاً من فحوصات محددة للمرض، يفضل اتباع استراتيجية منهجية باستخدام العديد من الاختبارات المنتظمة ذات الصلة بالمرض. هناك حاجة لمزيد من الدراسات لاستخدام الاختبارات المعملية كمؤشرات تنبؤية لشدة مرض COVID-19 ونتائجه من حيث تعريف شدة المرض.

الكلمات المفتاحية: كوفيد-19، كورونا، نتائج، قراءات مخبرية، فلسطين