T.C.
YEDİTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

THE EFFECTS OF COVID-19 INFECTION ON RESPIRATORY MUSCLE STRENGTH FUNCTIONAL EXERCISE CAPACITY, AND CORE STABILITY IN PHYSICALLY ACTIVE INDIVIDUALS

MASTER THESIS

İLDENİZ YALNIZ,PT.

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İLDENİZ YALNIZ,PT.

ADVISER

ASSIST. PROF. ELIF DEVELI,PT.

CO ADVISER

ASSIST. PROF. DR. YAŞAR KESKIN

İSTANBUL-2022

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	Unvanı, Adı-Soyadı (Kurumu)
Jüri Başkanı:	Prof. Dr. Feryal Subaşı Yeditepe Üniversitesi
Tez danışmanı:	Dr. Öğr. Üyesi Elif Develi Yeditepe Üniversitesi
Üye:	Prof. Dr. Sedat Ziyade
Üye:	
Üye:	

ONAY

Bu tez Yeditepe Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğinin ilgili maddeleri uyarınca yukarıdaki jüri tarafından uygun görülmüş ve Enstitü Yönetim Kurulu'nun 08/12/2022 tarih ve ..... sayılı kararı ile onaylanmıştır.

Prof. Dr. Bayram YILMAZ
Sağlık Bilimleri Enstitüsü Müdür

DECLARATION

I hereby declare that this thesis is my work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

İldeniz YALNIZ

DEDICATION

I want to dedicate my thesis to my beloved and loving parents Ayşegül and Hasan Yalnız, my older sister Ayşe Aydeniz Yalnız, and most of all to my grandparents, Suzan and Musa Oktay, who raised me.

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LIST OF SYMBOLS AND ABBREVIATIONS

COVID-19	Coronavirus Disease
WHO	World Health Organization
DRG	Dorsal Respiratory Group
VRG	Ventral Respiratory Group
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
COPD	Chronic Ostrictive Pulmonary Disease
CRP	C-reactive Protein
IL-6	Interleukin-6
LDH	Lactate Dehydrogenase
ESR	Erythrocyte Sedimentation Rate
ALB	Decreased Albumin
EOS	Eosinophil
CT	Computed Tomography
GGO	Gr**o**und Glass Opacification
RT-PCR	Reverse Transcriptase-polymerase Chain Reaction
BAL	Bronchoalveolar Lavage
CPR	Cardiopulmonary Physiotherapy and Rehabilitation
PF	Respiratory Physiotherapist
6-MWT	6-Minute Walking Test
ROM	Range of Motion
MRCS	Medical Research Council
TrA	Transversus Abdominis
TLF	Thoracolumbar Fascia
ATS	American Thoracic Society
ERS	European Respiratory Society
FEV_1/FVC	Tiffeneau Index
MIP	Maximum Inspiratory Capacity
MEP	Maximal Expiratory Capacity

IPAQ-SF	International Physical Activity Questionnaire – Short Form
MET	Metabolic Equivalent of Task
MMRC	Modified Medical Research Council Dyspnea Scale
SF36	Quality Of Life Short Form
SPSS	Statistical Package Analysis for Health Sciences
HRCT	High-resolution Computed Tomography
SpO2	Spirometry and Oxygen Saturation
STAI	State-Trait Anxiety Inventory
IG	Intervention Group
RG	Reference Group
ACT	Asthma Control Group
PEF	Peak Expiratory Flow

ABSTRACT

Yalnız, İ. (2022). The Effects of COVID-19 Infection on Pulmonary Parameters Functional Exercise Capacity, And Core Stability in Physically Active Individuals, Yeditepe University, Institute of Health Sciences, Department of Sport Physiotherapy, Master Thesis. Istanbul.

This study investigated the effects of COVID-19 infection on lung volumes, respiratory muscle strength, dyspnea, functional exercise capacity, core stability, and quality of life in physically active individuals. This study included 50 (32.56±.9.73) healthy and physically active volunteers from Bezmialem Vakıf University, Dragos Hospital, and Physical Therapy Clinic members between January and March 2022. A total of 50 healthy individuals (24 F, 26 F, 32.56±.9.73 years) applied to the Bezmialem Dragos Hospital Physical Therapy Clinic and did at least three months of exercise and moderate physical activity per week before being included in the study. We included 25 outpatients of COVID-19 infection without hospitalization and 25 healthy adults. Lung volumes (spirometry), respiratory muscle strength (Maximum Inspiratory Capacity (MIP) and Maximum Expiratory Capacity (MEP)), dyspnea (Modified Medical Research Council Scale), functional exercise capacity (six-minute walk test (6MWT)), core stability (McGill core endurance test) and quality of life (Short Form Survey -36) were assessed. The findings of this study revealed that exercise capacity ($p=0.045$), right lateral ($p=0.014$), and left lateral ($p=0.023$) core endurance and quality of life test ($p =0.040$) decreased in physically active COVID-19 survivors.

Furthermore, volunteers in the COVID-19 Group push more dyspnea ($p= 0.045$) than the Control Group. Moreover, there was a positive correlation between 6MWT and McGill Lateral Right and Left core endurance tests, McGill Core endurance parameters, and MIP value ($p<0.05$). Thus, physically active individuals may experience a decrease in their functional capacity and core endurance after COVID-19 infection, and this may lead to experiencing more dyspnea.

Key words: coronavirus, respiratory functions, core endurance, physical activity, quality of life.

ÖZET

Yalnız, İ. (2022). Fiziksel Aktif Bireylerde COVID-19 Enfeksiyonunun Pulmoner Parametreler, Fonksiyonel Egzersiz Kapasitesi Ve Kor Stabilite Üzerine Etkileri, Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Spor Fizyoterapisi Anabilim Dalı, Yüksek Lisans Tezi. İstanbul.

Bu çalışma, fiziksel olarak aktif bireylerde COVID-19 enfeksiyonunun akciğer hacimleri, solunum kas kuvveti, nefes darlığı, fonksiyonel egzersiz kapasitesi, kor stabilitesi ve yaşam kalitesi üzerindeki etkilerini araştırdı. Ocak-Mart 2022 tarihleri arasında Bezmialem Vakıf Üniversitesi Dragos Hastanesi Fizik Tedavi Kliniğine üye, sağlıklı ve fiziksel olarak aktif 50 gönüllü (32,56±.9,73) bu çalışmaya dahil edildi. Toplam 50 sağlıklı birey (24 K, 26 K, 32,56±,9,73) Bezmialem Dragos Hastanesi Fizik Tedavi Kliniğine başvurmuş ve çalışmaya alınmadan önce en az üç ay egzersiz ve haftada üç gün orta şiddette fiziksel aktivite yapmıştır. COVID-19 enfeksiyonunu ayaktan atlatan, hastane yatışı olmayan 25 kişiyi ve 25 sağlıklı yetişkini dahil edildi. Akciğer hacimleri (spirometri), solunum kas kuvveti (Maksimum İnspirasyon Kapasitesi (MIP) ve Maksimum Ekspirasyon Kapasitesi (MEP)), dispne (Modifiye Tıbbi Araştırma Konseyi Ölçeği), fonksiyonel egzersiz kapasitesi (altı dakikalık yürüme testi (6MWT)), çekirdek stabilite (McGill kor dayanıklılık testi) ve yaşam kalitesi (kısa form -36) değerlendirildi.Bu çalışmanın bulguları, egzersiz kapasitesi (p=0.045), sağ lateral (p=0.014) ve sol lateral (p=0.023) core dayanıklılığının olduğunu ortaya koydu ve yaşam kalitesi testi (p=0,040) fiziksel olarak aktif COVID-19'da düştü.Ayrıca COVID-19 Grubundaki gönüllüler, Kontrol Grubuna göre daha fazla nefes darlığı hissettiler (p= 0,045).

Ayrıca, arasında pozitif bir korelasyon vardı. 6DYT ve McGill Lateral Sağ ve Sol kor dayanıklılık testleri ve ayrıca McGill Core dayanıklılık parametreleri ile MIP değeri arasında (p=0.05). Dolayısıyla fiziksel olarak aktif bireyler COVID-19 enfeksiyonu sonrası fonksiyonel kapasitelerinde ve core dayanıklılıklarında azalma yaşayabilir ve bu durum daha fazla nefes darlığı yaşamalarına neden olabilir.

Anahtar sözcükler: koronavirüs, solunum fonksiyonları, kor endurans, fiziksel aktivite, yaşam kalitesi.

1.INTRODUCTION AND PURPOSE

Novel Coronavirus Disease (COVID-19) was defined by the World Health Organization (WHO) in 2019 as a respiratory infection caused by the SARS-CoV-2 virus. [1]. COVID-19 is an infectious disease that causes physical and psychological dysfunctions and decreased respiratory function. COVID-19 affects patients with a wide variety of conditions such that patients may recover without symptoms, or disease may lead to death in severe cases. The most observed symptoms are; fever, cough, and dyspnea. Moreover, patients with COVID-19 also report headaches, runny nose, sore throat, muscle and joint pain, general weakness, loss of sense of smell and taste, and diarrhea [2,3]. In addition to symptoms such as muscle weakness and fatigue in COVID-19 patients after the acute phase, dyspnea, increased oxygen demand and decreased exercise tolerance persist [4]. Early mobilization and participation in exercise programs are recommended to prevent, alleviate and improve complications that may occur in the acute period of COVID-19 infection. The literature reported that spirometry results showed that COVID-19 patients might have a restrictive pattern ranging from 15 to 58% after the disease [5]. Restriction in the pulmonary parameters may develop due to lung fibrosis or weakness of respiratory muscles. Furthermore, diffusion capacity, vital capacity, total lung capacity, and lung compliance decrease in restrictive lung diseases, so alveolar hyperventilation may occur. In addition, weakness may be observed in the strength of the respiratory muscles, especially the diaphragm, due to the decrease in respiratory capacity [6].

Boyle's law is the main reason the diaphragm is accepted as the primary driving force of respiration. By law, the diaphragm acts as a piston to appropriately fill the lungs with air [7]. Between inspiration and expiration, the diaphragm displaces about 7-8 cm; every 1 cm translation can provide 300- 400cc enlargement in the thorax cavity [8]. In other words, the diaphragm provides a pathway between the thoracic cage and the abdomen [9]. During inspiration, the diaphragm contracts, then move towards gravity by 1-2 cm, allowing the volume of the chest cavity to expand. Airflow in the abdominal cavity is provided by decreasing the pressure in the chest cavity to allow air to enter the lungs [7,8].

The central f breathing is the diaphragm. During inspiration, the diaphragm contracts, and the volume of the thorax increases. As a result, a decrease in intrathoracic pressure is observed, and air enters the alveoli thanks to the negative pressure created in this way. Expiration occurs passively with the relaxation of the diaphragm [10]. Although the diaphragm is primarily known as the respiratory muscle, it also plays a role in core stabilization [11]. Core stabilization controls the trunk during extremity movements and against external factors [12]. The development of core stabilization in biomechanics; plays a role in ensuring the harmonious action of different body parts, protecting the spinal cord and nerve roots, and carrying loads [13]. The proper functioning of the spine and proximal extremity muscles is essential in daily life, and spinal stabilization must function correctly. The diaphragm, transverse abdominus, pelvic floor, and multifidus muscles participate in core stabilization [14]. In addition, muscle weakness in the diaphragm can affect respiratory function and core stabilization [15].

In the literature, the relationship between respiratory muscle strength and core stabilization has been demonstrated previously. However, we could not find any studies conducted among physically active COVID-19 survivors. Participation in mild or moderate physical activity every day and 30 minutes a day is proven to help prevent and manage non-communicable diseases such as heart disease, stroke, diabetes, and several cancers. In addition, in an adult study, 150 minutes of physical activity per week reduced the risk of ischemic heart disease by 30%, the risk of Type II diabetes by 27%, and the risk of breast and colon cancer by 20-25%. [16]. Being physically active may reduce the side effects of COVID-19 infection. Therefore, the study aims to assess respiratory muscle strength, physical activity levels, and quality of life for survivors of COVID-19.

Hypothesis 0 (H0): There is no difference in the effects of core stabilization, respiratory functions, respiratory muscle strength, physical activity levels, and quality of life in healthy adults who do not have COVID-19 who do regular exercise compared to healthy adults who do regular training with COVID-19.

Hypothesis 1 (H1): Effects on core stabilization, respiratory functions, respiratory muscle strength, physical activity levels, and quality of life in healthy adults who do not have COVID-19 and who do regular exercise may be higher than in healthy adults who exercise regularly with COVID-19.

2. THEORETICAL INFORMATION AND LITERATURE

2.1. Respiratory System

Our body has a lung system that reaches from our nose to the alveoli. The lung system is divided into two parts of our body. Our upper respiratory tract consists of our nose, pharynx, and larynx. Our lower respiratory tracts are the bronchi and bronchioles after the trachea [18] (Figure 2.1).

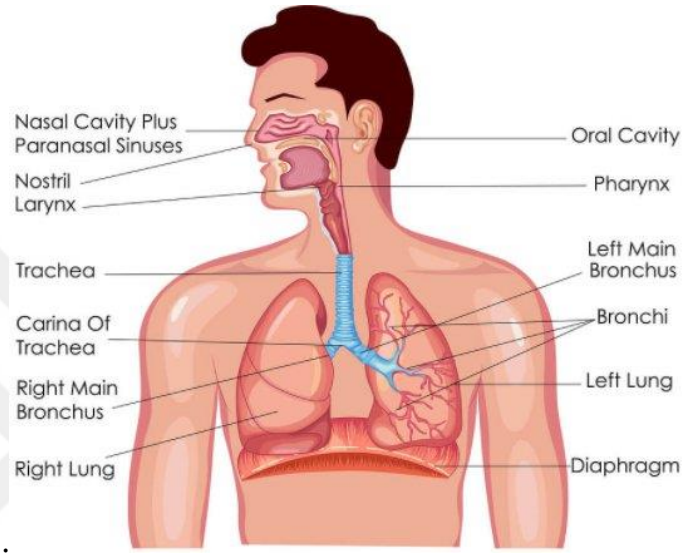


Figure 2.1: Structures constituting the lung system [11].

2.1.1. Upper Respiratory Tract

Our body has a lung system that reaches from our nose to the alveoli. The nose, pharynx, and larynx that make up the upper respiratory tract are located precisely on the vocal cords. The upper pulmonary tract consists of the air system and the Eustachian tube. The task of these structures is to clean harmful substances in the body, to humidify the air going to the lungs, to regulate the temperature of the air coming into the lungs, and to ensure that the air is cleaned of particles and harmful substances [18].

2.1.2. Lower Respiratory Tract

Those forming the lower respiratory tract are divided into two; trachea and lungs. The trachea starts from the 6th cervical vertebra and extends to the 4th and 5th thoracic vertebrae. The trachea divides into the right and left primary bronchi. The structure of the trachea consists of three tissues. The outer stratum is stringy and creates elastic tissue, causing the cartilage to be covered. The middle layer contains cartilage, and smooth muscle goblet cells in the inner layer are composed of ciliated columnar

epithelium. The right primary bronchus leaves the trachea at an angle of approximately 20-30 degrees. The left bronchus makes an angle of 45 degrees. The right bronchus is broader and shorter. It explains why aspirations in the suitable brooch are most common. [19, 20].

The right bronchus divides into three branches, and the left bronchus into two components. When the cartilages reach the bottom of the bronchi, they take on an irregular shape [19,20] (Fig. 2.2).

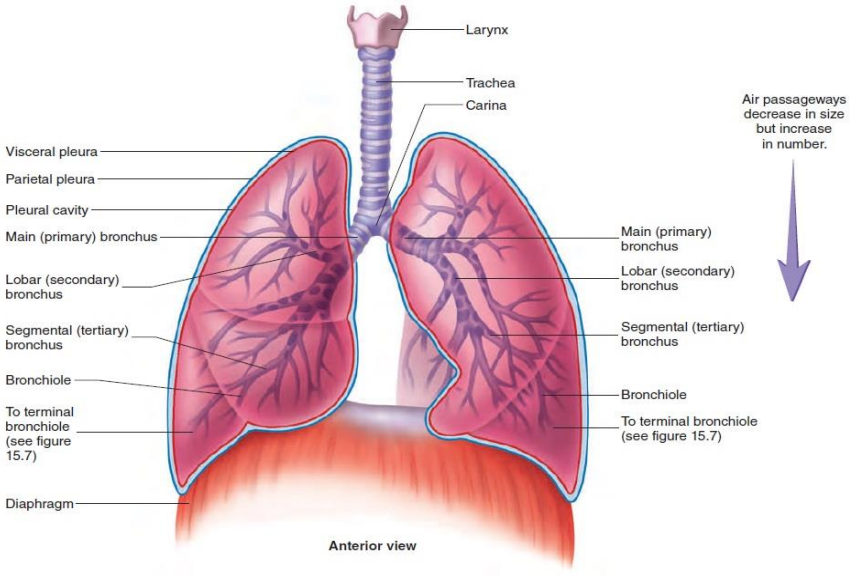


Figure 2.2: Front view of the respiratory system [12].

Our bronchioles divide into terminal bronchioles, while terminal bronchioles divide into respiratory bronchioles. The respiratory bronchioles then continue as alveolar ducts and divide into alveoli. The lung of an adult individual contains approximately 150 million alveoli. The alveoli control the gas exchange that occurs in the lungs. They consist of essential squamous epithelial cells encircled with many capillary networks, with all alveolar ducts. The place where gas exchange takes place is the respiratory membrane. Respiratory membrane; Composed of alveoli and capillary walls [20] (Figure 2.3).

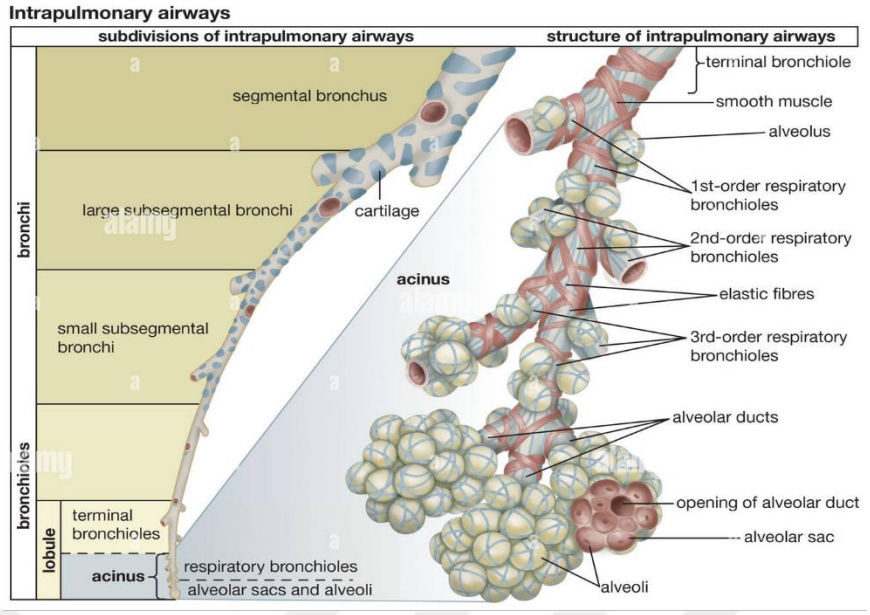


Figure 2.3: Internal structure of the lung airways [13].

2.2. Respiratory Physiology

The replacement of air traveling in the lungs with ambient air is called pulmonary ventilation. Air from the nose and mouth moves to other parts of the respiratory system. The air entering the conductive elements of the respiratory system adapts to the body temperature. It is filtered and wholly moistened as it passes through the windpipe. Incoming air passes through the large first-generation airways, which serve as primary channels in the lungs, into the two bronchi, where the ventilation process continues. Gas exchange surfaces in the lungs allow blood separation from the surrounding alveolar gas environment. In this way, while oxygen passes from the alveolus to the alveolar capillary, carbon dioxide in the blood moves toward the alveolar chambers. As a result, carbon dioxide flows into the ambient air. Numerous folds on the moist and vascularized face of the lungs are located on the sides of the chest cavity [19, 20, 21, 22].

The pulmonary membranes fold over themselves to interface with the blood to aerate. The lungs contain more than 600 million alveoli and have elastic, thin-walled membranous sacs. At the same time, alveoli are essential for gas exchange between lung tissue and blood. Numerous short, thin-walled capillaries and alveoli lie side by side in the lung. Air and blood move in opposite directions. The diffusion distance of gases and varying levels of exercise remains nearly constant as they diffuse through the fragile barrier of alveolar and capillary cells. Tiny Kohn pores within each alveolus distribute

evenly to reduce alveolar swelling and surface tension. Kohn pores allow gas exchange between adjacent alveoli, protecting damaged or closed alveoli [19, 20, 21, 22].

Approximately 250 ml of oxygen comes into our blood per minute from the alveoli at rest. On the other hand, about 200 ml of carbon dioxide is diffused. Pulmonary ventilation provides a comfortable and balanced supply of oxygen and carbon dioxide in the alveoli while exercising. When air circulation is appropriate, blood exits the lungs and leaves the body after gas exchange [19, 20, 21, 22].

2.2.1. Ventilatory Control

In the brainstem region, two structures form the respiratory center. These structures are; dorsal (DRG) and ventral (VRG) respiratory groups. DRG regulates automatic rhythm, especially the diaphragm, intercostal muscles, and peripheral chemoreceptors, providing afferent stimuli from the DRG. VRG consists of inspiratory and respiratory neurons, and more VRG occurs when ventilation demand increases.

The pons has pneumatic and apneustic centers that change inspiratory depth and velocity. Able to change breathing and emotion in case of illness; The cortex, limbic system, and hypothalamus can also alter breathing patterns [21].

2.3. Mechanics of Breathing

Stretching of the chest wall occurs due to the movement of the lungs along with the muscles of inspiration and expiration. After testing, resistance to airflow occurs, and a breathing machine is formed. Respiration is affected by any changes in these structures [21,23].

Important inspiratory muscles; diaphragm, internal and external intercostal muscles. Lung cavities located anteriorly (abdominal, thorax) are divided by the diaphragm, and the diaphragm is dome-shaped. The thoracic cavity volume increases with the diaphragm's contraction, which flattens in the abdominal cavity. The anterior ribs' upward protrusion widens the anterior-posterior diameter of the thoracic cavity, and external intercostal muscle contraction occurs. As the chest area expands, the negative pressure in the intrapleural space decreases. As a result, a suction force is created that causes the lungs to expand. As the lung expands by moving the anterior chest wall upwards, the alveolar pressure falls below atmospheric pressure, and air enters the lungs.

The auxiliary muscles of inspiration are the sternocleidomastoid and scalene. The working principles of the forces are the same as the external intercostal. Accessory muscles assist inspiration more when the respiratory rate increases during strenuous exercise or illness. The fact that the expiratory muscles do not take part in breathing is because normal expiration is a passive event. For example, when the minute volume rate increases, Abdominal and intercostal muscles, auxiliary muscles of expiration, assist in inspiration due to airway obstruction such as coughing. With the first contraction of the abdominal muscle, the abdominal pressure increases [21,23] (Fig. 2.4).

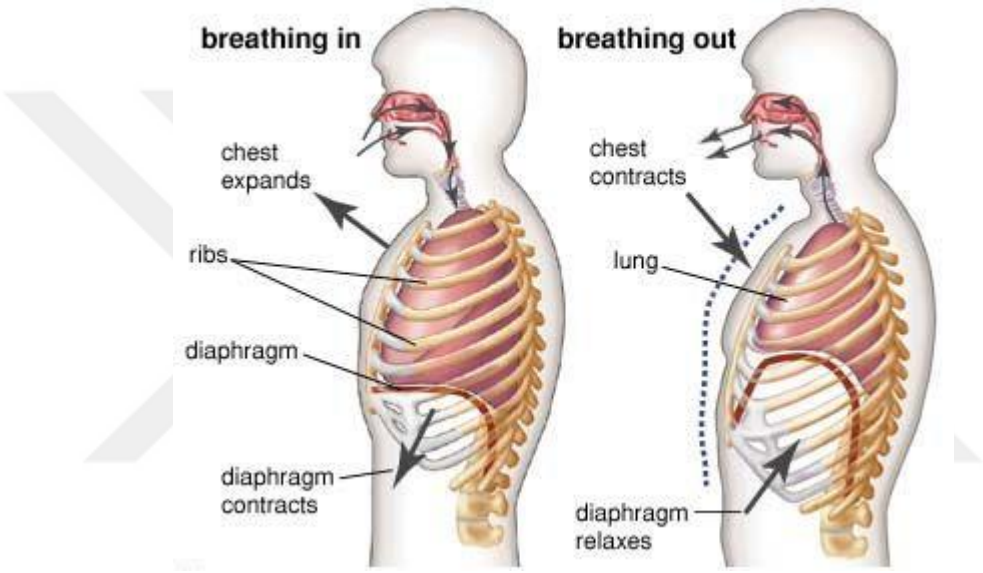


Figure 2.4: Formation of inspiration [16].

Inspiration causes the chest wall to expand. Expiration decreases the intrathoracic volume and increases alveolar pressure. Elastic recoil, which allows the lungs to return immediately after stimulation, is called passive expiration. Elastic recoil occurs with balance in the lungs and chest wall. Compliance is alveolar surface tension and elastic recoil of the lungs. With abnormal swelling, loss of elastic recoil in the lungs is observed.

The effort of the muscles in the ventilation performs the work of breathing. As a result, more oxygen consumption takes place. Increased oxygen consumption causes bronchospasm or mucus obstruction due to airway obstruction [21].

2.4. Pulmonary Pathophysiology

Lung problems can be classified as obstructive or restrictive. It is even classified as infectious and non-infectious [21,25]. When inflammatory damage to the lung parenchyma occurs, loss of small alveolar airways is observed, resulting in decreased lung elastic recoil. The changes experienced restrict the opening of the airways during expiration. This restriction in airflow is best calculated by spirometry. Therefore, spirometry is the most commonly used lung function test [24,25].

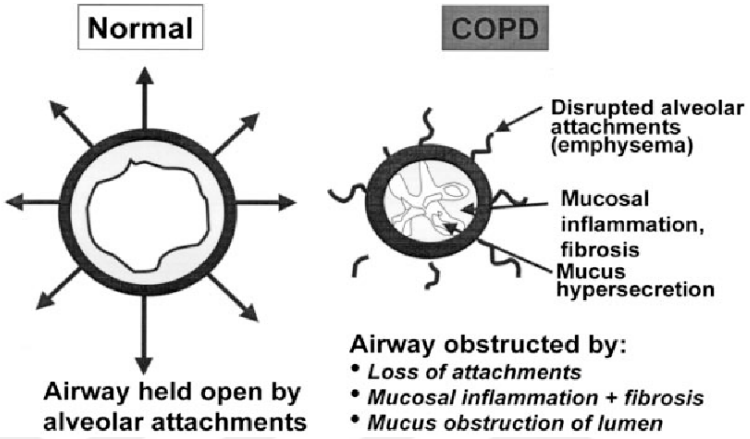


Figure 2.5: Those who cause limitation in COPD.

2.5. COVID-19

On December 31, 2019, pneumonia of unknown origin cases emerged in China. [22,23]. On January 7, 2020, the disease that causes pneumonia was named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) by the Chinese Center for Disease Control and Prevention. On February 11, 2020, the disease caused by SARS-CoV-2 was officially defined as the coronavirus disease "COVID-19" by WHO. The COVID-19 outbreak has been characterized as a pandemic [25,26].

Coronavirus is a single-stranded positive RNA virus that infects humans and different animal species. Gamma and delta originate from pigs and a bird, while alpha and beta coronaviruses inherit the virus from mammals such as bats. Beta coronaviruses cause severe disease, but alpha coronaviruses produce mild symptomatic or asymptomatic infections [27]. The first such severe case of illness was SARS-CoV-1, which emerged in China in 2002-2003. It has spread to other countries in the Americas, Asia, Europe, and Southern Africa, with 8098 patients infected and 774 deaths (about 10% mortality) reported. Middle East Respiratory Syndrome Coronavirus (MERS-CoV) was detected in the Middle East after SARS-CoV-1. After the Middle East, a record was recorded that 2458 people were infected with the MERS-CoV virus in South Korea, and

848 people died due to this virus. SARS-CoV-It belongs to two families of beta coronaviruses and is associated with SARS-CoV-1 and MERS-CoV [28].

2.5.1. COVID-19 Epidemiology

The first case of COVID-19 was seen in December 2019 in Wuhan, China [29]. Then, COVID-19 started to spread to various countries, especially Thailand, Korea, and Japan [30]. The first case of COVID-19 in Turkey was seen on March 10, 2020, in a 44-year-old man, and the first death was on March 17, 2020 [21,32]. According to the Republic of Turkey Ministry of Health data dated May 31, 2020, 5,249,404 cases were detected in Turkey, and 47,527 people died. According to WHO, on May 31, 2021, 169,597,415 people worldwide had the virus. Of these infected persons, 3,530,582 died [33]. SARS-CoV-2 is transmitted by direct person-to-person contact with the coronavirus. It is spread by respiratory droplets formed on surfaces where infected people cough or sneeze. It has been reported that people are infected by coming into contact with these contaminated surfaces [34].

2.5.2. COVID-19 Risk Factors And Clinical Findings

Those with chronic illnesses are at greater risk for COVID-19 [29]. Designed by Chen et al. > In 2020, it was reported that age is a risk factor for COVID-19 [35]. In another study conducted in 2020, it was stated that men and smoking are risk factors [36]. In addition, it is seen that conditions such as tuberculosis, ethnic origin, and socio-economic level are also among the risk factors [37,38].

It has been determined that one of the occupational groups with the highest risk of contracting COVID-19 is healthcare workers. Sahu et al. in 2020. It was determined that 10% of those with COVID-19 were healthcare workers [39]. Therefore, identifying risk factors is essential to protect healthcare workers against COVID-19 infection. Factors that increase the risk of contracting COVID-19; It was decided to lack protective furnishings, to have long working hours, and to work with contact patients [40].

The COVID-19 incubation period is individually different [41]. As a result of the analysis carried out on 88 people, when the disease due to the incubation period of Kovid-19 first appeared in China, it was observed that there was an incubation period of 2-11 days. It was observed that it took an average of 6.4 days (5.6-7.7 days) [42]. The

meta-analysis of Zaki et al., which included 25 studies in May 2020, revealed that the mean duration was 7.8 days. As a result of all analyzes and observations, the incubation period of COVID-19 is 0-14 days, according to WHO. The European Center for Disease Prevention and Control is accepted as 2-12 days [43].

The most common symptoms of COVID-19, fever, malaise, myalgia and arthralgia, cough, secretion, and shortness of breath, were detected [44]. Other signs; include sore throat, loss of taste and smell, headache, vomiting, nausea, diarrhea, abdominal pain, loss of appetite, tachycardia, and chest pain [45]. It was stated that some of the COVID-19 cases seen were asymptomatic. Symptoms differ between men and women according to gender. For example, fever is more common in men than women, while diarrhea is more common in women. In addition, the prevalence of loss of taste and smell in women may be higher than in men [46]. Fever, cough, sore throat, and fatigue are frequently detected in COVID-19 patients admitted to the hospital [47]. (Table 2.1).

Table 2.1. Findings of the Patients at the Time of Application

Results	**N**	**%**
Cough	69	46,3
Fire	44	29,5
Throat ache	41	27,5
Weakness	40	26,8
myalgia	32	21,5
Atralgia	28	18,8
Headache	25	16,8
Shortness of breath	16	10,7
runny nose	16	10,7
Nausea	12	8,1
Diarrhea	8	5,4
taste disorder	8	5,4
anosmia	6	4

2.6. COVID-19 Laboratory and Imaging Findings

There may be no laboratory findings in the acute period of COVID-19 [48]. The most common laboratory findings in COVID-19 cases include C-reactive protein (CRP), lymphopenia, interleukin-6 (IL-6), lactate dehydrogenase (LDH), erythrocyte sedimentation rate (ESR), and decreased albumin (ALB) and eosinophil (EOS) takes place [49]. Laboratory findings may occur when the cytokine storm caused by COVID-

19 attacks immune system cells and causes leukocytes [50]. The increase in LDH, CRP, and lymphopenia informs us about the stage of the disease [49]. It is observed that D-dimer and CRP levels are associated with pneumonia [47]. Ferritin and D-dimer levels are associated with mortality. Total leukocyte count and absolute lymphocyte count also indicate survival [51].

In COVID-19 patients, Computed Tomography (CT) is indicated for diagnosing and evaluating the disease, determining complications, and differential diagnosis [52]. CT used for the diagnosis of COVID-19 has high sensitivity (97%) and low specificity (25%). Different CT findings can be seen in cases of COVID-19: gr**o**und glass opacification (GGO), bilateral involvement, multiple lobe involvement, and peripheral distribution. The most common CT manifestations include GGO or a combination of isolated GGO and consolidative opacities. Other symptoms are interlobular bronchiectasis, pleural thickening, subpleural involvement, lymphadenopathy, septal thickening, pneumothorax, halo sign, pleural effusion, and cavitation findings [53].

Table 2.2. Adapted Recommended Reporting Language for COVID-19 Related CT Findings Used in the Hospital

Appearance	**Recommended reporting language**
Typical	It is thought that imaging should be included pneumonia in the differential diagnosis of COVID-19 infection.
Uncertain	Imaging is nonspecific and can be observed in a variety of infectious and non-infectious processes, including COVID-19.
Atypical	Imaging suggests pulmonary infection, but the model usually does not suggest a COVID-19 case.
Negative	There is CT suggestive of pulmonary infection.

2.7. Diagnosis of COVID-19

WHO reports that COVID-19 is highly contagious, and identifying and isolating people infected with COVID-19 would reduce the risk of transmission of the disease. Positive real-time reverse transcriptase-polymerase chain reaction (RT-PCR) is the gold standard in diagnosing COVID-19 [54]. The RT-PCR test diagnoses using nasal swabs, bronchoalveolar lavage (BAL), or tracheal aspirate samples [55].

If the first RT-PCR test is negative and the next test is positive, this indicates a false negative diagnosis. Therefore, in cases with COVID-19 symptoms, the test is requested to be repeated for diagnosis [56].

The diagnosis of COVID-19 can also be made by measuring the patient's immune responses with serological tests [57]. In the diagnosis of COVID-19, serological tests are more advantageous compared to RT-PCR due to their high efficiency, fast response time, easy application, and cheapness [58]. In addition, ELISA-based IgM and IgG antibody tests were observed to have a specificity of 95% in the diagnosis of COVID-19 [57]. In the guide prepared by the Ministry of Health, if the RT-PCR test is negative in people with high suspicion, the test is requested to be repeated within 24-48 hours [33].

2.8. Treatment of COVID-19

Clinical experience, it has been observed that the individual's nutritional status should be evaluated before the treatment approaches of antiviral drugs (Lopinavir/Ritonavir, Favipiravir, Umifenovir (Arbidol), Galidesivir, Oseltamivir, and Sofosbuvir/Dacla) consisting of Remdesivir, Chloroquine/Hydroxychloroquine. In addition, a weakened immune system affects the treatment, so it is recommended to use omega-3, unsaturated fatty acids, iron, selenium, and zinc supplements in addition to vitamins A, B, C, D, and E to strengthen the immune system in the treatment of COVID-19 [58]. The development of vaccines is a method used in managing COVID-19, and as of February 18, 2021, vaccination has been considered a priority. In Turkey's first phase of the COVID-19 vaccine, healthcare workers, people over 65 years old, and disabled individuals were vaccinated. As of August 01, 2022, Turkey's total number of vaccines is 150,289,743 [33].

Among the vaccine types developed, there are classical inactivated and attenuated vaccines. In addition, there is a new DNA and RNA-based vaccine

technology [59]. All vaccines are administered in two doses, 4-6 weeks apart. As of August 23, 2022, precisely 12,449,443,718 doses of vaccine were administered [33].

2.9. Cardiopulmonary Physiotherapy and Rehabilitation

From a holistic perspective, Cardiopulmonary Physiotherapy and Rehabilitation (CPR) is an effective method used in treating various cardiopulmonary diseases with treatment guidelines. Studies have shown that CPR improves oxygen uptake and functional capacity, reduces mortality and cardiac risk factors, and provides psychological well-being. However, the number of patients referred to CPR and the rate of participation in the rehabilitation program are low. Therefore, regulations should be implemented to increase the use of CPR programs [60].

CPR depends on the existing chronic heart-lung disease and the patient's condition. Its main goal is to increase the patient's exercise tolerance and functional capacity. It increases the patient's independence by regulating daily activities to reduce symptoms. The components of the CPR program are aerobic and endurance exercises, breathing techniques, behavior, and patient education. Benefits of the program; including reducing stroke volume and blood pressure, prolonging exercise time, reducing the need for respiration, and reducing pulmonary and skeletal symptoms [61].

Evidence-based and low-cost CPR practices in the acute period have been used effectively since the beginning of the COVID-19 pandemic [62]. The studies determined that the CPR applications used in the follow-up of COVID-19 were safe, effective, and applicable [63].

2.9.1. Respiratory Physiotherapy

There are objective evaluation tests used in respiratory physiotherapist (PF) practices. Examples of these evaluation tests are; the 6-Minute Walk Test (6MWT), dynamometer, range of motion (ROM) measurements by a goniometer, Medical Research Council Scale (MRCS), Modified Ashworth Scale, and Barthel Index.

Early mobilization and rehabilitation are also crucial for CPR applications for COVID-19 in the ICU. It was the sight that dyspnea symptoms were observed even in the simplest activities in patients who underwent different rehabilitation programs according to their clinical findings and the effectiveness of the posture training

rehabilitation program and cardiopulmonary rehabilitation applications. The study stated the clinical impact of the program's implementation in the subacute COVID-19 period [64].

2.10. Core Stabilization

Core; diaphragm above, with abdominal muscles anteriorly and paraspinal forces posteriorly, and below is a cylinder formed by the pelvic floor. In addition, It controls the movement of the lumbar vertebrae, pelvis, and hip joint. The core consists of active and passive structures, limits the displacement of systems, and creates structural integrity [65]. Passive and active structures affect stabilization; the contribution of passive constructions to stabilization is relatively tiny compared to functional designs—active ingredients, intra-abdominal pressure, spinal axial forces, and hip-trunk muscle contraction [66].

Core muscles in the sagittal plane are M.Transversus abdominis, M.Multifidus spinae, M.Erector spinae, M.Gluteus Maximus, and M.Hamstring [67]. Laterally, M. Gluteus medius, M. Gluteus minimus, and M. Quadratus lumborum are located. Controls its position on the pelvis in taking, managing, and transferring the situation to the terminal segments. The contraction of the muscles that provide core stabilization occurs with the change in intra-abdominal pressure [68].

2.10.1. Neural control

Neural control results from processing proprioceptive input from active and passive systems. For core stabilization, dynamic neural systems must work harmoniously and communicate with each other [69]. Afferent information is transmitted to the central nervous system, and a motor response occurs in the efferent system and muscles.

The first neuromuscular control occurs as a result of experiences with the motor response created by the forces, and first stabilization is provided, then the supporting muscle groups are activated. Advanced neuromuscular control effectively creates corrective reactions and provides postural control [70]. The feedback neuromuscular control mechanism is the motor produced by the muscles and is a control mechanism in

which the response is provided by reflex means. The change in position and velocity perceived by mechanoreceptors and muscle spindles are opposite [71].

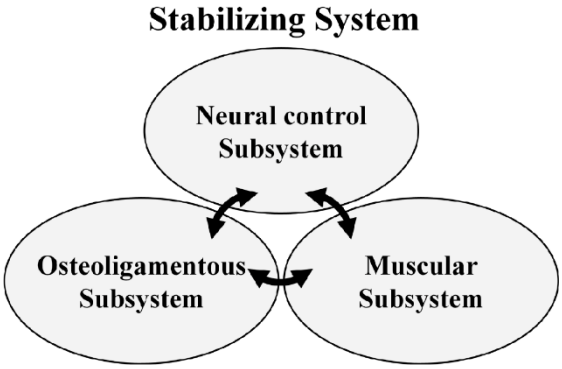


Figure 2.6: Core stabilization control systems (Panjabi, 1992)

2.10.2. Core Stabilization Muscles

The core consists of anterior abdominal muscles, posterior paraspinal muscles, the roof of the diaphragm, and pelvic muscles. All anatomical structures are included in the core region from the sternum to the knee [72].

Abdominal Core Muscles

M.Transversus abdominis, M. Rectus abdominis, M. Obliquus externus abdominis, and M. Obliquus internus abdominis contract together, increasing intra-abdominal pressure. In addition, it increases the tension in the thoracolumbar fascia and stabilizes the lumbar region. Co-contraction, which occurs through the abdominal fascial connections, stabilizes the upper and lower extremity [73].

The transversus abdominis (TrA) is the deepest of the abdominal muscles. TrA is unique in that it has no action. Instead, the abdominal fascia fuses with M. obliquus externus and M. obliquus internus, an intact connective tissue sheath, then terminates anteriorly with linea alba. It extends superficially to the rectus abdominis. Its most important task is to support and stabilize the lumbar region during movement [74]. The rectus abdominis muscle is the most superficial abdominal muscle. Supports body flexion and side flexion. It stabilizes and contracts by bringing together the same rectus, ipsilateral leg muscles, and M. erector spinal muscles. Muscle weakness in the rectus abdominis causes anterior pelvic tilt [75]. M. obliquus externus and M. obliquus internus muscles are located on the surface and lateral of the rectus abdominis muscle.

The obliquus internus is essential for the expiration of the abdominal cavity. In addition, the transversospinal muscles keep the spine stable in flexion [76].

Posterior Core Muscles

The intertransversarii muscle keeps the spine straight. It controls the lateral flexion of the trunk by making eccentric contractions with the help of gravity. As a muscle, it sends proprioceptive feedback to the neural system and provides activation of the muscles. [77]. The rotators are the deepest of the transversospinal muscles and have a solid rotation and weak extension. Together with the obliquus internus, the transversospinal muscles keep the spine flexibly stable [78].

Thoracolumbar Fascia

The thoracolumbar fascia (TLF) surrounding the lower part of the trunk provides posture and load transfer. Most importantly, the amount of the myofascial structure plays a critical role in respiration. TLF connects the gluteus maximus and lower extremity muscles and M. latissimus dorsi and upper extremity muscles. It provides three-dimensional support in the region and contributes to stabilization [79].

Diaphragm and Pelvic Floor Muscles

Intra-abdominal contraction of the diaphragm, pelvic floor muscles, and abdominal muscles increase pressure. As a result, the load on the body decreases, and trunk stability increases [80].

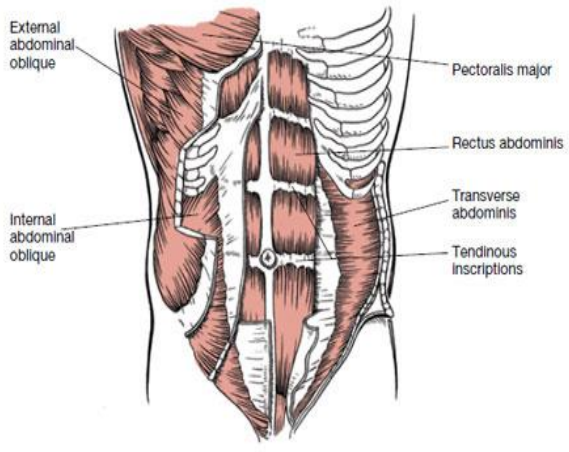


Figure 2.7: Core stabilization muscles.

3. MATERIAL AND METHODS

3.1. Subjects

The study sample (n=50) consisted of volunteers aged 18 and 50 who did aerobic exercise at least three days a week in the last three months and moderate-intensity physical activity per week [81]. This participant is a cross-sectional, case-controlled study approved by the Yeditepe University Faculty of Health Sciences Ethics Committee (No: 202112122) (Annex A). The study was also registered on ClinicalTrials.gov (NCT05461391).

Participants were included in the study voluntarily, and the purpose and details of the study were explained to each participant. Written informed consent was obtained from all individuals (Annex B). The Declaration of Helsinki wrote our permission.

We have calculated the power analysis using G * Power version 3.1.9.2 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf Germany) software. Based on a priori analysis of differences between two dependent instruments (matched pairs) in sample size calculated. A total of 50 cases for an initial investigation was determined with a power independent of 0.9 and an alpha (α) error of 0.05.

3.1.1. Inclusion Criteria

- To be between the ages of 18-50,
- Volunteering to participate in the research,
- Those who do moderate-intensity physical activity per week (minimum active: 600-3000 MET-min/week),
- Those who have done aerobic exercise at least three days a week in the last three months [81].

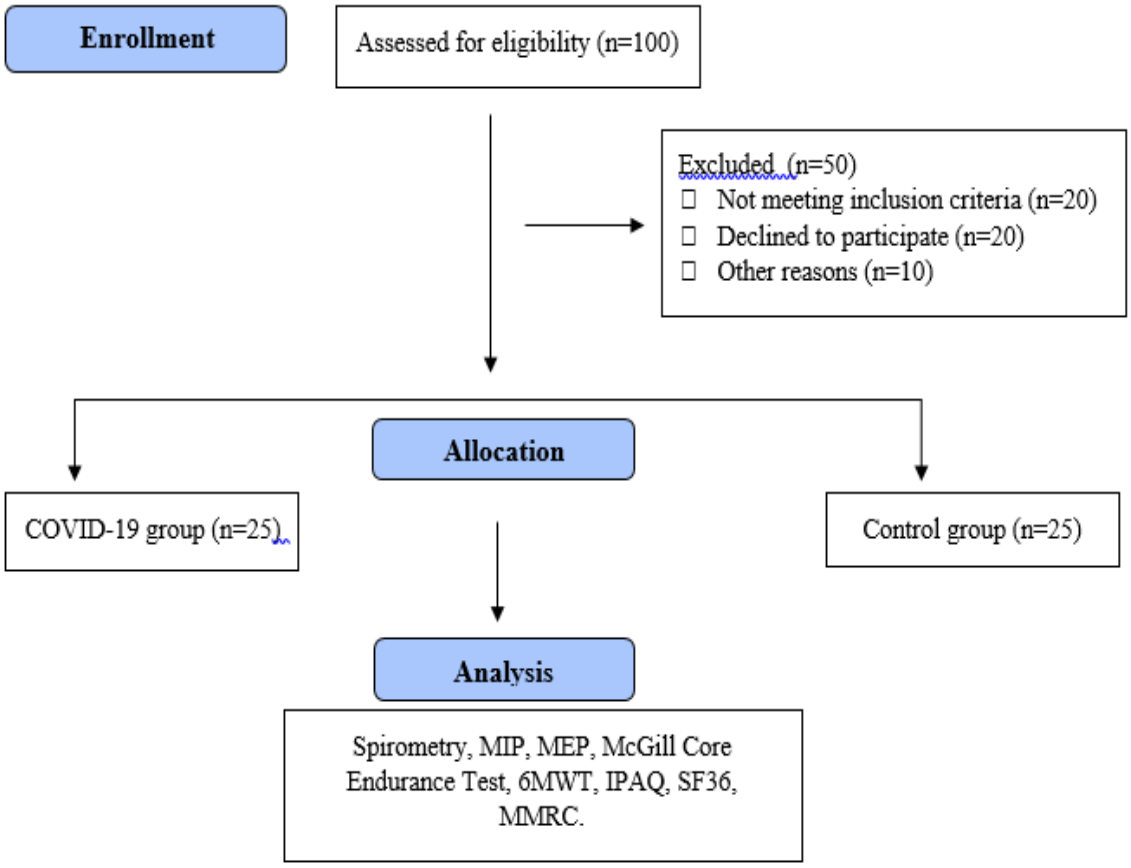
3.1.2. Exclusion Criteria

- Neurological deficits in the upper or lower extremities,
- Fractures or orthopedic problems in the upper or lower extremities,
- Cardiovascular diseases that prevent rehabilitation,

- Systematic rheumatic disease (rheumatoid arthritis, ankylosing spondylitis),
- History of surgery in the last three months,
- Patients with spine problems,
- Chronic respiratory problem.

3.1.3. Flow Chart: Study Process

Volunteers were recruited from the members of Bezmialem Dragos Hospital, Physical Therapy Clinic, between January 2022 and March 2022. We invited all the employees and intern students of the Physical Therapy Clinic to attend the study (N=250). Members who responded to the invitation were assessed for eligibility (n=100). We included 25 outpatients of COVID-19 infection without hospitalization and 25 healthy adults (Table 3.1.).



3.1.4. Study Protocol

Our study consisted of 25 COVID-19 survivors in a COVID-19 Group and 25 healthy adults in a Control Group [82, 83]. Healthy adults who agreed to participate in the study in the clinic at Bezmialem Vakıf University Dragos Hospital between January

and March were determined. After being informed about the study, they were included by signing the attached informed consent form (Appendix B). During the face-to-face interview, volunteers participating in the study were asked to fill in the attached document, which includes their demographic and clinical characteristics (Appendix C).

A pulmonary function test, respiratory muscle strength measurement, six-minute walking test, McGill core endurance test, short-form international physical activity test, and quality of life test were planned to be administered to all healthy adults in our two groups. These tests would be evaluated by comparing the experimental and control groups.

3.2. Assessment

3.2.1. Structured Questionnaire

We asked questions in the survey by talking to each other in interviews. In the first questions of the questionnaire, age, weight, height, exercise frequency, and smoking status were included to understand the socio-demographic situation of the participants. In the second question of the questionnaire, questions about gender, vaccination status, presence of chronic diseases, and education level were asked (Annex C).

3.2.2. Pulmonary Function Test

Spirometry was used to assess participants' pulmonary function, and Spirometry used Medical International Research Spirodoc® Spiro (Italy brand) [84,85,86]. The American Thoracic Society (ATS) recommends certainty and repeatability for spirometers [85]. In addition, Spirometry evaluates patients' inspiration and expiration date [87].

The European Respiratory Society (ERS) has reported that Spirometry is applicable for diagnosis, follow-up, and disease [87]. Therefore, we noted the FVC, FEV1, FEV1/FVC, and FEF25-75 parameters of the pulmonary function test in our study. The FEV1 value indicates the severity of the airflow obstruction, and the FEF25-75 suggests the severity of the block of the small airways in the early period [88, 89].

- The steps recommended by ATS/ERS are followed during implementation:
- Ask participants to sit down and explain the Spirometry.
- Please pinch the spirometer with your lip.

- Breathe through your mouth, and don't breathe through your nose. Place the latch on your nose.
- Take a deep breath through your mouth, then listen to the sound from the spirometer. Exhale fully during the cooldown and breathe deeply again.

We used a specially filtered Medialp moth part during the test. We asked the participants to take deep breaths through their mouths, exhale as forcefully as possible for at least 6 seconds, and inhale deeply.

The test is performed three times, and the best value is obtained [90] (Figure 3.1).

Figure 3.1: Spirometri

3.2.3. Respiratory Muscle Testing

Respiratory muscle strength was measured by Micro Medical Micro RPM (UK). Maximal Inspiratory Pressure (MIP) indicates inspiratory muscle strength, and Maximal Expiratory Pressure (MEP) means expiratory muscle power. MIP opens closed alveoli, while MEP can reduce the diameter of narrowed alveoli [91].

MIP and MIP measurement shows the strength of respiratory muscles. It is a widely used, simple, fast, and non-invasive assessment parameter [92, 93]. For the MIP evaluation, we told the participants to do a deep expiration using clips, then a deep inspiration for 1 to 3 seconds. We wanted deep stimulation first and then the top end for

MEP measurement. Measurements were repeated three times, and the best value of the participants was recorded [94–95] (Figure 3.2).

Figure 3.2: Respiratory Pressure Meter

3.2.4. Functional Exercise Capacity

We evaluated the functional exercise capacities of the participants by measuring them with the Six-Minute Walk Test (6MWT). Balke et al. implemented the 6-minute walk test, first used in patients with chronic bronchitis. The ATS reported that it is feasible compared to other walking tests using minimal technology and demonstrating daily activities. The 6MWT is also practicable for evaluating treatment efficacy before and after treatment of individuals with lung illness [96].

According to the ATS, a 6-minute walk test should be performed on a 30-meter straight, rigid corridor in the clinic [97]. While walking a little behind the patient, we also asked the participants to walk briskly for 6 minutes. Participants are told to stop when they are short of breath. Borg Dyspnea Scale level, heart rate, and blood pressure were recorded at the beginning and end of the test [98] (Annex D).

Figure 3.3: Six-Minute Walking Test

3.2.5. Physical Activity

IPAQ-SF was used to determine the physical activity levels of all participants. In 1998 and 1999, the IPAQ was initiated in 2000 to meet the population's need for determining physical activity levels [101]. The results showed that the IPAQ is revealed that it is the most widely used physical activity questionnaire appropriate to describing the physical activity levels of adults 15-69 years [102].

There are two versions of the International Physical Activity Questionnaire (IPAQ); The person himself fills out the 9-item short form. In our study, we used this version of the IPAQ that is safe and available in the Turkish population [100,103].

The short form includes four areas and three types of physical exercise in the last seven days. The four researched areas are; vigorous-intensity physical activity, moderate-intensity physical activity, and time spent walking and sitting [98,104]. The IPAQ-SF is scored separately for walking, medium-volume, and high-intensity activity. Task Metabolic Equivalent (MET) values are used for scoring:

- Vigorous = 8.0 × minutes × days moderate-intensity activity
- Moderate = 4.0 × minutes × days moderate-intensity activity
- Walking = 3.3 × walking minutes × days

Total MET = Walking + Moderate + Vigorous [105].Physical Activity is classified into 3 levels; Inactive: < 600 MET-min/week, Minimum Active: 600 – 3000 MET-min/week, Severely Active: > 3000 MET-min/week [106] (Annex E).

3.2.6. Dyspnea

In our study, we measured dyspnea, one of the disease's symptoms, using the Modified Medical Research Council Dyspnea Scale (MMRC). Dyspnea is perceived as any limitation in performing activities of everyday living. It began to be used in patients with chronic bronchitis in the 1940s [107,108]. MMRC is simple to implement and is often used. It is also a key clinical method for assessing dyspnea, which is consistent with other measures and affects patients' movements [107,109,110]. The MMRC scale consists of 5 items and patients choose the condition that causes shortness of breath [111, 112] (Annex F).

- Grade 0: Not troubled with breathlessness except with strenuous exercise
- Grade 1: I troubled by shortness of breath when hurrying on the level or walking up a slight hill.
- Grade 2: I walk slower than people of the same age on the level because of breathlessness, or I have to stop for breath when walking on my own pace on the level.
- Grade 3: I stop for breath after walking about 100 meters or after a few minutes on the level.
- Grade 4: I am too breathless to leave the house or I am breathless when dressing or undressing

3.2.7. Core Endurance

We assessed the core endurance of participants with the McGill Core Endurance Test consisting of 4 different positions; trunk anterior flexor test, suitable and left lateral plank, and trunk posterior extensor. We asked the participants to practice the test before the actual test started. Participants tried to position their bodies correctly and stayed static for a few seconds in each position during the practice test. When we started the test, the patients were asked to maintain their roles for the maximum time, and three repetitions were applied. The investigator visually determined the result of all tests to

ensure test reliability. The assessor used the “start” and “stop” commands to start and end the test. Positions during the trial were randomly assigned to volunteers. [112,113].

Figure 3.4: McGill Core Endurance Test

3.2.8. Quality Of Life

Quality of life was evaluated using the 36-Item Short Form Survey (SF-36) (Appendix 14). It includes measuring each of the eight multi-item health concepts, 1) physical functioning, 2) role limitations due to physical health problems, 3) bodily pain, 4) social functioning, 5) general mental health problems, 6) role limitations due to emotional problems, 7) vitality (energy/fatigue) and 8) general health perceptions.

Each scale is scored from 0-100; a higher score represents better quality of life [114]. In addition, the SF-36 questionnaire was asked of the participants as a face-to-face interview by the researcher (Annex G).

Data Analysis

Statistical Package Analysis for Health Sciences (SPSS) version 22.0 software (SPSS Inc. Chicago, IL, USA) was used for statistical analysis. Significance level was accepted as $p \leq 0.005$. We used Chi-square test to compare categorical (nominal) variables between groups and continuous variables were compared with the t-test or Mann-Whitney U test (if the variables nonparametric). Pearson correlation test was used to evaluate the correlation of variables within hemselves. The significance level of the study, P: 0.05 value and 95% confidence interval were considered statistically significant.

4. RESULTS

Fifty healthy individuals (24 F, 26 M, 32.56±.9.73 years old) applied to Bezmialem Dragos Hospital, Physical Therapy Clinic. They exercised for at least three months and moderate physical activity per week before being included in the study. 25 COVID-19 patients and 25 volunteers were included.

The main demographic parameters comparing the two study groups showed that there was no significant difference in age, gender, weight, height, exercise frequency, and smoking according to the results of the independent sample t-test or chi-square test ($p>0.05$) (Table 4.1).

Table 4.1. Comparison the sociodemographic parameters between study groups

Variable	COVID-19 Group	Control Group	t/z p value
Age (year)	32.56±.9.73	32.36±8.21	0.107 0.915
Weight (kg)	78.28±22.54	74.16±18.86	0.701 0.487
Height (m)	167.92±18.58	194.60±199.98	1.099 0.277
Exercise (day)	3.84±0.98	3.76±1.16	0.089 0.794
Exercise (minute)	51.40±22.66	69.20±35.75	**0.089** **0.041**
Smokers (many year)	5.48±9.522	4.72±8.648	0.295 0.760
Cigarettes (per a day)	4.48±7.75	6±9.24	0.630 0.532

Data expressed as mean ± standard deviation or number (percentage).

The primary demographic parameters comparing the two study groups showed that there was no significant difference in terms of gender, systemic diseases, and educational status according to chi-square test results ($p>0.05$) (Table 4.2).

Table 4.2. Comparison the demographic parameters between study groups

Variable		COVID-19 Group	Control Group	λ^2/t p value
Gender	**Female**	12(48)	12(48)	0.000 1.000
	Male	13(52)	13(52)	
Systemic diseases	**Thyroid**	1(4)	1(4)	0.000 1.000
	Diabetes	2(8)	0	2.083 0.149
	Hypertension	2(8)	0	2.083 0.149
Education status	**Primary school**	1(4)	2(8)	2.100 0.552
	Middle school	1(4)	0	
	High school	2(8)	4(16)	
	University	21(84)	19(79)	

Data expressed as number (percentage).

Comparing the two study groups, the parameters related to COVID-19 infection showed significant differences in terms of exercise during COVID-19, ongoing complaint after COVID-19, and symptoms during COVID-19 according to the results of the chi-square test ($p>0.05$), (Table 4.3).

Table 4.3. Comparison COVID-19 infection effects and sypmtoms between study groups

Variable		COVID-19 Group	Control Group	λ^2/t p value
Exercising during COVID-19	**Yes**	6(24)	0	6.818 **0.009**
	No	19(76)	0	
Ongoing complaint after COVID-19	**Yes**	4(16)	0	4.348 **0.037**
	No	21(84)	0	
Symptoms during COVID-19	**Fever**	12(48)	0	15.789 **0.000**
	Cough	13(52)	0	17.568 **0.000**
	Back pain	16(64)	0	25.259 **0.000**
	Taste-smell loss	13(52)	0	17.568 **0.000**

Data expressed as number (percentage).

An independent sample t-test was used to compare study variables between the two groups. The data underlined no statistical significance in spirometry, MIP, and MEP ($p>0.05$). In addition, the data emphasized that it was statistically significant in the COVID-19 group in terms of MMRC **($p<0.05$)** (Table 4.4).

Table 4.4. Comparison of MMRC, Pulmonary Function Test and Respiratory Muscle Testing in between groups.

	COVID-19 Group	Control Group	t/z p value
FEV_1 (L)	2.37 ±0.68	2.27±0.72	0.501 0.618
FVC(L)	3.39±0.88	3.22±0.99	0.639 0.526
FEV1/FVC	62.09±16.52	63.29±20.18	0.181 0.857
FEF25-75 (L/s)	2.30±0.96	2.06±0.98	0.857 0.395
MIP (cmH2O)	70.80±16.57	72.04±18.43	0.250 0.804
MEP (cmH2O)	83.92±19.14	78.76±13.76	1.094 0.279
MMRC	1.32±0.62	1.16±0.47	1.088 0.045

Data expressed as mean ±standard deviation, FEV_1: Forced vital capacity in 1 second, FVC: Forced Vital Capacity, FEV_1/FVC: Tiffeneau Ratio, FEF25-75: the mean forced expiratory flow during the middle half of the FVC, MIP: Maximum Inspiratory Pressure, MEP: Maximum Expiratory Pressure, MMRC: Modified Medical Research Council Dyspnea Scale.

An independent sample t-test was used to compare study variables between the two groups. The data underlined that 6MWT was statistically significant in the COVID-19 group **($p<0.05$)** (Table 4.5).

Table 4.5. Comparison of 6MWT and IPAQ-SF in between groups.

	COVID-19 Group	Control Group	t/z p value
6MWT (m)	611.82±157.67	709.40±217.86	2.002 **0.045**
IPAQ-SF (met)	3552.92±3552.31	3832.68±3653.59	0.679 0.497

Data expressed as mean ±standard deviation. 6MWT: Six Minute Walking Testi IPAQ: International Physical Activity Questionnaire.

An independent sample t-test was used to compare study variables between the two groups. The data underlined no statistical significance regarding McGill flexor and extensor core endurance (p>0.05). In addition, the data emphasized that it was statistically significant in the COVID-19 group in terms of McGill's right and left lateral core endurance **(p<0.05)** (Table 4.6).

Table 4.6. Comparison of McGill Core Endurance Test between groups.

	COVID-19 Group	**Control Group**	**t/z p value**
McGill (Flexor)	104.31±50.78	125.84±51.63	1.148 0.144
McGill (Lateral Right)	59.86±27.67	83.48±37.32	2.541 **0.014**
McGill (Lateral Left)	61.54±30.24	84.56±38.76	2.340 **0.023**
McGill (Extansor)	119.15±63.78	145.90±60.37	1.523 0.134

Data expressed as mean ±standard deviation.

An independent sample t-test was used to compare study variables between the two groups. Data, physical functioning, role limitations due to physical health, emotional well-being, and social functioning underlined that there was no statistical significance (p>0.05). However, it also highlighted that data role limitations due to emotional problems, energy/fatigue, pain, and general health status were statistically significant in the COVID-19 group **(p<0.05)** (Table 4.7).

Table 4.7. Comparison of quality of life between groups.

	COVID-19 Group	Control Group	t/z p value
Physical functioning	86.48±14.13	88.84±18.09	1.093 0.273
Role limitations due to physical health	60.40±34.12	55±45.06	0.590 0.555
Role limitations due to emotional problems	57.78±25.64	73.22±29.35	2.056 **0.040**
Energy /fatigue	52.78±20.23	69.12±17	3.089 **0.003**
Emotional well-being	83.64±122.61	73.12±16.19	0.425 0.673
Social functioning	70.23±20.35	76.76±17.97	1.197 0.237
Pain	74.22±17.88	85.10±12.89	2.218 **0.027**

Data expressed as mean ±standard deviation. Mean values. In the same row are significantly different (p=0.05)

Pearson correlation test was used to evaluate the correlation of variables within themselves in the Control group. MIP and MEP values show a positive correlation. At the same time, it was observed that McGill Core endurance parameters were positively correlated **(p<0.05)** (Table 4.8).

The Pearson correlation test was used to evaluate the correlation of variables within themselves in the COVID-19 group. The 6MWT and McGill Lateral Right and Left core endurance tests demonstrate a positive correlation. At the same time, it was observed that all McGill Core endurance parameters were positively related to the MIP value **(p<0.05)** (Table 4.9).

Table 4.8. Correlation of the test parameters in Control Group

CC / P	**6MWT**	**MMRC**	**MİP**	**MEP**	**Mcgill Flexor**	**Mcgill Extansor**	**Mcgill Lateral R.**	**Mcgill Lateral L.**
6MWT	1	-0.23 0.25	0.27 0.18	0.11 0.59	0.18 0.36	0.15 0.45	-0.08 0.97	-0.01 0.94
MMRC	-0.23 0.25	1	0.07 0.71	0.19 0.34	0 0.98	-0.01 0.93	0.00 0.99	-0.06 0.76
MIP	0.27 0.18	0.19 0.34	1	**0.57**** **0.00**	-0.07 0.73	-0.13 0.52	0.83 0.69	-0.24 0.23
MEP	0.1 0.59	0.07 0.71	**0.57**0.00**	1	0.63 0.76	0.06 0.77	-0.24 0.24	0.07 0.73
Mcgill Flexor	0.18 0.36	0.00 0.98	-0.07 0.73	0.06 0.76	1	0	**0.81**0**	**0.81**0**
Mcgill Extansor	0.15 0.45	-0.18 0.93	-0.13 0.52	0.06 0.77	**0.75**** **0**	0	**0.68**** **0**	**0.69** 0**
Mcgill Lateral R.	-0.00 0.97	0.00 0.99	-0.24 0.24	0.08 0.69	**0.81**0**	0	1	0.99**0
Mcgil Lateral L.	-0.01 0.94	-0.06 0.76	-0.24 0.23	0.07 0.73	**0.81**** **0**	0	**0.99**** **0**	1

Data expressed as mean ±standard deviation. Mean values. In the same row are significantly different (p=0.05). FEV_1: Forced vital capacity in 1 second, FVC: Forced Vital Capacity, FEV_1/FVC: Tiffeneau Ratio, FEF25-75: the mean forced expiratory flow during the middle half of the FVC, MIP: Maximum Inspiratory Pressure, MEP: Maximum Expiratory Pressure, MMRC: Modified Medical Research Council Dyspnea Scale. 6MWT: Six Minute Walking Testi IPAQ: International Physical Activity Questionnaire.

Table 4.9. Correlation of the test parameters in COVID-19 Group

CC / P	**6MWT**	**MMRC**	**MIP**	**MEP**	**Mcgill Flexor**	**Mcgill Extanso r**	**Mcgill Lateral R.**	**Mcgill Lateral L.**
6MWT	1	-0.21 0.29	0.06 0.75	-0.04 0.82	0.15 0.46	0.29 0.16	**0.45*** **0.02**	0.47 0.01
MMRC	-0.21 0.29	1	-0.32 0.11	-0.13 0.51	-0.33 0.09	-0.36 0.07	**-0.44*** **0.02**	**-0.46* 0.01**
MIP	0.06 0.75	-0.36 0.11	1	0.38 0.05	**0.54**** **0.00**	**0.53**** **0.00**	**0.55**** **0.00**	**0.53**** **0**
MEP	-0.04 0.82	-0.13 0.51	0.38 0.05	1	0.35 0.07	0.30 0.13	0.28 0.17	0.26 0.18
Mcgill Flexor	0.15 0.46	-0.33 0.09	**0.54**0. 00**	0.35 0.07	1	**0.91**0**	**0.79**0**	0.80**0
Mcgill Extansor	0.29 0.16	-0.36 0.07	**0.53**** **0.00**	0.30 0.13	**0.91**** **0**	1	**0.89**** **0**	**0.91**** **0**
Mcgill Lateral R.	**0.45*** **0.18**	-0.44* 0.02	**0.55**** **0.00**	0.28 0.17	**0.79**** **0**	**0.89**** **0**	1	**0.98**** **0**
Mcgil Lateral L.	**0.45*** **0.02**	-0.46* 0.01	**0.53**** **0.00**	0.27 0.18	**0.80**** **0**	**0.91**** **0**	**0.98**** **0**	1

Data expressed as mean ±standard deviation. Mean values. In the same row are significantly different (p=0.05). FEV_1: Forced vital capacity in 1 second, FVC: Forced Vital Capacity, FEV_1/FVC: Tiffeneau Ratio, FEF25-75: the mean forced expiratory flow during the middle half of the FVC, MIP: Maximum Inspiratory Pressure, MEP: Maximum Expiratory Pressure, MMRC: Modified Medical Research Council Dyspnea Scale. 6MWT: Six Minute Walking Testi IPAQ: International Physical Activity Questionnaire.

5. DISCUSSION

The findings of this study revealed that exercise capacity, core endurance, and quality of life decreased in physically active COVID-19 survivors. Furthermore, volunteers in the COVID-19 Group push more dyspnea compared to the Control Group.

The finding of this study demonstrated that the data from spirometry and mouth pressure which are the hall lung functions and respiratory muscle strength parameters were not statistically different in the COVID-19 Group compared to the Control Group. However, the MMRC scale assessing dyspnea was statistically higher in the COVID-19 Group. In the literature, the study conducted by Torres-Castro et al. showed differences in the results of spirometry performed early after COVID-19 infection [115]. In another study by Rodrigues M. et al., it was observed that the MIP, MEP, and MMRC values of patients hospitalized after COVID-19 were affected in the early period. Still, the results improved after three months, namely chronic disease [116]. Consistent with the literature, the COVID-19 survivors had normal spirometry, MIP, and MEP values during the chronic stage of COVID-19. Moreover, our study showed that COVID-19 survivors reported more dyspnea than the Control Group. The participants in the COVID-19 Group exercise regularly, so they push their physical performance in their everyday life more than sedentary individuals, which may be the possible reason for that finding.

One of the significant results of our study is that the 6MWT results were statistically decreased in the COVID-19 Group compared to the Control Group. In the literaturature, a survey conducted on COVID-19 patients during the chronic stage of the disease showed that patients who had dyspnea after COVID-19 had decreased 6MWT distance [116]. Another experimental study included 70 COVID-19 survivors. They prescribed the strength, endurance, and flexibility exercises and taught patients airway clearance techniques (if needed). The researchers assessed the patients after 3- and 6-months periods and found that the 6MWT distance did not improve statistically [117]. Thus, functional exercise capacity may be affected by increased dyspnea because COVID-19 survivors may be afraid to increase their exercise intensity due to fear of dyspnea.

The study's finding was that right, and left core endurance values were statistically decreased in the COVID-19 Group. We evaluated participants in 3 different positions during the McGill core endurance test. In flexor and extensor evaluations, we can

observe the endurance of the abdominal and back muscles in isolation. The lateral core position testing includes side plank position, so the persistence of the forces, namely Vastus Lateralis, Peroneus Longus, Serratus Anterior, Pectoralis Minor, Deltoid, Gluteus Medius, and Tensor Fasciae Latae, Internal and External Oblique muscles can be evaluated. In the literature, most of the studies conducted on COVID-19 survivors focused on peripheral muscle strength [118]. A study assessed muscle thickness with isometric quadriceps maximal voluntary contraction (MVC) three times with a computerized dynamometer and muscle ultrasound in 14 patients with post-COVID-19 quadriceps muscle weakness. Following 14 weeks after mild COVID-19, muscle weakness was observed in 59% of hospitalized patients and 65% of outpatient patients. The study by De Andrade-Junior, M. C. also reported that intensive care patients with severe COVID-19 underwent early and rapid muscle wasting and decreased muscle strength in the 10-day intensive care unit. Although they remained below normal levels, mobility and respiratory functions improved. These findings may provide insight into skeletal muscle wasting and process in severe COVID-19 patients [119].

Another study showed that a manual handheld dynamometer determined peripheral muscle strength among COVID-19 survivors was similar to muscle strength in the healthy Group [120]. Moreover, a review showed that physically active COVID-19 survivors are unlikely to have post-COVID syndromes, including chronic pain, decreased muscle strength, and pulmonary problems [121]. Although we did not assess peripheral muscle strength, volunteers in our study completed the 6MWT, which may reflect the peripheral muscle's exercise capacity. Moreover, we found a positive correlation between 6MWT and McGill Lateral Right and Left core endurance tests in the COVID-19 Group. In the literature, it was well described that individuals having good core stability have stronger peripheral muscles [122,123]. Thus, a decrease in the peripheral muscle strength indicated in the literature may be caused by the reduction of lateral core endurance.

Another study finding showed that all the McGill Core endurance test parameters were positively associated with MIP value in the COVID-19 Group in the intragroup analysis. In the literature, it is reported that diaphragmatic control is required for facilitating inspiration [124,125], and the primary function of core stabilization could not be achieved without a diaphragm contraction [126].

In another study, it was reported that trunk muscles are active in forced expiration and trunk stabilization, and trunk endurance exercises positively affect respiratory functions [127]. Thus, weakness in the core muscles may reveal a decrease in the MIP value in the COVID-19 Group. Considering the correlation between MIP and core stability, we may add core stabilization exercises to conventional COVID-19 rehabilitation approaches to help recovery in the earlier period.

The study had several limitations. The first limitation of the study is that we did not evaluate individuals prior to COVID-19 infection. We did not set an upper limit for selecting individuals infected with COVID-19. However, we added the Control Group to understand the effects of COVID-19 disease on respiratory muscle strength, functional exercise capacity and core stability. Another limitation is that we could add the peripheral muscle strength assessment to this study because we needed the proper tools for the evaluation. Thus, we did 6MWT to understand the functional exercise capacity of our patients. Lastly, we may add another COVID-19 group, including physically inactive individuals, to understand the effect of regular exercise.

Conclusion

Twenty-five participants were included in the COVID-19 Group and twenty-five in the Control group. As a result of the study, we emphasized that MMRC, 6MWT, McGill lateral right, left core endurance, and SF-36 were statistically decreased in the COVID-19 Group. Furthermore, a positive correlation was observed in the MIP-MEP and McGill core endurance results, which are the evaluation parameters of the control group. In addition, a positive correlation was observed between 6MWT-McGill right/left lateral core endurance and McGill core endurance-MIP parameters in the COVID-19 Group. Thus, physically active individuals may experience a decrease in their functional capacity and core endurance after COVID-19 infection, and this may lead to experiencing more dyspnea. When applying exercise programs after COVID-19 infection, we recommend core exercises combined with respiratory control.

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APPENDIX A: ETHICAL COMMITTEE APPROVAL

KARAR FORMU

27.01.2022

ETİK KURUL BİLGİLERİ		
	Etik Kurulun Adı	Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu
	Açık Adres	Yeditepe Üniversitesi Diş Hekimliği Fakültesi, Bağdat Cad. No. 238 Göztepe 34728 Kadıköy, İstanbul
	İnternet Sayfası	http://goetik.yeditepe.edu.tr/
	Telefon	0216 363 60 44
	E-posta	goetik@yeditepe.edu.tr

DEĞERLENDİRİLEN BELGELER	
Islak imzalı başvuru dosyası, CD'si ve elektronik başvuru	☒
Araştırma başlığı ve araştırmacıların isimleri	☒
Başvuru dilekçesi	☒
Araştırmanın;	☒
• Niteliği	☒
• Önemi ve özgün değeri	☒
• Amaç ve hedefleri	☒
• Yöntemi	☒
• Yönetimi	☒
• Yaygın etkisi	☒
• Araştırma bütçesi (Mevcutsa)	☒
• Süresi ve uygunluğu (Zaman cetveli)	☒
• Kaynakları	☒
Araştırma izin belgesi / belgeleri	☒
Bilgilendirilmiş Gönüllü Olur Formu (yapılan araştırmaya özel olarak hazırlanmış)	☒
Taahhütname-1 Dünya Tıp Birliği Helsinki Bildirgesinin son versiyonunun ve Sağlık Bakanlığı'nın ilgili tüm kılavuzlarının okunmasına dair taahhüt	☒
Taahhütname-2 Daha önce yapılmış etik kurul başvuruları mevcut olup olmadığına dair taahhüt	☒
Taahhütname-3 Araştırma sırasında araştırma bütçesinde yer almayan ve gönüllünün kendisine veya Sosyal Güvenlik Kurumuna ek yük getirecek hiçbir işlem uygulanmayacağına dair taahhüt	☒
Taahhütname-4 COVID-19 hastalarında tedavi yaklaşımları ve bilimsel araştırmalar genelgesi okunmasına dair taahhüt	☒
Araştırmacıların her birisine ait özgeçmiş formu	☒
Ek belgeler (Varsa kullanılan ölçek izinleri vb.)	☒

KARAR BİLGİLERİ		
	Başvuru Numarası	202112122
	Toplantı Tarihi	14.01.2022
	Toplantı Yeri	Çevirim içi (Google Meet)
	Karar No	2

Araştırmanın Başlığı	COVID-19 enfeksiyonunun egzersiz yapan sağlıklı yetişkinlerde solunum kas kuvveti ve core stabilizasyon üzerine etkisi
Araştırmacılar	Fzt. İldeniz Yalnız, Dr. Öğr. Üyesi Elif Develi, Dr. Öğr. Üyesi Yaşar Keskin

BAŞVURU NUMARASI: 202112122

KARAR 27.01.2022

☒ **KABUL**	☐ **RET** ☐ *KAPSAM DIŞI (GİRİŞİMSEL)* ☐ *BİLİMSEL VE/VEYA ETİK KURALLARA AYKIRI* ☐ *BİR SORUMLU ARAŞTIRMACININ (TEZ İSE TEZ DANIŞMANI), BİR TOPLANTIYA **İKİ (2) ADETTEN FAZLA ÇALIŞMA BAŞVURUSUNDA** BULUNMASI* ☐ *KURUM İÇİ BAŞVURULARINDA **YEDİTEPE UZANTILI E-POSTA HESABI** İLE GİRİŞ YAPILMAMIŞ OLMASI* ☐ *ŞARTLI KABULDE BELİRTİLEN REVİZYONLARIN ZAMANINDA VE/VEYA İSTENİLDİĞİ ŞEKİLDE YAPILMAMIŞ OLMASI*

APPENDIX B: INFORMED WRITTEN CONSENT

Araştırmanın adı: COVID-19 Enfeksiyonunun Fiziksel Aktif Bireylerde Solunum Kas Gücü Ve Kore Stabilizasyonu Üzerindeki Etkisi

Sayın Katılımcı,

Yukarıda adı yazılı araştırmaya katılmak üzere davet edilmiş bulunmaktasınız. Çalışmaya katılıp katılmama kararı tamamen size aittir. Katılmak isteyip istemediğinize karar vermeden önce araştırmanın neden yapıldığını, bilgilerinizin nasıl kullanılacağını, çalışmanın neleri içerdiğini, olası yararları ve risklerini ya da rahatsızlık verebilecek yönlerini anlamanız önemlidir. Lütfen aşağıdaki bilgileri dikkatlice okumak için zaman ayırınız. Sorularınız olursa sorunuz ve açık yanıtlar isteyiniz.

Bu araştırma ile COVID-19 enfeksiyonun solunum sistemi ve gövde kasları üzerinde etkisini gözlemlemek amaçlanmıştır. Solunum sistemini değerlendirmek için iki ayrı cihaza nefesinizi almanız ve vermeniz istenecek sonra da ölçümleriniz not alınacaktır. Günlük yürüme aktivitenizi değerlendirmek için 6 dakika yürümeniz istenecektir. Gövde kaslarınızı değerlendirmek için dört ayrı pozisyonda en uzun sürede durmanız istenecektir ve bu süreniz not alınacaktır. Ek olarak sizlerin fiziksel aktivite seviyenizi, yaşam kalitenizi ve nefes darlığınızı değerlendirmek için belirlediğimiz anketi doldurmanız istenecektir. Araştırma için Bezmialem Vakıf Üniversitesi Dragos Hastanesinden izin alınmıştır. Araştırmaya sizin dışınızda 49 kişi katılacaktır. Sizden bu çalışmaya 1 saat ayırmanız istenecektir. Bunun size ve yakınlarınıza hiçbir zararı olmayacaktır. Çalışmaya katılmakta parasal yük altına girmeyeceksiniz ve size de herhangi bir ödeme yapılmayacaktır.

Bu araştırmaya katılıp katılmamakta tümüyle özgürsünüz. Gerek duyduğunuz tüm bilgileri istemeye ve doğru, açık, anlaşılır bilgi almaya hakkınız vardır. Araştırmaya katılmayı istemezseniz burada size verilen hizmet olumlu veya olumsuz şekilde etkilenmeyecektir. Gerekli gördüğü takdirde araştırmanın herhangi bir kısmında katılımcı araştırmadan çıkabilir, araştırmacı çalışmayı sonlandırabilir. Araştırmanın tüm aşamalarında kimlik bilgileriniz gizli tutulacaktır. Araştırma kapsamında elde edilen bilgiler bilimsel amaçlarla kullanılabilir gizlilik kurallarına uyulmak kaydıyla sunulabilir ve yayınlanabilir.

Araştırma ile ilgili daha fazla bilgiye ihtiyaç duyarsanız araştırmacıya ildenizyalnizzz@gmail.com e-posta adresi veya 0530 946 46 75 numaralı telefondan ulaşabilirsiniz.

Yukarıda yer alan ve araştırmaya başlanmadan önce katılımcılara verilmesi gereken bilgileri içeren metni okudum (yada sözlü dinledim). Araştırma kapsamında elde edilen şahsıma ait bilgilerin bilimsel amaçlarla kullanılmasını, gizlilik kurallarına uyumak kaydıyla sunulmasını ve yayınlanmasını, hiçbir baskı ve zorlama altında kalmaksızın, kendi özgür irademle kabul ettiğimi beyan ederim.

İmza/Tarih	İmza/Tarih
Katılımcı adı soyadı	Sorumlu Araştırmacının adı soyadı

APPENDIX C: STRUCTURED QUESTIONNAIRE

T.C. YEDİTEPE ÜNİVERSİTESİ
Fizyoterapi ve Rehabilitasyon Anabilim Dalı

Yaş: Kilo: Boy:

Telefon numarası:

Cinsiyetiniz: Kadın ☐ Erkek ☐ Belirtmek istmiyorum ☐

Eğitim durumunuz: Okuryazar değil ☐

İlköğretim ☐

Lise ☐

Üniversite ve üzeri ☐

Mesleğiniz:

Sistemik hastalığınız var mı?:

Evet ☐ Hayır ☐

Sistemik hastalığını varsa:

Nelerdir: Ne zaman tanı aldınız?

İlaç kulanıyor musunuz?:

Evet ☐ Hayır ☐

Kullanıyorsanız:

Nelerdir: Ne zamandır:

Son 3 aydır düzenli egzersiz yapıyor musunuz ?:

Evet ☐ Hayır ☐

Egzersiz yapıyorsanız:

Nelerdir:

Haftada kaç gün: Kaç dakika:

COVID-19 geçirdiniz mi?:

Evet ☐ Hayır ☐ (COVID-19 sorularını geçiniz)

Hastalığı geçirdiyseniz:

Kaç kere geçirdiniz?:

İlk ne zaman geçirdiniz?:

Başvuru nedeniniz olan yakınmalarınız?: ☐ Ateş

☐ Öksürük

☐ Tat-koku kaybı

☐ Sırt ağrısı

☐ Diğerleri (belirtiniz)

Yakınmalarınız ne kadar sürdü?:

COVID-19 geçirdikten sonra hala devam eden yakınmalarınız var mı?:

Evet ☐ Hayır ☐

Evet ise nelerdir:

COVID- 19 olduğunuz sürede egzersiz yaptınız mı?:

Evet ☐ Hayır ☐

Evet ise nelerdir:

Aşı oldunuz mu?:

Aşı olduysanız, ne zaman ve kaç doz?:

Sigara kullanıyor musunuz?:

Evet Hayır

Sigara kullanıyorsanız:

Kaç yıldır: Günde kaç tane:

Solunum Fonksiyon Testi

FEV1:

FVC:

FEV1/FVC:

TLC:

PEF:

Solunum Kas Gücü

MIP:

MEP:

McGill Core Endurans Testi (saniye)

Gövde fleksör endurans test süresi:

Gövde lateral endurans test süresi: sağ sol

Gövde ekstansör endurans test süresi:

APPENDIX D: 6 MINUTES WALKING TEST

T.C. YEDİTEPE ÜNİVERSİTESİ
Fizyoterapi ve Rehabilitasyon Anabilim Dalı

Boy:

Ağırlık:

Kan basıncı: /

Testten önce alınan ilaçlar (doz ve süre):

Test sırasında ek oksijen:

Zaman ___:___ ___:___

Kalp Atış Hızı:

SpO2 %:

6 dakikadan önce durduruldu mu veya duraklatıldı mı?: (EVET ise nedeni)

Egzersizin sonundaki diğer semptomlar:

anjina baş dönmesi kalça, bacak veya baldır ağrısı

Tur sayısı: (60 metre)

Son kısmi tur: metre

6 dakikada yürünen toplam mesafe: metre
Öngörülen mesafe: metre

Öngörülen yüzde: %

Yorumlama (müdahale öncesi 6MWD ile karşılaştırma dahil)

Nefes Darlığı	Modifiye Borg Skalası			Yorgunluk
	0	Hiç yok	0	
	0,5	Çok çok hafif nefes darlığı var	0,5	
	1	Çok hafif	1	
	2	Hafif	2	
	3	Orta	3	
	4	Biraz şiddetli	4	
	5	Şiddetli	5	
	6		6	
	7	Çok Şiddetli	7	
	8		8	
	9	Çok çok şiddetli	9	
	10	Maksimal	10	

APPENDIX E: INTERNATIONAL PHYSICAL ACTIVITY QUESTTIONNAIRE SHORT FORM (IPAQ)

Son 7 günde yaptığınız şiddetli aktiviteleri düşünün. Şiddetli fiziksel aktiviteler; zor fiziksel efor yapıldığını ve nefes almanın normalden çok daha fazla olduğu aktiviteleri ifade eder. Sadece herhangi bir zamanda en az 10 dakika yaptığınız bu aktiviteleri düşünün.

1. Geçen 7 gün içerisinde kaç gün ağır kaldırma, kazma, aerobik, basketbol, futbol veya hızlı bisiklet çevirme gibi şiddetli fiziksel aktivitelerden yaptınız mı?

Haftada _____ gün
Şiddetli fiziksel aktivite yapmadım. -> (3.soruya gidin.)

2. **Bu günlerin birinde şiddetli fiziksel aktivite yaparak genellikle ne kadar zaman harcadınız?** Günde ___ saat

Günde ___ dakika
Bilmiyorum/Emin değilim

Geçen 7 günde yaptığınız orta dereceli fiziksel aktiviteleri düşünün. Orta dereceli aktivite orta derece fiziksel güç gerektiren ve normalden biraz sık nefes almaya neden olan aktivitelerdir. Yalnız bir seferde en az 10 dakika boyunca yaptığınız fiziksel aktiviteleri düşünün.

3. **Geçen 7 gün içerisinde kaç gün hafif yük tasıma, normal hızda bisiklet çevirme, halk oyunları, dans, bowling veya çiftler tenis oyunu gibi orta dereceli fiziksel aktivitelerden yaptınız?** (Yürüme hariç)

Haftada___gün
Orta dereceli fiziksel aktivite yapmadım. -> (5.soruya gidin.)

4. Bu günlerin birinde orta dereceli fiziksel aktivite yaparak genellikle ne kadar zaman harcadınız?

Günde ___ saat
Günde ___ dakika
Bilmiyorum/Emin değilim

Geçen 7 günde yürüyerek geçirdiğiniz zamanı düşünün. Bu işyerinde, evde, bir yerden bir yere ulaşım amacıyla veya sadece dinlenme, spor, TGzersiz veya hobi amacıyla yaptığınız yürüyüş olabilir.

5. Geçen 7 gün, bir seferde en az 10 dakika yürüdüğünüz gün sayısı kaçtır?

Haftada_____gün
Yürümedim. -> (7.soruya gidin.)

6. Bu günlerden birinde yürüyerek genellikle ne kadar zaman geçirdiniz?

Günde ___ saat
Günde ___ dakika
Bilmiyorum/Emin değilim

7. Geçen 7 günde hafta içinde oturarak geçirdiğiniz zamanlarla ilgilidir. İşte, evde, çalışırken ya da dinlenirken geçirdiğiniz zamanlar dahildir. Bu masanızda, arkadaşınızı ziyaret ederken, okurken, otururken veya yatarak televizyon seyrettiğinizde oturarak geçirdiğiniz zamanları kapsamaktadır.

Günde ___ saat
Günde ___ dakika
Bilmiyorum/Emin değilim

APPENDIX F: MODIFED MEDICAL RESEARCH COUNCIL OF DYSPNEA SCALE (MMRC)

☐ Ağır efor dışında solunum sıkıntım yok

☐ Yokuş çıkarken veya düz zeminde hızlı hareket ederken nefes darlığım var

☐ Düz zeminde kendi yaşıtlarıma göre daha yavaş hareket etme yada düz zeminde normal hızla yürürken (bir mil sonra veya 30 dakika sonra) durmak zorunda kalıyorum

☐ Düz zeminde 100 m veya birkaç dakika yürüdükten sonra nefes darlığı nedeniyle durmak zorunda kalıyorum

☐ Evden çıkmak veya giyinmek gibi aktiviteler sırasında belirgin nefes darlığım var

APPENDIX G: QUALITY OF LIFE QUESTIONNAIRE

Aşağıdaki sorular sizin kendi sağlığınız hakkındaki görüşünüzü, kendinizi nasıl hissettiğinizi ve günlük aktivitelerinizi ne kadar yerine getirebildiğinizi öğrenmek amacındadır. Her hangi bir sorunun yanıtı hakkında emin değilseniz bile size en uygun yanıtı verin. Ayrıca 10 uncu sorudan sonraki boşluğa yorumlarınızı yazabilirsiniz.

1-Genel sağlık durumunuz hakkında aşağıdaki tanımlardan hangisi doğrudur? Lütfen tek bir yanıt veriniz.

- Mükemmel
- Çok iyi
- İyi
- Orta (fena değil)
- Kötü

2-Bir yıl öncesi ile karşılaştırdığınızda genel sağlık durumunuzu nasıl değerlendirirsiniz?

- Bir yıl öncesinden çok daha iyi
- Bir yıl öncesinden biraz iyi
- Hemen hemen aynı
- Bir yıl öncesinden biraz daha kötü
- Bir yıl öncesinden çok daha kötü

SAĞLIK VE GÜNLÜK AKTİVİTELER

3-Aşağıdaki sorular bir gün içinde yapabileceğiniz işlerle (aktivitelerle) ilgilidir.

Sağlığınız bu aktiviteleri kısıtlıyor mu? Eğer kısıtlıyorsa, ne kadar? a)Zorlu aktiviteler; örneğin koşma, ağır eşyaları kaldırma, zor sporlara katılma vb b)Orta derecede aktiviteler; örneğin bir masayı kaldırma, elektrikli süpürgeyi itme, hafif sporlara katılma vb c)Ağır kaldırma ve yük taşıma	Evet, çok kısıtlı	Evet, biraz kısıtlı	Hayır, hiç kısıtlı değil

4-Son 4 hafta içinde çalışma sırasında veya günlük aktiviteleriniz sırasında aşağıdaki problemlerden herhangi birini yaşadınız mı?

Her bir soruya evet veya hayır yanıtı verin.	*Evet*	*Hayır*
a)Çalışma yaşamınızda veya diğer aktivitelerinizde geçirdiğiniz zamanı kısalttınız mı?		
b)Arzu ettiğinizden daha az şey mi yaptınız?		
c)Çalışma veya diğer yaptığınız işlerin çeşidinde kısıtlama yaptınız mı?		
d)Çalışma yaşamınızda veya diğer aktivitelerinizi yapmakta güçlük çektiniz mi? (aşırı efor gösterdiniz mi?)		

5-Son 4 hafta içinde çalışma sırasında veya günlük aktiviteleriniz sırasında duygusal sorunlar nedeniyle (depresyon veya sıkıntı gibi nedenlerle) aşağıdaki problemlerden herhangi birini yaşadınız mı?

Her soruya yanıt veriniz.	Evet	Hayır
a)Çalışma yaşamınızda veya diğer aktivitelerinizde geçirdiğiniz zamanı kısalttınız mı?		
b)Arzu ettiğinizden daha az şey mi yaptınız?		

6-Son 4 hafta içinde fizik sağlığınız veya duygusal sorunlarınız sizin ailenizle, arkadaşlarınızla, komşularınızla olan sosyal ilişkilerinizi ne ölçüde etkiledi?

Lütfen tek bir yanıt veriniz.

Hiç etkilemedi

Çok az

Orta derecede

Epeyce

Çok fazla

7-Son 4 hafta içinde ne kadar ağrınız oldu?

Lütfen tek bir yanıt veriniz.

Hiç olmadı

Çok az

Az

Orta derecede

Çok

Pek çok

8-Son 4 hafta içinde ağrınız sizin normal çalışmanızı ne kadar etkiledi (hem ev dışında, hem de ev işi olarak)?

Lütfen tek bir yanıt veriniz.

Hiç etkilemedi

Biraz etkiledi

Orta derecede etkiledi

Epey etkiledi

Çok etkiledi

GENEL SAĞLIK

9-Aşağıdaki cümlelerin sizin için ne kadar doğru veya yanlış olduğunu belirtiniz.

	Kesinlikle doğru	Çoğunlukla doğru	Emin değilim	Çoğunlukla yanlış	Kesinlikle yanlış
a)Ben diğer insanlara göre daha kolay hastalanıyorum					
b)Tanıdığım kişiler kadar sağlıklıyım					
c)Sağlığımın kötüleşmekte olduğunu sanıyorum					
d)Sağlığım mükemmel					

DUYGULARINIZ

10-Aşağıdaki sorular duygularınızı ve son bir ay içinde nasıl olduğunuzu anlamak için düzenlenmiştir. Her bir soru için lütfen size en uygun tek bir yanıtı işaretleyin.

	Kesinlikle doğru	Çoğunlukla doğru	Emin değilim	Çoğunlukla yanlış	Kesinlikle yanlış
a)Kendinizi yaşam dolu olarak mı hissediyorsunuz?					
b)Çok sinirli biri mi oldunuz?					
c)Kendinizi lağım çukuruna düşmüş gibi hissettiğiniz ve hiçbir şeyin moralinizi düzeltemeyeceğini düşündüğünüz oldu mu?					
d)Kendinizi sakin ve barışçı hissettiniz mi?					
e)Çok enerjik oldunuz mu?					
f)Kendinizi kalbi kırık ve üzgün hissettiniz mi?					
g)Kendinizi yıpranmış hissettiniz mi?					
h)Mutlu bir insan oldunuz mu?					
i)Yorgunluk hissettiniz mi?					
j)Sağlığınız sosyal aktivitelerinizi sınırladı mı? (arkadaşları veya yakın akrabaları ziyaret etmek gibi)					