**Deanship of Graduate Studies**

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# The Effect of Physiotherapy Intervention on Functional Outcomes among COVID19 patients at Governmental Hospitals in Hebron/Palestine.

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**M.Sc Thesis**

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# The Effect of Physiotherapy Intervention on Functional Outcomes among COVID19 patients at Governmental Hospitals in Hebron/Palestine.

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## Thesis Approval

The Effect of Physiotherapy Intervention on Functional Outcomes among COVID19 patients at Governmental Hospitals in Hebron/Palestine.

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## Dedication

First and foremost, I would like to dedicate this work to the gad; thank you for your guidance, strength, power of mind, protection, and for giving me a healthy life.

This study is wholeheartedly dedicated to my beloved family, especially to my wonderful husband Ashraf who has been a source of inspiration. They have given me strength when I considered giving up and they continuously provide their moral, spiritual, and emotional support.

I dedicate this work to my father Khaled and to my beloved mother Muna for her nonstop and unconditional support and encouragement throughout the completion of my academic journey.

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This thesis is especially dedicated to Dr. Akram Amro who encouraged and helped me stay motivated throughout the completion of my thesis. Thanks to the Al-Quds University family, and lecturers for always inspiring me to excel and grow as a researcher.

## Declaration

This thesis is submitted in partial fulfillment of the requirement for the Master's degree in Physiotherapy.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other University or institution.

Name: Athar Khalid  Daher Abufara

Signed …Athar Abufara.

Date 18/8/2021

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## Abstract

**Background**: COVID-19 is a highly contagious coronavirus that spread via large aerosol droplets or direct contact with infected secretion, as the novel virus enters the body it will leave dysfunctions in the whole body systems. The main cause of its increased mortality rate is pneumonia that rapidly progresses to acute respiratory distress. Physiotherapy is a health care profession involved in the management of many respiratory conditions; it plays a key role in the non-invasive support management, postural changes, chest physiotherapy, and bed mobility, in terms of COVID-19 there is scarce evidence about the effect of physiotherapy interventions on COVID-19 patients'. **The aim of this study is to investigate the effects of physiotherapy intervention on functional outcome level among COVID -19 patients in the acute stage.**

**Methods:** This study is Quasi-experimental designs/ non-equivalent groups, targeted severe COVID-19 patients recruited from Hebron and Dura governmental hospitals of COVID- 19 departments by using Systematic random sampling, 54 male and 6 female, the mean age was 50 years. Intervention group (n=30) received 2 physiotherapy sessions/daily, consisting of positioning, chest physiotherapy, aerobic exercises, breathing exercises, and early mobility, while the control group received regular medical care only. Patients have been evaluated 2 times at the baseline and discharge using peripheral oxygen saturation, respiratory rate test, dyspnea rate, 2 minutes - walk test, and spirometer scores to test (FVC, FEV1).

**Results:** The two groups showed significant improvements between the baseline and the discharge scores, however the intervention group achieved significant improvement in all outcome measures at the discharge ($p < 0.05$). Furthermore the gender, pre-exciting diseases, and increased BMI are general risk factors of the COVID- 19 severity, length of hospitalization.

**Conclusion:** This study shows that physiotherapy management with COVID- 19 patients improved the oxygen saturation, respiratory rate, dyspnea, 2 - minutes – walk, and lung function tests (FVC, FEV1).

**Key words**: Physiotherapy, COVID-19, Coronavirus, Severe Acute Respiratory Syndrome.

**تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كورونا في المستشفيات الحكومية في مدينة الخليل/ فلسطين**

**الاسم: أثير خالد ظاهر أبو فارة**

**إشراف: د. اكرم عمرو**

**الملخص**

هو بحث هدفه دراسة تأثير تدخل العلاج الطبيعي على مستوى الاداء الوظيفي لمرض كورنا من خلال المقارنة بين مستشفى الخليل الحكومي حيث يتلقى المرضى العلاج الطبيعي ومقارنته بمرضى مستشفى دورا الحكومي حيث لا يوجد خدمة علاج طبيعي.

التدخل العلاجي يقوم به اخصائي العلاج الطبيعي بهدف تحسين المستوى الوظيفي والتنفسي عند المرضى من خلال بعض الوضعيات الخاصة التي تساعد على التخلص من البلغم وزيادة مستوى الأكسجين في الدم، بالإضافة لذلك يقوم الأخصائي بعمل ضربات متوسطة القوة بيده على منطقة الصدر والظهر كي يساعد المريض على تحفيز الكحة المصحوبة بالبلغم واخراجه عن طريق الفم، ومن ثم يقوم الاخصائي بإعطاء تعليمات للمريض لعمل تمارين خاصة لتحريك الأطراف العلوية والسفلية كل مريض حسب قدرته، وسيكون المؤشر على استمرار التمرين او ايقافه هو معدل نبضات القلب بحيث لا يزيد عن 130 ضربة في الدقيقة.

**المقدمة:** كوفيد 19 هو فيروس كورونا شديد العدوى ينتشر عبر قطرات كبيرة من الهباء الجوي أو الاتصال المباشر بإفرازات مصاب بالعدوى، حيث يدخل الفيروس الجديد إلى الجسم ويترك اختلالات في أجهزة الجسم بالكامل. والسبب الرئيسي لزيادة معدل الوفيات للمصابين هو الالتهاب الرئوي الذي يتطور بسرعة إلى ضائقة تنفسية حادة.

العلاج الطبيعي هو مهنة رعاية صحية تشارك في علاج العديد من أمراض الجهاز التنفسي؛ حيث يلعب العلاج الطبيعي دورًا رئيسيًا في مساعدة المرضى على التنفس بشكل افضل، واتخاذ وضعيات مريحة تساهم في التخلص من البلغم وزيادة معدل الاكسجين في الدم، والمحافظة عل صحة العضلات والمفاصل من

خلال الحركة والتمارين، بالإشارة الى كوفيد 19 على وجه التحديد، هناك دراسات نادرة حول تأثير تدخل العلاج الطبيعي على هؤلاء المرضى.

**هدف الدراسة:** دراسة تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي بين مرضى كوفيد -19 في المرحلة الحادة.

**المنهج المتبع للدراسة:** هذه الدراسة هي دراسة تجريبية، حيث تم دراسة 60 مريض ومريضة مصابين بفيروس كوفيد 19 شديد ( ذكور=22، اناث=8) في كل مجموعة ، متوسط العمر للمجموعة التجريبية 51 عام، بينما المجموعة الضابطة حوالي 50 عام تم تقسيمهم لمجموعتين اعتماداً على الموقع : المجموعة الاولى هي المجموعة التجريبية في مستشفى الخليل الحكومي ( 30 مريض) ، والمجموعة الثانية هي مجموعة الضابطة (30 مريض) في مستشفى دورا الحكومي. جميع المرضى في المجموعة الاولى خضعو للعلاج الطبيعي مرتين يوميا لمدة 40-50 دقيقة، على مدار 7 ايام اسبوعيا. بينما المجموعة الضابطة خضعت للعلاج الطبي فقط ولا يوجد أي تدخل للعلاج الطبيعي او ما يشبهه.

خضعت جميع العينة للاختيارات القبلية والبعدية لمستوى الاكسجين في الدم، معدل ضيق التنفس، اختبار المشي خلال دقيقتين، واختبارات وظيفة الرئة.

**نتائج الدراسة:** بعد انتهاء العلاج و خروج المرضى من المستشفى، اظهرت النتائج تحسن معنوي في كلا المجموعتين بين نتائج الاختبار القبلي والبعدي (P<.05). وكما اظهرت النتائج بان هناك تحسن معنوي لصالح المجموعة التجريبية في نتائج الاختبار البعدي في جميع المقاييس الاختبار(P<.05) بما فيها اختبارات الرئة FVC & FEV1. كما وان الجنس والامراض المصاحبة ومعدل كتلة الجسم كان ارتباط سلبي معنوي مع شدة المرض و مدة الاقامة في المستشفى.

**الاستنتاج:** ان العلاج الطبيعي هو علاج فعال مع مرضى كوفيد19،حيث انه يحسن مستوى الأكسجين في الدم، ويحسن قصر النفس، ويقلل من معدل التنفس في الدقيقة الواحدة ، ويزيد عدد المترات التي يستطيع المريض ان يمشيها في دقيقتين كما وانه يحسن اختبارات الرئة.

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## List of abbreviations.

2MWT: 2 Minutes -Walk Test.

ACE2: Aangiotensin Converting Enzyme 2.

ARDS: Acute Respiratory Distress.

BIPAP: Bilevel Positive Airway Pressure.

COVID: Corona Virus Disease.

CPAP: Continuous Positive Airway Pressure.

FiO2: Fraction of Inhaled Oxygen.

HFNO : High Flow Nasal Oxygen.

ICU: Intensive Care Unit.

IV: Invasive Mechanical ventilation.

LOS: Length of Stay in hospitals.

NIV: Non-Invasive Mechanical ventilation.

PPE: Personal Protective Equipment.

SARS-CoV: Severe Acute Respiratory Syndrome Coronavirus.

SpO2: Oxygen Saturation.

WHO: World Health Organization.

# Chapter one

1.1 Introduction statement
1.2 Problem Statement
1.3 Study Hypothesis
1.4 Study objectives
1.5 Study Rational
1.6 Terminology

## 1.1 Introduction Statement

The recent international pandemic of COVID-19 has brought the worldwide to standstill, causing morbidity, death, and alteration in the personal roles. Globally, by 15 July 2021, confirmed cases of COVID-19 is 187M, including 4.04M, were reported to WHO. Palestine is also experiencing a spike of COVID-19 Cases, confirmed number from the start of pandemic till 18 December 2020were 119,612and total Deaths were 1,097victims. More than a third has been in Hebron governorate (WHO Statistics, COVID-19 Worldwide Dashboard - WHO Live World Statistics).

COVID -19 is  SARS-COV-2, is a highly contagious coronavirus belongs to the b-corona cluster that spread via droplets (Sun et al. 2020). The spectrum of disease severity ranges from asymptomatic infection or mild upper respiratory tract illness to severe viral pneumonia with respiratory failure and/or death. Current reports estimate that 80% of cases are asymptomatic or mild; 15% of cases are severe (infection requiring oxygen), and 5% are critical require ventilation and life support (WHO, situation report 46, 2020).

The major cause of death among COVID patients is a respiratory failure. Patient needs a mechanical ventilator and/or any technique to improve respiratory function, one of the major techniques physiotherapists used to apply is "chest physiotherapy". Chest physiotherapy (CPT) is a broad term by which therapist use group of techniques that address the removal of secretion to improve airway clearance, decrease work of breathing, promote the expansion of the lungs, help improving respiratory efficiency, and prevent the lungs from collapse(Chaves et al. 2019). In addition, respiratory problems will challenge functionality(McHugh et al. 1994) and daily living activities among COVID patients, so the aim of this study to investigate the effect of physiotherapy management on functional outcomes among inpatient COVID-19.

## 1.2 Problem statement

Physiotherapy has been used in many different respiratory conditions such as cystic fibrosis, Asthma, and COPD, it has been proved that chest physiotherapy can improve gas exchange, reverse pathological progression, reduce the need for artificial ventilation, and increase the level of patient's function (Wilson, Morrison, and Robinson 2019)(Tang, Taylor, and Blackstock 2010). The evidence on the effectiveness of Physiotherapy intervention on respiratory and functional outcomes of COVID-19 patients is still lacking, especially during the acute stage at Palestine. Therefore, investigating the effect of physiotherapy intervention on COVID-19 patient's outcomes may help in highlighting its importance in preventing further complications and promoting better both respiratory and functional outcomes.

## 1.3 Study Hypothesis

- Physiotherapy intervention significantly improves respiratory and functional outcomes among COVID-19 patients.
- Prevalence of comorbidities negatively affect both functional and respiratory outcomes among COVID-19 patients.
- Patients with specific personal characteristics (older age, smoker, over-weight) negatively affect respiratory and functional comes among COVID-19 patients.

## 1.4 Study Objectives

The main objectives of this study are:

- To investigate the effect of physiotherapy intervention on functional outcome among COVID -19 patients in the acute stage.
- To investigate the effect of physiotherapy intervention on respiratory outcomes among COVID -19 patients in the acute stage.
- To investigate the effect of personal and co-morbidities factors on both respiratory and functional outcomes among COVID-19 patients.

## 1.5 Study Rationale

The results of this study will be beneficial for different communities and individuals such as, decision makers in the Palestinian ministry of health to adopt the physiotherapy as a vital part of the integral management of COVID-19 patients. In addition, physiotherapists themselves will benefit from the results of this research; as it may contribute to the evidence based protocol that explored PT work with COVID-19 patients , especially at acute stages . Also, the study results will hopefully add a new suggestion to the COVID-19 international literature.

## 1.6 Terminology

- Acute respiratory distress (ARDS): is a syndrome manifested by acute onset of tachypna, hypoxemia, and loss of compliance after a variety of stimuli; the syndrome did not respond to usual and ordinary methods of respiratory therapy(Ashbaugh et al. 1967).

- Invasive Mechanical ventilation (IV): is an intervention to save lives for patients have respiratory failure. The commonly used modes of mechanical ventilation are synchronized intermittent mandatory ventilation, assist-control, and pressure support ventilation(Singer and Corbridge 2009).

- Non-Invasive Mechanical ventilation (NIV): is the delivery of oxygen (ventilation support) through a face mask to eliminate the need of an endotracheal airway. NIV achieves comparative physiological benefits to conventional mechanical ventilation by decreasing breathing work and improving gas exchange(Vitacca et al. 2001).

# Chapter Two

2.1 Review of literature

2.2 Similar Studies

# Review and related literatures

## 2.1 Theoretical Framework

COVID-19 has sounded alarm bells worldwide, which imposed the nations and societies to set international guidelines, recommendations, and protocols to assist medical team in evaluating and treating different conditions of COVID-19, as physiotherapy plays a fundamental role in multidisciplinary care, working in order to identify, elaborate and develop kinetic-functional diagnosis in cardiopulmonary disorders caused by viral infection, it had a many of protocols to follow in COVID-19 management (Vitacca, Carone, et al. 2020).

### 2.1.1 Epidemiology of COVID-19:

In December 31, 2019, many hospitals reported a cluster of unexplained pneumonia in Wuhan, China attracting worldwide concern (C. Wang et al. 2020). On the first of January,2020, the public health authorities of Wuhan decided closing Seafood Wholesale Market, where live and wild animals were sold, as they suspected that there is a link between the seafood market and the outbreak of the new virus. On 12 January 2020, the World Health Organization (WHO) called the new virus as the 2019 novel coronavirus (2019 nCoV). Then, on 11 February 2020, WHO officially named it as coronavirus disease (COVID-19) to be a Public Health Emergency of International Concern (PHEIC) and declared it as international epidemic after 24, 2020, 80,239 confirmed cases of COVID- 19 worldwide (Zhu et al. 2020).

The COVID-19 pandemic in Palestine was spread to the West Bank on March 5, 2020, the first case was detected at a hotel in the Bethlehem area, where a group of Greek tourists had COVID-19, visited the hotel in late February. Nowadays West Bank and Gaza Strip are spiking in the global new pandemic

SARS-CoV-2 is a coronavirus and belongs to the β-coronavirus cluster. COVID-19 is the third known zoonotic coronavirus disease after SARS and the Middle East respiratory syndrome (MERS). SARS-CoV and MERS-CoV also belong to the β-coronavirus cluster (Zhu et al. 2020). It was confirmed that the transmission of COVID virus started from bats to the human body, it also proved that SARS-CoV2 was a new coronavirus closely related to the bat SARS-CoV (Chan et al. 2020)(Hui et al. 2020). Moreover, Wu et al(2020), Zhou et al (2020) found in their studies that there is 79.5% sequence homology between SARS-CoV and SARS-CoV-2; also, they discovered that the bat corona viruses had high homology withSARS-CoV2 (F. Wu et al. 2020) (Zhou et al. 2020).

### 2.1.2 Mechanism of COVID19 Transmission:

Direct contact with infected secretion or large aerosol droplets are the two ways of COV2 human to human transmission (Jangra and Saxena 2020), when the infection is already transmitted to the human, ACE2 (Aangiotensin Converting Enzyme 2) is the receptor for the SARSCoV-2 which is located in the normal human lung.

When SARSCoV2 fastens on its receptor (ACE2), it will cause an elevated expression of ACE2, then it will start damaging the alveolar cells. The alveolar cells function under normal circumstances is to synthesize and secrete surfactant, carry out xenobiotic metabolism, help with transepithelial movement of water, and regenerate alveolar epithelium following lung injury (Abdullahi 2020), so any damage to the alveolar cells will cause respiratory challenges, sequentially, trigger a progression of systemic reactions and even death (Wrapp et al. 2020).

In general, Asians showed a higher amount of ACE2 expression in the alveolar cells than the African and white American, also the alveolar cells of men contains a higher ACE2 level than women(Zhao et al. 2020).

### 2.1.3 Prevention:

Hand washing is the core of viral infection control. Also contact isolation gear like, masks, gowns, and gloves are also recommended. COVID-19 could transmit via ocular surface so eye protection should also be used when dealing with COVID-19 patients(N. Chen et al. 2020).

### 2.1.4 COVID-19 manifestations & complications:

Symptoms of COVID-19 seem to be respiratory distress in the first, So far, the most common early symptoms of this disease are believed to be **Pyrexia** 55.7%**, Cough** 48.8%, **Headache** 31.5%, and **Dyspnea** 30.5%, **upper respiratory tract infection** 3% according to Sarker et al(2020) (Sarker et al. 2020) Twitter survey. However, recently, evidence is arising on the effect of COVID-19 on different human systems, such as, the nervous, cardiac, and musculoskeletal systems (Iadecola, Anrather, and Kamel 2020)(Babapoor-Farrokhran et al. 2020)(Franceschi et al. 2020).

The cause of respiratory complications were clear as the virus is a respiratory pathogen in its nature attacks the alveoli and damage them, but the causes of neurological and musculoskeletal symptoms that accompany COVID-19 could be secondary to respiratory distress or secondary to immune system war.

First of all, the virus has an access to enter these systems easily, for example, the virus can get into the central nervous system through the bloodstream, then infect endothelial cells and leukocytes, or via retrograde neuronal routes by infecting the peripheral nerves (Baig 2020) (Iadecola et al. 2020).

Secondly, the virus can cause **lung fibrosis due to pneumonia**, that may result in systemic hypoxia, which could damage **the brain and other nerve cells** (Koralnik and Tyler 2020). The processes through which the damage occurs include peripheral vasodilatation, hypercarbia, hypoxia, and anaerobic metabolism, which will result in **neuronal swelling and brain edema** (Baig 2020). Moreover, neural swelling and brain edema can raise intracranial pressure

and result in impaired **consciousness** and **seizure** that estimated 29.3% of total reported symptoms of The international European Academy of Neurology survey(Moro et al. 2020). or can irritate the trigeminal nerve and cause **headache** (Paliwal et al. 2020).

In addition, cytokine storms (CSS, the immune system response toward a pathogen, they are a group of proteins made by the immune system, the immune cells use cytokines to communicate, they acting as chemical messengers, Cytokines released from one cell affect the actions of other cells by binding to receptors on their surface) (Iadecola et al. 2020) cytokine storms will increased levels of inflammatory cytokines that characterized by hyper inflammation due to rapid accumulation of T-cells and macrophages, and endothelial cells, resulting in the release of massive levels of cytokines into the bloodstream to eliminate the offending pathogen, that could also cause **neural damage** (Koralnik and Tyler 2020)**.**

In some cases of severe COVID-19, the patients develop cytokine storms with an interleukin-6 release that could cause vascular leakage and activation of complement and coagulation cascades (Koralnik and Tyler 2020). Therefore, it was noted that severe COVID-19 patients having elevated D-dimer test result, which is a marker of a hypercoagulable state and endogenous fibrinolysis, despite the use of anticoagulation/antiplatelet treatment (Katz et al. 2020) (Franceschi et al. 2020). These factors are believed to be the major risk of developing **Cerebrovascular Accident** (CVA), **Myocardial Infarction** (MI), and **pulmonary embolism** in patients with COVID-19.

The high level of serum interleukin-6 during cytokine storms, in addition to increased lactate levels, low pH, and low oxygen levels form the main causes of **Myalgia** which defies as muscle aches and pain, which can involve ligaments, tendons, and fascia, the soft tissues that connect muscles, bones, and organs, consisted 50.4% of total reported symptoms according to international European Academy of Neurology survey (Moro et al. 2020). The cytokine storm could also be the main cause of the **Arthralgia** 2%, and **dizziness/ balance disturbance** 15%, **anosmia** (change in taste), 49.2%, **Ageusia** (change in smell) 39.8% according to the survey of Moro et al (2020) (Moro et al. 2020). long period of bed ridden also can cause **muscle weakness**, **shoulder, cervical,** and **back pain** (Abdullahi et al. 2020).

The effect of cytokine storm combined by interleukin-6 release affect not only the central nervous system but also the cranial nerves and the peripheral nerve system, Many patients with COVID-19 have developed **cranial nerve neuropathy**, such as **facial nerve palsy** and **vertebrobasilar vasculitis**, in other cases some patients had **diplopia**(double vision) (Iadecola et al. 2020), the patient has cranial neuropathy usually had lung involvement due to COVID-19 infection (Koralnik and Tyler 2020).

COVID-19 also could leave the patients with **Gillian bare syndrome** (GBS), which is an immune-mediated disease and molecular mimicry, this could be caused by the stimulation of inflammatory cells and the production of storm inflammatory cytokines (Sedaghat and Karimi 2020) (Paliwal et al. 2020).

By return to the Cardiovascular complications, **heart arrhythmia** seems to be the most common feature constitutes 19% of hospitalized patients (Kochi et al. 2020), arrhythmia occurs when the electrical impulses that coordinate heartbeats don't work properly, causing the heart to beat too fast **Tachyarrhythmia**, or too slow **Bradyarrhythmia** or irregularly, arrhythmias in general had a historical connection with viral infections causing viral **myocarditis** (Babapoor-Farrokhran et al. 2020).

Arrhythmias also could be caused by hypoxemia, metabolic abnormalities, inflammatory syndrome, comorbidities, and medications as opposed to direct viral effects on the heart such as Hydroxychloroquine**,** Azithromycin, lopiavir, Remidvisir (Barkas et al. 2021) (Babapoor-Farrokhran et al. 2020)(Kang et al. 2020).

**Sinus bradycardia** it is a type of slow heartbeat which is the most common arrhythmias seen in COVID-19 patients estimated about 14.9%, and it can be persistent for up to 2 weeks (Kochi et al. 2020), Sinus bradycardia usually caused by impaired work of group of cells that begins the signal to start the human heartbeat, these cells are located in the sinoatrial (SA) node. Normally, the SA node fires the signal at about 60 to 100 times per minute at rest (Barkas et al. 2021)., however, in sinus bradycardia, the node fires less than 60 times per minute.

The other COVID-19 complication on the cardiac muscle could be **heart Failure** & **cardiomyopathies** (as evidenced by elevated levels of cardiac biomarkers such as cardiac troponin or electrocardiogram abnormalities), the development of heart failure in patients infected with severe acute respiratory syndrome coronavirus- 2 has been described to involve 2 different, and overlapping, mechanisms, the first is cytokine release resulting in myocardial inflammation, while the other is purported to be a direct viral infection causing myocarditis (Walsh et al. 2020).

Compared to the other respiratory viruses, COVID-19 infection had a longer disease course and duration, so a long duration of olfactory and taste abnormalities were observed, about 70% of the patients had taste problems after 1 month (Chi et al. 2020), however, the severity of olfactory abnormality improved rapidly after the first 10 days. The suggested mechanism of COVID19 causing altered taste and smell is its ability to bind to angiotensinconvertingenzyme-2 receptor (ACE2), which is readily expressed on multiple organ systems, including the surface of the tongue, oral cavity, nose, and lungs (Xu et al. 2020).

The estimated proportion of severe cases and case-fatality rate (CFR) was ( 25.6%). 80% of death cases for adult are ≥65 years old and have comorbidities (Fu et al. 2020). These findings are similar to data from USA that indicated 80% of deaths occurred among adults aged ≥65 years with the highest percentage of severe outcomes among people aged ≥85 years ( USA Report 2020). Approximately 52.4 million U.S. persons aged ≥65 years (Living 2019) who are at risk for severe COVID-19–associated illness so the fatality rate in this age is expected.

### 2.1.5 COVID-19 Severity definitions according to WHO:

• "Critical COVID-19: Defined by the criteria for acute respiratory distress syndrome (ARDS), sepsis, septic shock, or other conditions that would normally require the provision of life

sustaining therapies such as mechanical ventilation (invasive or non-invasive) or vasopressor therapy.

• Severe COVID-19: Defined by any of:

- ✓ Oxygen saturation < 90% on room air.
- ✓ Respiratory rate > 30 breaths/min in adults and children > 5 years old; ≥ 60
- ✓ breaths/min in children < 2 months old; ≥ 50 in children 2–11 months old; and ≥ 40 in
- ✓ children 1–5 years old.
- ✓ Signs of severe respiratory distress (accessory muscle use, inability to complete full sentences, and, in children, very severe chest wall indrawing, grunting, central cyanosis, or presence of any other general danger signs).

- Non-severe COVID-19: Defined as absence of any criteria for severe or critical COVID-19."

(Diaz, Janet; Appiah, John; Askie, Lisa; Baller, April; Banerjee, Anshu; Barkley, Shannon; Bertagnolio, Silvia; Hemmingsen, Bianca; Bonet, Mercedes; Cunningham 2021)

### 2.1.6 COVID-19 Medical Management:

Table 2.1 showed comparison between the treatment of COVID-19 inside Palestinian hospital and guidelines for coronavirus disease from WHO, the USA, Europe:

World Health Organization guidelines are general, recommending management of symptoms only. When treating COVID-19 patients should provide special caution to pediatrics patients, pregnant women and patients with underlying co-morbidities. **No approved treatment for COVID-19,** only providing supportive management according to the patient's needs (e.g. antipyretics for fever, Oxygen therapy for respiratory distress, etc).

**Table 2.1 Medical COVID-19 treatment at different countries:**

| | USA | Europe (Ireland) | Egypt | Palestine |
|---|---|---|---|---|
| Mild-moderate | • Remdesivir | • Chloroquine (oral)<br>• Lopinavir/ritonavir (oral)<br>• Hydroxychloroquine (oral)<br>• Remdesivir (intravenous)<br>Ireland ministry of health | • Oseltamivir<br>• Hydroxychloroquine<br>• Chloroquine phosphate | • Azithromycin.<br>• Paracetamol.<br>• Baby Aspirin.<br>• Vitamin C.<br>• Muli- vitamins. |
| Sever | • Remdesivir<br>• Hydroxychloroquine<br>• Chloroquine<br>• Lopinavir/ritonavir<br>• Darunavir/cobicistat | | • Oseltamivir<br>• Hydroxychloroquine<br>• Chloroquine phosphate<br>• Lopinavir/ritonavir<br>• Serum ferritin, D-dimer | • Azithromycin.<br>• Paracetamol.<br>• Baby Aspirin.<br>• Vitamin C.<br>• Muli- vitamins.<br>• Hydroxychloroquine. |
| Critical | interferon-b B1 (Betaseron)(Criteria 2020) | | • Antibiotics<br>• Oseltamivir<br>• Hydroxychloroquine (or<br>• chloroquine phosphate)<br>• Azithromycin<br>• Hydrocortisone<br>• Therapeutic<br>• anticoagulants if D-Dimerhigh<br>Egypt Ministry of Health and Population.<br>/ | • Azithromycin<br>• Paracetamol<br>• Baby Aspirin<br>• Vitamin C<br>• Muli- vitamins<br>• HydrocortisoneTherapeutic.<br>• Anticoagulants if D-Dimer high.<br>Palestinian Ministry of Health |

**Corticosteroids** were the most commonly used medication in COVID-19 management (Uttamani et al. 2020), however they aren't recommended by WHO or US Centers for Disease Control and Prevention (CDC) to be used routinely for pneumonia and acute respiratory distress, but they indicated in some cases such as, asthma, COPD, or septic shock, as it improved the mortality rate and outcomes(Ye et al. 2020).Monitoring the drug dosage is very important to prevent the adverse effects of these drugs such as, hyperglycaemia, hypernatraemia and hypokalaemia(C. Chen et al. 2020)(Russell, Millar, and Baillie 2020).

The seconded most reported medication was **Lopinavir/ritonavir (Kaletra)** which used to treat HIV(Baron et al. 2020), studies from china about its effect was used the dosage 400 mg/ twice daily for up to 14 days didn't show remarkable efficiency(Yao et al. 2020)(Lim et al. 2020)(Jun et al. 2020).

The third most reported drug was **Oseltamivir (Tamiflu)**usually used to treat influenza A and B based as the WHO recommended, observational study about its effect with COVID-19 didn't show solid results(Welliver et al. 2001)(Sheahan et al. 2020).

Finally, **Chloroquine phosphate** and **hydroxychloroquine** (anti- malaria drugs, with or without Azithromycin) these drugs showed a favorable results when used in treatment of COVID-19,they changes the pH of endosomes to prevent viral entry, transport, and post-entry events( reduce glycosylation of ACE2), hence, preventing COVID-19 from binding to the host cells(Patel et al. 2020)(Wright, Ross, and Mc Goldrick 2020)(Galvis et al. 2020).

### 2.1.7 Oxygen supplements

According to the Italian Association of Respiratory Physiotherapists (ARIR) which concentrated more on the oxygen therapy and its indications, it layout ten recommendations and advices for best respiratory physiotherapist practice that includes many situations (Lazzeri et al. 2020). For example, in case of non- invasive ventilator support (NIV) oxygen therapy that delivered by nasal cannulas are not recommended as they could cause a higher dispersion of droplets than other systems, instead they can use facemask with an oxygen flow up to 5 L/min, or reservoir mask up to 10 L/min of O2 or a Venturi mask up to 60% of FiO2 (Lazzeri et al. 2020).

In case a respiratory therapist forced to use High Flow Nasal Oxygen (HFNO) as it may reduce the need for invasive ventilation and escalation, the nasal cannulas must be well- placed inside the nostril (Agarwal et al. 2020) and the patient should wear a surgical mask that should be changed every 6-8 hours.

Moreover, For patients who adopt an open-mouth breathing pattern, non-vented mask with T-tube can be used to improve saturation (Leung et al. 2019) (Hui et al. 2019), if the patient saturation got worse (<85, even using source of oxygen), the health care team have to decide using a type of Non-Invasive Ventilation such as Continuous Positive Airway Pressure(CPAP), or Bilevel Positive Airway Pressure (BIPAP) a (total face or helmet, or nasal mask). However, CPAP have achieved excellence over BIPAP in treating COVID-19 hypoxemia (Pagano et al. 2020).

When using CPAP/NIV, it is very important to consider the potential environmental dispersion of the virus, the helmet is the safest interface, which is relatively closed to the environment in comparison with a mask. the helmet acts as a reservoir; it has antiviral filters to the expiratory port to decrease the droplets transmission (Yang et al. 2020).

Other studies discussed the using of two sources of oxygen in patient who has elevated blood carbon dioxide level, they suggested to use combination of nasal cannulas plus non-breathing mask (reservoir), as it was proven that the non-breathing mask not only provide oxygen, it also get rid of carbon dioxide (Righetti et al. 2020) ( Philippe ,et al. 2020).

### 2.1.8 Chest Physiotherapy for mechanically ventilated COVID-19 Patients:

Chest physiotherapy which includes postural drainage, percussion, vibration, , and brochial clearance, used to be the main intervention in many respiratory diseases such as, COPD and Cystic fibrosis in order to remove secretions that affect the whole lung's function. While, in case of COVID-19, the short term goal of chest physiotherapy is to improve dyspnea, relieve anxiety and depression, and the long-term is to regain the maximum extent of patient's function and improve his/her quality of life (L.-L. Yang and Yang 2020).

COVID-19 characterized by dry cough because of infected endothelial cells more than epithelial cells, In such patients Acute respiratory distress syndrome (ARDS) begins a bit later than in

other ARDS, often between 8 and 12 days after infection (N. Chen et al. 2020) (Guan and Zhong 2020) (J. Wu et al. 2020), so they suffer from dyspnea and cough (Li and Ma 2020), consequently mild to moderate symptoms usually resolves without chest physiotherapy, however, severe and critical cases need chest physiotherapy while they are mechanically ventilated.

### 2.1.9 Early mobile/ Aerobic Exercises for COVID-19 Patients:

Patients who are immobilized for more than 3 days, will start developing neuromuscular weakness regardless of receiving full supportive medical care (Page and Gough 2010), in addition, using mechanical ventilation for longer than 7 days, will increase the incidence of ICU acquired (neuromuscular) syndrome, it constitutes around 50% of all ICU admissions. (Page and Gough 2017), patient weakness usually contribute to increased mechanical ventilation duration, increased hospital length of stay, and poor functional outcomes among survivors, so early patient's mobile is critical in these conditions.

Traditional physiotherapy intervention aids COVID-19 patients who are functionally limited, or patients who are at risk of functional decline. Physiotherapist can do, passive, active assisted , active exercise, or walking based on the patient's situation, and his/her ability to engage in the treatment (Fila et al. 2021) (Vitacca, Carone, et al. 2020). By contrast, many hospitals used the electrical muscle stimulation to maintain the muscle function, as well as they using electronic cycle ergometer (López-López et al. 2019)

### 2.1.10 Physiotherapy and Safety Procedures:

Thomas et al (2020) are strongly emphasis on airborne precautions adherence during respiratory physiotherapy interventions (Thomas et al. 2020), also these recommendations were strongly approved by the Europe and Brazilian guidelines. In addition, those guidelines aroused the need

for negative room pressure in performing aerosol-generating procedures (Alhazzani et al. 2020) (Righetti et al. 2020).

COVID-19 is very infectious disease, so physiotherapists must commit to the protection protocols and infection control, it is very important to make a mark on the physiotherapists equipment of COVID-19 departments, in order not to move the equipment between the infectious and non-infectious departments of the hospital and avoid sharing equipment (Righetti et al. 2020).

Physiotherapists who have to work with COVID-19 will require specialized knowledge, skills and decision making to work within the ICU. Moreover, the intervention of physiotherapy shouldn't be for all patients, it should be provided where there is indication that can be identify by regular meeting with the medical staff, so that physiotherapist's exposure to patients with COVID-19 will be minimized (Simonelli et al. 2020) (Shamsi, Mugheeb, and Khan n.d.).

## 2.2 Similar studies

COVID-19 is highly infectious disease that spreads rapidly, so health care professionals argued that chest physiotherapy should be forbidden for such patients, as it may cause aerosolization (Cooke and Shapiro 2003), but this idea was disapproved by the findings of Simonds et al (2010) (Simonds et al. 2010) as they concluded that the chest physiotherapy usually produced droplets of >10μm, this size of droplets are not respirable, the range of respirable droplets (about 5μm) that can transmit the infection (Brankston et al. 2007).

Physiotherapy had been approved as effective treatment for improving long-term physical function among ICU survivors (Weatherald et al. 2020) However, the significant benefit of chest physiotherapy among ICU patients remains debatable, particularly in those patients with already developed alveolar destruction (Vitacca, Lazzeri, et al. 2020), (Thomas et al. 2020). The ARIR (the Italian Association of Respiratory Physiotherapists) recently published a position paper

concerning the role of chest physiotherapy in COVID-19 patients, suggesting forbidden some physiotherapy procedures (as diaphragmatic breathing, bronchial hygiene, manual mobilization, lung re-expansion techniques , respiratory muscle training, nasal washing, and exercise training in the critical phase of the illness, till the medical stability achieved (Lazzeri et al. 2020). This was contradicting by Abdullahi et al, (2020) in a critical review that summarized chest physiotherapy role in each phase of COVID19, even it could be effective during mechanical ventilation, as it decrease the incidence of lunge collapse or ventilator-associated pneumonia, researchers argued that the chest physiotherapy is very important method in intubated patients, as it decreases the risk of mortality, since chest physiotherapy could prevent the pathological progression, lung atelectasis, through improvement of the gas exchange (Abdullahi 2020).

Victoria A. Goodwin, (2021), in their systematic review that included another 24 systematic reviews, 11 RCTs and 8 qualitative studies of severe respiratory disease patients at ICU, to evaluate the effect of progressive exercise program and early mobilization brought at ICU for these patients, they aimed to generalize these articles results on dealing with COVID- 19 patients at ICU, and concluded finally that physiotherapy intervention at ICU within severe COVID-19 patients may improve the patients' recovery (Goodwin et al. 2021).

Most international guidelines of COVID-19 management support the idea that prone position for at least 12-16 hours per day for mechanically ventilated patients is the best position for ventilation (Spruit et al. 2020) (da Silva e Silva et al. 2020) (Vitacca, Carone, et al. 2020) (Dean et al. 2020) (Righetti et al. 2020), this position may improve lung mechanics and gas exchange, thus increasing oxygenation in most patients with ARDS (Retucci et al. 2020).

In the quick review of Weatherald et al(2020) (Weatherald et al. 2020), they contradicted with the findings of Retucci(2020) in that the prone position for awake, non-intubated patients, may not improve the O2 saturation of the patients, and could increase their low back pain (not tolerable position), the review sample were pregnant women, discopathy patients, or people who don’t tolerated the prone position, these type of sample cannot adhere to the prone position,

because it may be very tiring position for them, on the other hand, the review used 35 studies (12 prospective cohorts, 18 retrospective cohorts, and 5 case reports) a total of 414 patients who had hypoxemic respiratory distress), these types of studies usually had some shortages in some missing information that may be important for clinicians. So , this study results does not affect the idea of prone position !

Abdullahi (2020) concluded that the prone ventilation is the most effective position to improve hypoxia associated with COVID-19 (Abdullahi 2020). This result was confirmed also by Davide Bastoni (2020), who conducted a study on 10 selected patient 8 male, 2 female who didn't response to the traditional intervention, approved that prone position combined with CPAP at least 1 hour daily can improve the oxygen saturation in severe COVID -19 patients, which in turn may improve the physical outcomes (Bastoni et al. 2020).

Prud'homme (2021), noted a dramatic improvement in oxygen saturation after one hour of prone awake non-intubated patients in surgical department, the program summarized by two treatments, 31 patients underwent prone position for more 3-12 hours daily, while the other group 37 don't have any instructions about their positions. However, the study had several limitations, such as, sample size, one episode of Prone Position was evaluated, no follow-up was assessed (Prud'homme et al. 2021).

Wakde et al. (2021) conducted a research on 5 moderate to severe Indian patients with DM type 2, and hypertension, one of the patients had obesity, mean age was 60 years old, the researchers used the same interventions in this research (pronging, positioning, chest PT, early ambulation, breathing exercises, and active or active assisted exercises), the researchers found significant improvements of the oxygen saturation compared with the baseline was achieved (Wakde et al. 2021).

In a case study done by Kachiple et al (2020) concentrated only on breathing exercises and spirometer training for a 52 years old patient who had Covid-19, with pre-existing hypertension, DM, and known as alcohol addicted, post six weak of treatment the patient got weaned from the oxygen, and O2 saturation changed from75 to 90 at the discharge point, one of the possible reasons behind the difference in LOS in their study, may be explained by the fact that in Kachpile et al. study they did not use the Early mobility as part of the intervention (Kachpile et al. 2020).

Kader et.al (2021) have used quasi-experimental design, they recruited 110 COVID-19 hospitalized patients in acute stage, the age mean in the study was around (49 years), the control group received standardized medical care, while the intervention group received respiratory exercises program that included (breathing control, diaphragmatic breathing, thoracic breathing, huffing (forced expiratory technique), coughing active respiratory exercises, breathing control, and in some cases they used training Spirometer. They concluded significant improvements in oxygen saturation, respiratory rate, FVC, FEV1, and length of stay in the intervention group (Kader et al. 2021).

Javaherian et al (2021) in their single-blind RCT, in which 40 severe COVID-19 patients were randomized into pulmonary physiotherapy program group (n=20), or medical primary care group (n=20), the intervention group received six session of pulmonary rehabilitation that included, postural drainage, chest physiotherapy, deep diaphragmatic breathing exercise, active cycle of breathing. After the six sessions, both groups were evaluated in oxygen saturation, 3MWT, and mortality rate. Intervention group had significant improvement in 3 minutes- walk test p=.01 compared with the control group, in addition the author reported significant improvement in oxygen saturation, and mortality rate in favor of the intervention group P-value <.05 (Javaherian et al. 2021).

Kai Liu, et al (2020) conducted a randomized control trail on 72 older people (above 60 years) who have severe COVID-19 patients, to investigate the effect of 6 weeks of pulmonary rehabilitation on lung functional capacities (FVC, FEV1, FEV1/FVC%, DLCO%) 6MWT, quality of life as well as on depression and anxiety outcome measures, the intervention group

(n=38) underwent pulmonary rehabilitation which consists of respiratory muscle training, cough training, diaphragmatic training, home program, while the control group (n=34) has no program. Finally the intervention group have achieved a statistically significant results in all the above mentioned outcome measures contrast with the control group (Liu et al. 2020).

In Palestine territory physiotherapists followed the global guidelines in treating COVID-19 patients without examine the effectives of different physiotherapy interventions on our patients, there was no unified physiotherapy protocol in dealing with acute COVID-19 patients, so searching about the best intervention will be an ethical obligation to our patients.

# Chapter Three

## Methods and Materials

**3.1 Introduction**

**3.2 Research Settings**

**3.3 Sampling and Population**

**3.4 Methodology**

**3.5 Statistical Analysis**

**3.6 Ethical Consideration**

## 3.1 Introduction

This chapter aims at presenting the sampling method, sample size, inclusion and exclusion criteria, besides the methodology of the research represented in the design, tools of data collection procedure, intervention, and statistical analysis in addition to the ethical considerations of this research.

## 3.2 Research setting

This study was conducted at two Palestinian governmental hospitals in Hebron, Alia governmental hospital where physiotherapy is one of the therapeutic interventions for each COVID-19 patient protocol, and Dura governmental hospital where physiotherapy management isn't available.

Alia governmental hospital consists of 2 COVID-19 departments (ICU & surgical), ICU contains 6 bed while surgical consists of 30 beds.

Dura governmental hospital, located to the south of Hebron it's about 6000km$^2$, consists of 4 floors, 2 of them are working to serve hospitalized COVID-19 patients.

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## 3.3 Sampling and population

### 3.3.1 Sampling method

**the researcher used the Systematic sampling,** choose the 60 COVID-19 patients, from the pool of COVID patients coming to the 2 hospitals during the period of the study implementation, based on systematic sample of (K/k), which is a type of probability sampling by which the researcher chooses the sample member from a very large population according to the fixed, periodic interval.

**In this research,** the intervention sample was 30. Usually, Alia governmental hospital has 90 admissions every month, as the intervention period is 1 month and we recruited 30 patients for the experimental group, so 90/30=3. The skip interval was **3**. A random selection of the number to start with was taken through random selection in between 1-3, so the third admission of COVID-19 patient who meet the inclusion and exclusion criteria chosen. The same sampling method was used in the control group at Dura hospital (Sharma 2017)

### 3.3.2 Sample size

60 patients COVID19 was divided into 30 patients treated at Alia governmental hospital (experimental group) &30 patients treated at Dura governmental hospital (control group).

The researcher chose the 60 of COVID-19 patients as its a sufficient sample size to answer the researcher question and sufficient for the use of the intended statistical analysis.

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### 3.3.3 Inclusion criteria

Participants were included for this study if they were:

- Severe COVID-19 patients treated at Alia governmental hospital and Dura governmental hospital, male & female.
- Age 18-60.
- Had a medical referral for physiotherapy.
- Medically stable.

### 3.3.4 Exclusion criteria

- A patient who refused participation as the acceptance of being part of the study as this one of the main ethical issues.

- Ventilated patients, these patients will be under sedation, they can't interact with the therapist in subjective examination and treatment.
- Kidney failure as the mortality rate among these patients is high due to complications that could affect on the validity of the results.
- Cancer patients as the mortality rate among these patients are high due to complications that could affect on the validity of the results.
- COPD, Asthma, Cystic fibrosis patients, or any patients has any respiratory disease, because they have a specific consideration that differs from another patients who don't have respiratory diseases.

The subjects fulfilling the inclusion criteria were (n=60), they were assigned into two either group based on the location.

## 3.4 Methodology

### 3.4.1 Study design

This study adopted the **Quasi-experimental designs/ Nonequivalent groups design** which is an experimental study with a manipulation of an independent variable, but there is no random assignment of either intervention group or control group, This design more ethical than randomized control trail in such condition as physiotherapy is part of Alia governmental hospital treatment for COVID-19 patients, so deprived patients from this intervention considered unethical behavior, also this design is usually used in medical field to rapidly evaluate the association between the intervention and an outcome in outbreak condition as it less expensive and require fewer resources compared with randomized controlled trials, by contrast The greatest weakness of quasi-experimental studies is the absence of group randomization, will restrict the study's ability to conclude a causal association between an outcome and the intervention (BRUFFAERTS, R., MORTIER, Ph., KIEKENS, G., AUERBACH, R. P., CUIJPERS, P., DEMYTTENAERE, K., GREEN, J. G., NOCK, M. K., KESSLER 2017)

In this study groups divided into intervention or control group based on the **location**, as physiotherapy management is one of the selected interventions at Alia governmental hospital, while it is not available at Dura governmental hospital, COVID-19 patients at Alia hospital was the experimental group, while COVID-19 patients at Dura hospital was the control group.

### 3.4.2 Study tools

#### *3.4.2.1 Data collections sheet (Appendix 1).*

Data collection sheet that included the following:

- ✓ Personal data: Name, Age, Gender, Socioeconomic status, Education level.
- ✓ Previous comorbidities.
- ✓ Smoking history.
- ✓ BMI.
- ✓ Patient discharged on ventilation, O2 or not.
- ✓ Vital signs at assessment and re-assessment (specifically respiratory rate, the number of respirations in one minutes, will be taken from the monitor attached to the patient).
- ✓ Length of Stay: which is define as the length of stay at hospitals (LOS) usually used as an indicator of effectiveness of intervention. Less LOS means more effective treatment, less expensive cost (Schwarz and Vallance 1987).

#### *3.4.2.2 Pulse Oximeter(SPO2):*

Pulse Oximeter is a valid (Louw et al. 2001) and reliable (Muñoz et al. 2008)standard monitoring device, is a tiny device that usually inserts over the fingertip, or on the ear lobe, it uses infrared light refraction to measure oxygenation level in peripheral capillaries(SpO2) as well as measuring the pulse and respiratory rate (Bucher et al. 1989). The Pulse Oximeter used in the study was made with the directive MDD93/42/EEC for medical device and harmonized standards, and it is periodic validated.

#### *3.4.2.3 Electronic Spirometer (Appendix 2):*

The researcher assessed lung function through Spirometer (electronic handheld Spirometer, SP10 brand medical Spirometer, manufactured in China), according to the recommendations from the American Thoracic Society/European Respiratory Society (Graham et al. 2019).The variables assessed by Spirometer were forced vital capacity (FVC) and forced expiratory volume in 1 second (FVC1). The test was performed while the patient was in the sitting or supine position according to the patient status. The best result of three trails was captured (Overend et al. 2001)**.**

### 3.4.3 Outcome measures

#### *3.4.3.1 2 minutes- walk test (Appendix 3):*

First outcome measure used in this study at baseline and posttest was physical capacity by using **2 minutes - walk test which is reliable** (Butland et al. 1982)(Selman et al. 2014) and valid test (Bohannon, Wang, and Gershon 2015) it is a measure of self-paced walking ability and functional capacity. The test performed in the Patients room, the patient was instructed to walk as far as possible for two minutes, a break was possible if needed, the patient was able to use any assistive device if needed or respiratory support, Plus Oximeter was attached to the patient fifth finger - tip during the test, to monitor O2 saturation and pulse rate, the researcher gave a practice before recording the final result. The output parameter was the **mean of walking distance** that contrasted to the normative values, differs according to gender and age, increases the mean of walk distance indicates better physical capacity and vice versa (Bohannon 2017).

#### *3.4.3.2 Dyspnea(Appendix 4):*

The researcher assessed Dyspnea assessed according to Modified Medical Research dyspnea scale, it is the most commonly used scale to assess dyspnea in activities of daily

living for chronic respiratory patients, it is valid (Stenton 2008) and reliable (Hsu et al. 2013).The scale Composed of five statements that describe the entire range of disability caused by breathlessness, (0) grade indicates the least severe grade, while grade (4) is the most severe one, the scale was self-administered by asking patients to choose a statement that describes their conditions, for example, 'I only get breathless with strenuous exertion' (Grade 0) or 'I am too breathless to leave the house or breathless when dressing/undressing' (Grade 5).

### 3.4.4 Data collection procedures

After discussing the study topic with the higher education committee of the physiotherapy department, ethical approval was granted from the Al-Quds University central ethical committee (Appendix 5). Palestinian Ministry of health was contacted and the approval of was granted. Patients and potential participants were identified from the medical records of their hospital admissions, then a screening stage for inclusion and exclusion criteria started. Patients fitting inclusion and exclusion criteria were requested and encouraged to participate in the study through a meeting in the hospital.

The nature of the study and the technique of the intervention were explained to the patients in information sheet (appendix 5), and those who were willing to participate were included. Before proceeding with the intervention, the participants signed a written consent form (Appendix 6). Afterwards, baseline assessment was done including the above-mentioned data collection sheet and the above-mentioned tests (venous O2 saturation, Respiratory Rate, Dyspnea, 2MWT, FVC, FEV1) and the results were recorded. Then, each group received its allocated intervention till the patient discharge (2 sessions daily), then posttests were performed using the same outcome measures and tests that were performed at baseline.

### 3.4.5 Intervention Procedures

All assessments were performed by the investigator of this study. The intervention was conducted by 3 licensed physiotherapists (the investigator is one of them), Those who performed

the experimental interventions were certified. 5 meetings and training sessions were performed together with a therapist to finalize the unified intervention approach.

All participants were familiarized with the nature of the intervention based on the allocated group. There were two groups: the intervention group (n=30) and the control group (n=30). Intervention group was the only group received physiotherapy for around 40-50 minutes, 2 sessions per day till the patient's discharge, the physiotherapy session consisted of positioning, chest physiotherapy, air-way clearance, active or active –assisted exercise, breathing exercise, training spirometer, and early mobility, physiotherapy interventions are summarized in the following table .

**Table 3.2 Physiotherapy interventions:**

| Physiotherapy intervention | Consist of | Time | Precautions consideration |
|---|---|---|---|
| **Positioning.** | • Prone ventilations recommended , preferably within 72 hours of endotracheal intubation.as, it is the best position to improve hypoxia(Thomas et al. 2020).<br>• If prone position not applicable, semi sitting is recommended, or side lying (WHO 2020) | 5 minutes to be carried out.<br><br>Sustained this position from 1-3 hours. | Use droplet precautions.<br><br>Use airborne precautions if close contact required or possible aerosol generating procedures.<br><br>If not ventilated, where possible, the patient should wear a surgical mask during any physiotherapy (Thomas et al. 2020).<br><br>Always monitor the saturation level.<br><br>Stop the exercise when heart rate more than 130 beats/min. |
| **Chest physiotherapy (air way clearance).** | Auscultations.<br>Vibration<br>Moderate Cupping. | 10-15minutes | |
| **Mobilization, active, active assisted, or passive bed Exercises (Shukla, Chauhan, and Raj 2020).**<br>ROM aerobic Exercises for upper and lower limbs.<br>• | Patient who at significant risk of developing functional limitations or who has already developed functional decline.<br>• Ankle pumping<br>• Straight leg raise<br>• Knee flexion, extension.<br>• Shoulder ROM Exercises<br>• Elbow Rang of Motion Exercises.<br>Wrist and Fingers Rang of Motion Exercises. | 10 repetition of each movement, 3 sets of exercise/ 2 times daily.<br><br>Scheduled program to be repeated by patient under nurse supervision. | |

| | | | |
|---|---|---|---|
| **Breathing Exercise**<br><br>Deep Diaphragmatic breathing Exercises. | Patients were instructed to take a deep breath from nose only, hold 3 seconds, then exhale through mouth. | 5-10 Repetition./2 sets daily/ 30s rest between the sets. | |
| Pursed lip breathing exercise. | patients were instructed the pursed-lip breathing and coughing training, they were asked to undergo 30 sets per day. | 5-10 Repetition./2 sets daily/ 30s rest between the sets. | |
| Spirometer training | Patients were instructed how to exhale and inhale in balls spirometer to improve lung capacity. | 5-10 Repetition./2 sets daily/ 30s rest between the sets. | |
| **Early mobility.** | 2 times daily. | As soon as possible.<br>Patient should be medically stabile. | |

## 3.5 Statistical analysis

Data was statistically analyzed using SPSS version 26. Independent variables such as age, height, weight, and BMI were presented with mean and standard deviation. The nominal variables such as gender, comorbidities, smoker or not were presented as frequencies and percentages in both groups. Normality was tested using the Shapiro test. An independent t-test was used to compare the differences between the groups (control and intervention groups) for the continuous (scale) variables. Paired t-test was used to analyze the effect of the intervention within groups (pre- and post-intervention). When data was not normal, the Mann Whitney non-parametric test was performed to examine the significance of the difference of the posttests between groups, while Wilcoxon test was used to investigate the difference between pre and posttests within groups. According to the correlation, the researcher used Person correlation in continues variables, and Spearman correlation was performed in ordinal variables. Finally, researcher calculate the improvement variable by subtracted the posttest from the pretest, and applied the multivariate regression on this variable to investigate the effect of intervention in the presence of all other variables, P value was set at $<0.05$.

## 3.6 Ethical Consideration

All participants received oral and documented information (Appendix 6), about the purpose of the study, procedures, potential fatigue and minimum risks. They agreed to participate voluntarily and their safety was highly considered throughout the duration of the study .

In addition, each participant signed an informed consent written in Arabic language before enrolment in the study (Appendix7). Administrative approval was obtained from Palestinian ministry of health, and from the ethical committee at Al-Quds University prior to the start of the study.

Anonymity and confidentiality were guaranteed for all patients. Their right to withdraw from the study at any stage without any harm to their interests was explained. Data analysis was done using codes rather than names and it will be locked in an unreachable safe place under the supervision of the chief investigator. The results of this study will be accessible and delivered to the participants of this study.

# Chapter Four

4.1 Results and analysis

4.2 Discussion

4.3 Study Limitations

## 4.1 Result presentation and analysis

### 4.1.1 Recruitment and follow-up process

Patients were recruited from two different governmental hospitals, 30 patients from Alia governmental hospital (intervention group), 30 from Dura governmental hospital (control group), they were assessed two times at the admission and  at the discharge.

### 4.1.2 Descriptive statists of variables

#### *4.1.2.1 Age of participants.*

The average of ages in the experimental group was **51.13** years, while the average age of the control group was **48.93** years (Figure 1.4).

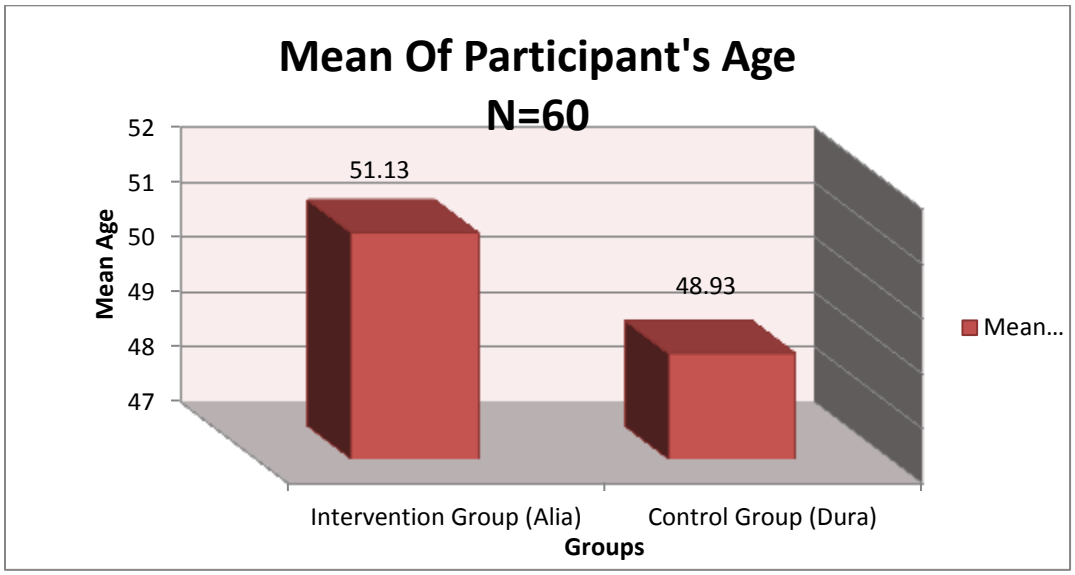


**Figure 0-1: Mean  Age of the Participants**

### *4.1.2.2 Gender of participants.*

The study sample divided into two groups, intervention and control group, each group has 30 participants. The intervention group included (**22**), **73.3%** Males and (**8**), **26.7%** Females, also the control group included (**22**), **73.3%** Males and (**8**), **26.7%** Females (Figure 2.4).

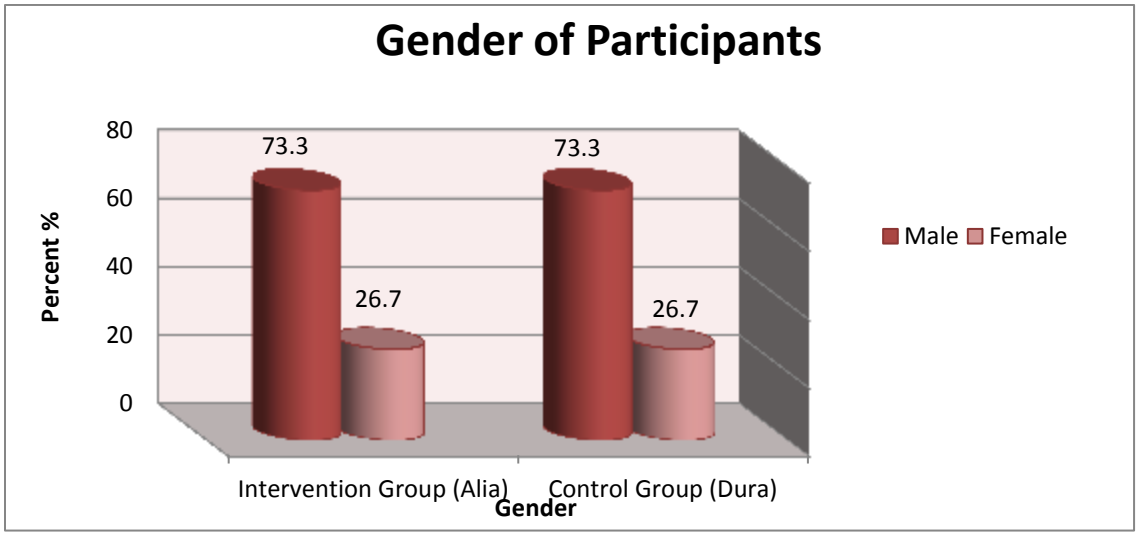


**Figure 0-2 : Gender of the Participants**

### *4.1.2.3 BMI of participants.*

Body Mass Index (BMI) mean of the intervention group was 28.12, while it was 28.6 in control group.

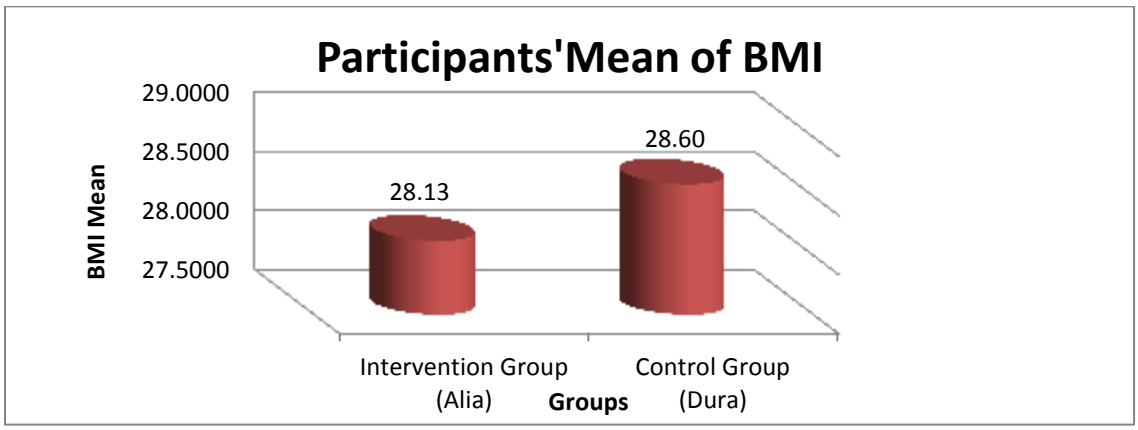


**Figure 0-3 BMI of the Participants**

Regarding BMI Categorization of the Participants, in the intervention group, the distribution was: **8**(**26.7%**) participants have normal BMI, **12**(**40%**) are normal weight, and **10**(**33%**) are obese, while in the control group, **5**(**16.7**) participants have normal weight, **13**(**43.3%**) are overweight, and also **12**(**40%**) are obese (**Figure 3.4**).

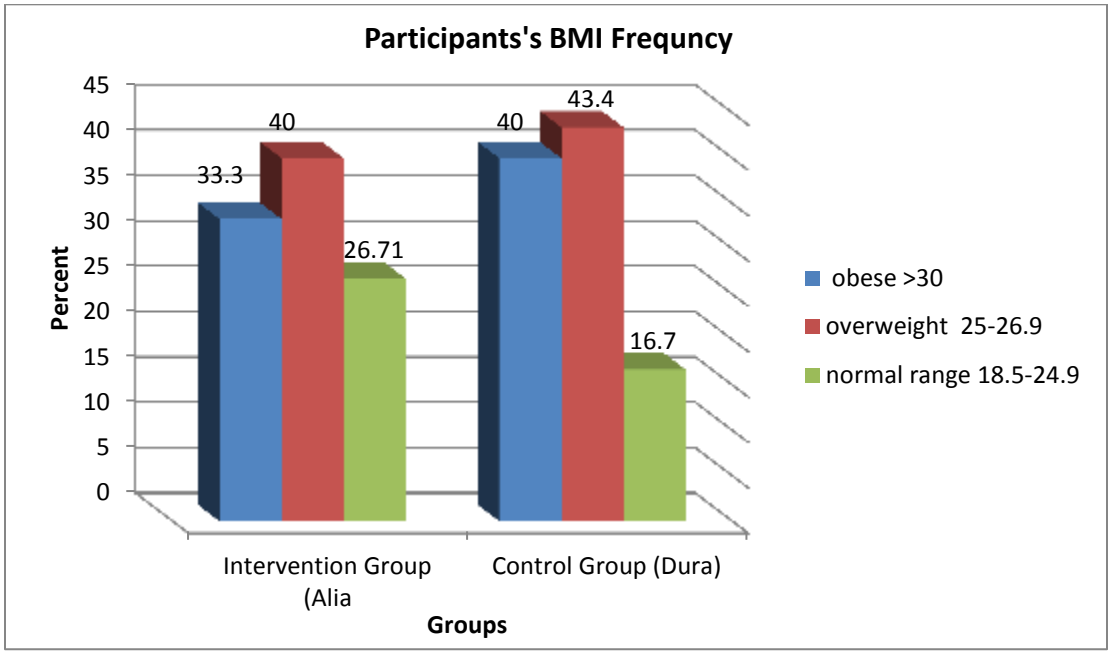


**Figure 4-4 BMI categories of the Participants**

### *4.1.2.4 Occupation of the participants.*

Regarding Occupation of the Participants, in the intervention group, the distribution was: 5(16.7%) participants are working on office, 10(33.3%) have physical demand job, and 15(50%) don't have occupation, on the other hand, the control group have, 8(26.7%) participants working in office, 11(36.7%) are physical demand Job, and 11(36.6%) don't have occupation. (Figure 4.4).

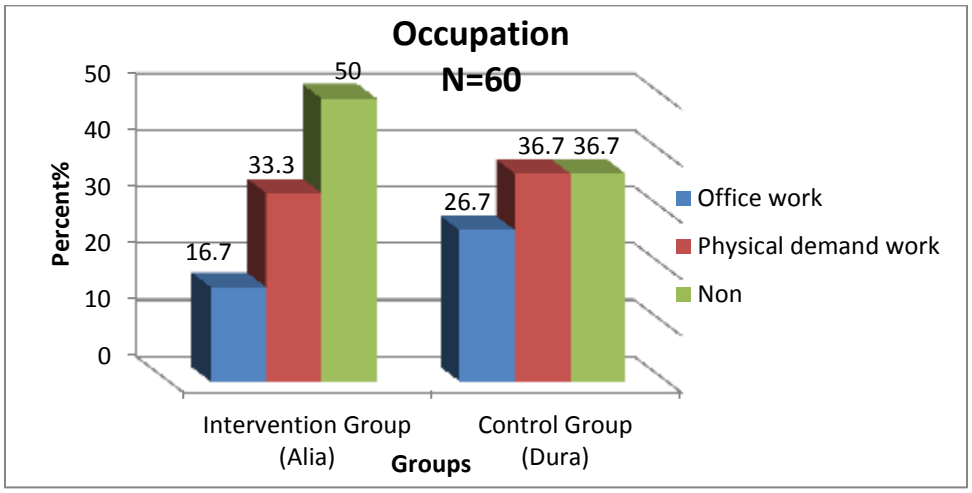


Figure 0-5 The Participants Occupation

### *4.1.2.5 History smoking*

In the intervention group 16(53.3%) of the participants are smokers, and 14(46.7%) are non-smoker, while in the control group the distribution is 17(56.7%) are smokers, 13(43.3%) are non-smoker. (Figure 5.4).

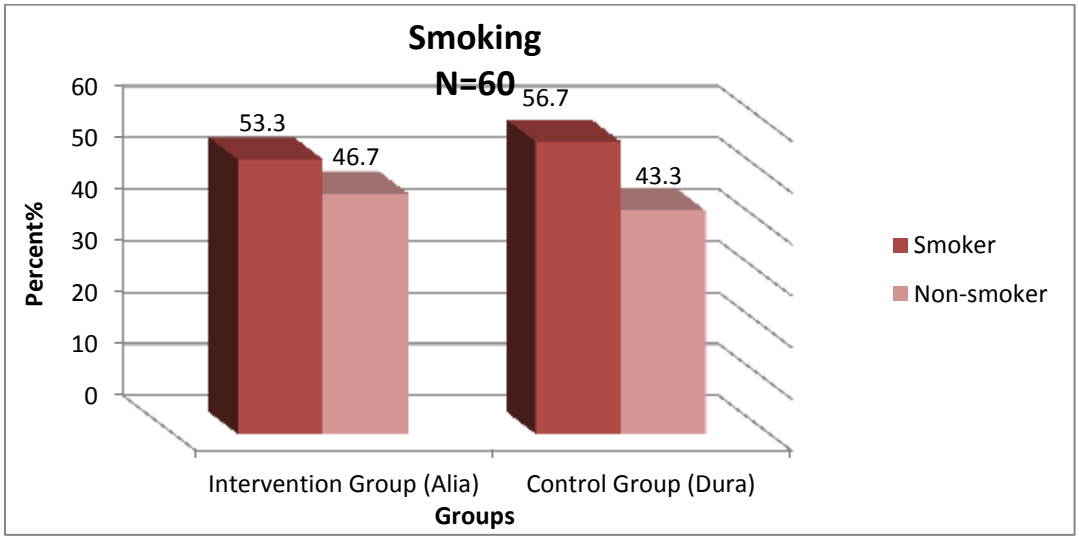


Figure 0-6: History of smoking.

### *4.1.2.6 History of Diabetes.*

The intervention and control groups have the same distribution which is 27(90%) of the participants have diabetes, and 3(10%) of them don't have diabetes.(Figure 6.4)

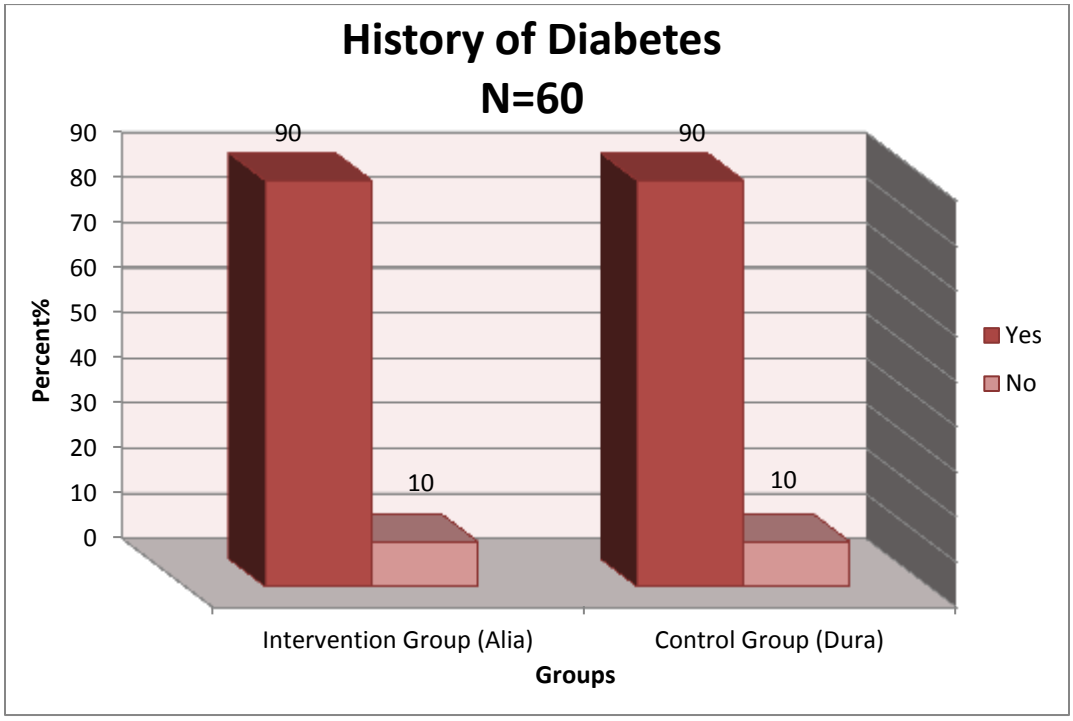


**Figure 0-7 : History of Diabetes.**

### *4.1.2.7History of Hypertension.*

14(46.7%) of the intervention have a history of hypertension disease, while 16(53.3%) of the intervention group don't have, in the other hand, 13(43.3%) have a history of hypertension disease, while 17(56.7%) don't have(Figure 7.4).

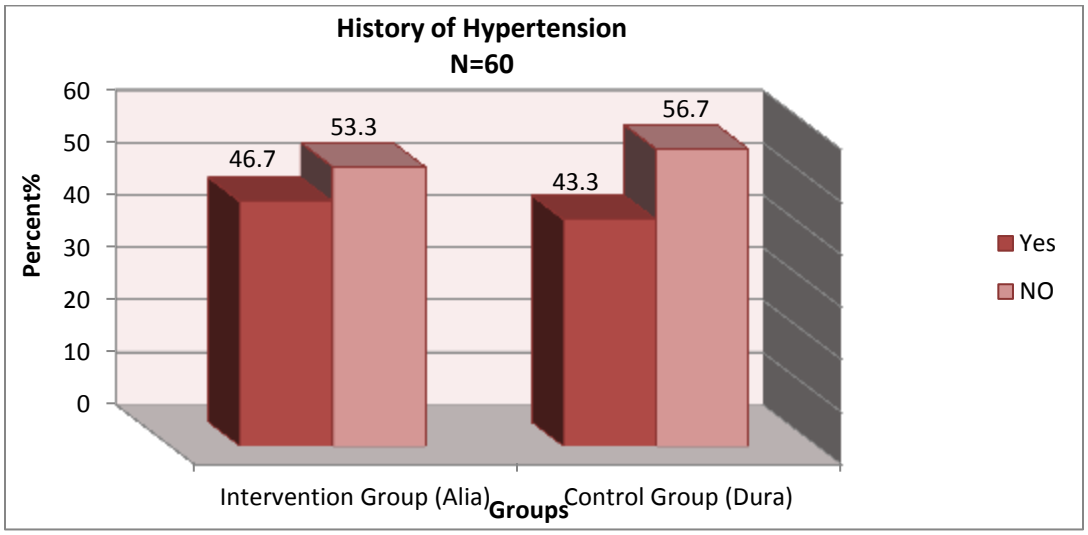


**Figure 0-8 : History of Hypertension.**

### 4.1.2.8 History of cardiovascular Disease:

7(27.3%) of the intervention have a history of cardiovascular disease, while 23(76.7%) of the intervention group don't have cardiovascular disease, in the other hand, 5(16.7%) have a history of cardiovascular disease, while 25(83.3%) don't have cardiovascular disease (Figure 8.4).

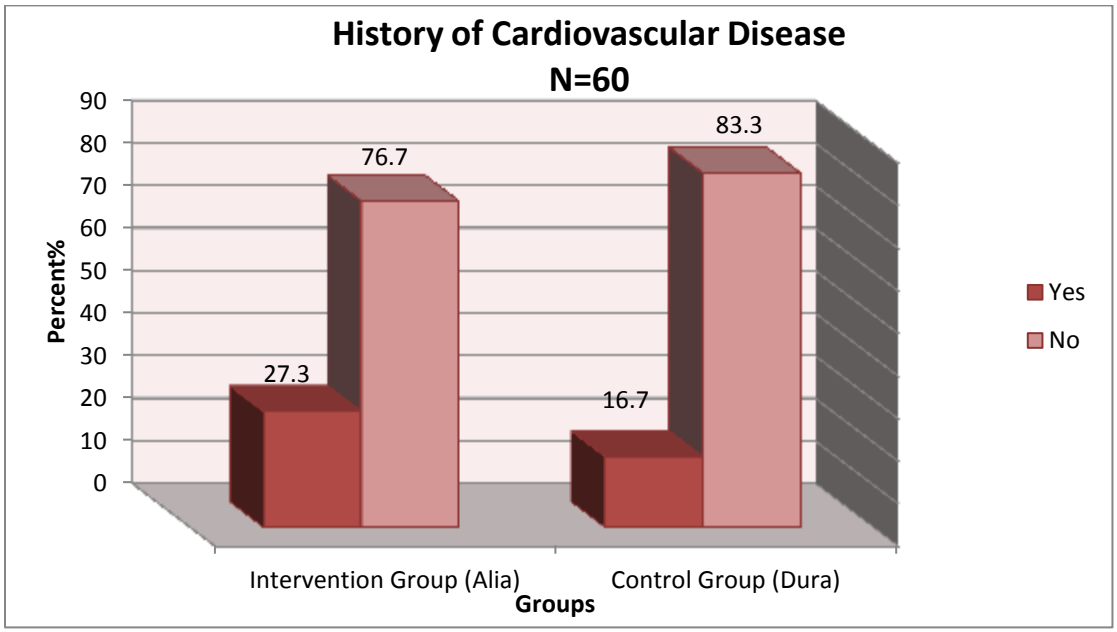


**Figure 4-9** *: History of Cardiovascular Disease.*

### 4.1.3 Normality distributed of the parametric data

**Normality Shapiro-Wilk testing for parametric data**

Normality of study variables among the study groups(intervention and Control) was conducted before starting the data analysis. The test of Kolmogorov-Smirnov Z was used for this purpose, and the following table (Table 1.4) shows the results of this test:

**Table 4.3 The results of Kolmogorov-Smirnov Normality Test**

| Study variables | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| 2 Minutes' Walk Test at Admission | .294 | 30 | .000 | .511 | 30 | .000 |
| 2 Minutes' Walk Test at discharge | .144 | 30 | .112 | .909 | 30 | .014 |
| Forced Vital Capacity at Admission | .198 | 30 | .004 | .871 | 30 | .002 |
| Forced Vital Capacity at discharge. | .144 | 30 | .112 | .954 | 30 | .211 |
| Forced Expiratory Volume in one second at Admission | .226 | 30 | .000 | .891 | 30 | .005 |
| Forced Expiratory Volume in one second at discharge. | .128 | 30 | .200* | .933 | 30 | .059 |
| Oxygen Saturation at Admission | .156 | 30 | .060 | .908 | 30 | .014 |
| Oxygen Saturation at discharge. | .249 | 30 | .000 | .844 | 30 | .000 |
| Respiratory Rate at Admission | .107 | 30 | .200* | .966 | 30 | .437 |
| Respiratory Rate at Discharge | .188 | 30 | .008 | .909 | 30 | .014 |
| Length of Stay | .144 | 30 | .112 | .951 | 30 | .175 |
| Lung function Test at admission | .098 | 30 | .200* | .937 | 30 | .074 |
| lung function Test at discharge. | .148 | 30 | .093 | .962 | 30 | .352 |

The results of the normality test in the table above shows that most of the study variables among the study groups(intervention, Control) were normally distributed since the P-values of the Kolmogorov-Smirnov Z test are higher than 0.05 except in (2MWT at admission and at discharge, FVC at admission, FEV1 at admission, O2 saturation at admission and discharge, RR at discharge). The results ensure that the normality condition of study variables were satisfied, and it is allowed to use Parametric statistical methods in this research even in not normally distributed variables as mentioned above, since the N=60, and based on the central limit theory, they can be analyzed using parametric tests, as the sample size is more than 30, and there is a tendency for normal distribution around the mean.

### 4.1.4 Inferential statistical analysis of the tested variables.

First test: Oxygen Saturation, the intervention group oxygen saturation Improves from 78.63 at baseline to 93.77 discharge.

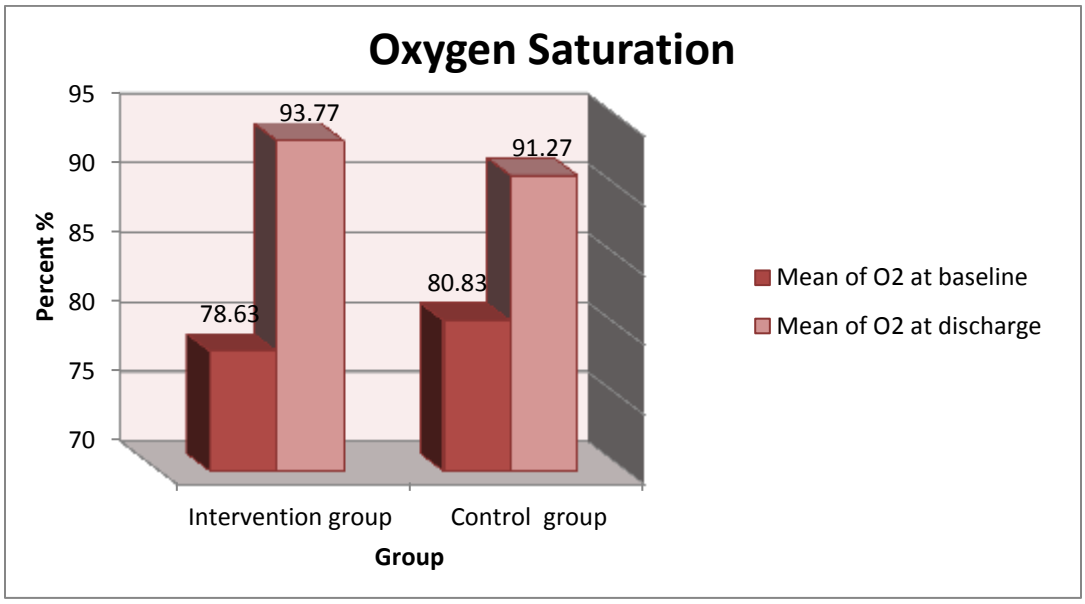


Figure 0-10 illustrates Oxygen Saturation variations

### *4.1.4.1 Testing variables in between groups at baseline and post-test for both groups*

Table 4.2 Shows the mean and SD at baseline and post-test for O2 saturation testing variables in the intervention and control groups. This demonstrates that there is no significant difference between the intervention and control group at baseline, while there is a significant difference between both groups at post-test. Statistical significance for α was set at (P<0.05).

**Table 4.4: Testing O2 Mean at baseline and post-test for both groups**

| Test | O2 at baseline | STD | O2 at discharge | STD | Difference | df | t-test | Sig. |
|---|---|---|---|---|---|---|---|---|
| O2 in intervention group | 78.63 | 6.81 | 93.77 | 1.869 | 15.133 | 29 | -11.45 | .000 |
| O2 in control group | 80.83 | 5.58 | 91.27 | 3.016 | .10.433 | 29 | -10.15 | .000 |

### *4.1.4.2 Testing O2 in between groups at baseline and post-test for both groups*

Table 4.3 Shows the mean and SD at post-test for O2 saturation testing variables in the intervention and control groups. This demonstrates that there is a significant difference between the intervention and control group at discharge point in favor of the intervention group (P<0.05).

**Table 4.5: Oxygen Saturation (Post the treatment in 2 groups).**

| Test | Mean posttest intervention | STD | Mean post control | STD | Mean Difference | T test | df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| O2 Saturation | 93.77 | 1.869 | 91.26 | 3.016 | 2.50 | 3.85 | 58 | .00 |

**Second Test: Respiratory Rate:**

The respiratory rate of the intervention group improves from 26.83 respiration per one minute at baseline to 16.3 respiration per one minute at discharge.

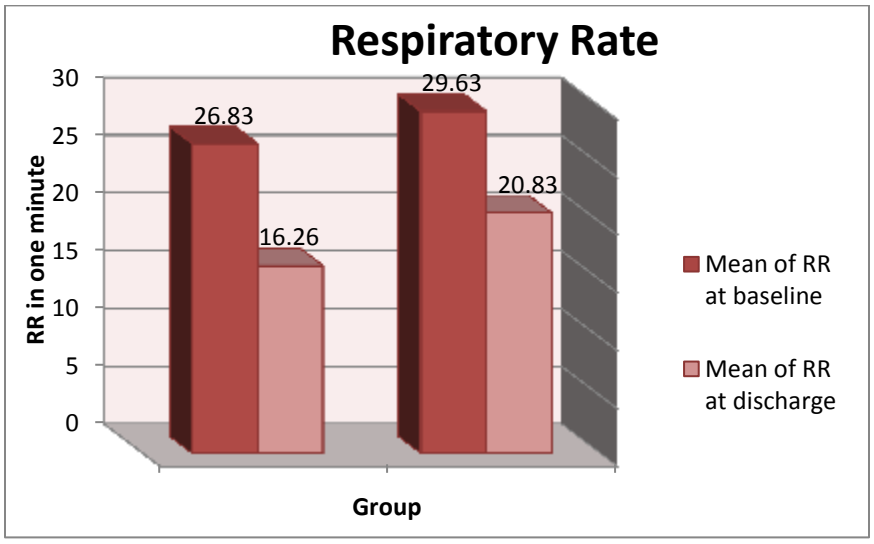


**Figure** 0-11 illustrates Respiratory Rate variations between both groups at admission and discharge.

### *4.1.4.3 Difference between baseline and discharge mean of Respiratory Rate in the intervention and control groups*

Table 4.4 Shows the mean and SD at baseline and post-test for RR in the intervention and control groups. This demonstrates that there is no significant difference between the intervention and control group at baseline, while there is a significant difference between both groups at post-test. Statistical significance for α was set at (P<0.05).

**Table 4.6: Testing RR Mean at baseline and post-test for both groups**

| Test | Mean of RR at baseline | STD | Mean of RR at discharge | STD | Difference | df | T- test | Sig. |
|---|---|---|---|---|---|---|---|---|
| RR intervention | 26.83 | 4.308 | 16.27 | 2.586 | 10.567 | 29 | 13.249 | .000 |
| RR control | 29.6333 | 4.311 | 20.83 | 2.574 | 8.800 | 29 | 13.164 | .000 |

### *4.1.4.4 Difference of mean Respiratory Rate (RR)posttests In intervention and control groups.*

Table 4.5 Shows the mean and SD at post-test for RR in the intervention and control groups. This demonstrates that there is a significant difference between the intervention and control group at discharge point in favor of the intervention group (P<0.05).

**Table 4.7: Respiratory Rate (Post the treatment in 2 groups).**

| Test | Mean posttest intervention | STD | Mean post control | STD | Mean Difference | t- test | df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| RR | 16.2677 | 2.586 | 91.26 | 2.57 | 4.566 | -6.856 | 58 | .00 |

**Third Test: Forced Vital Capacity:**

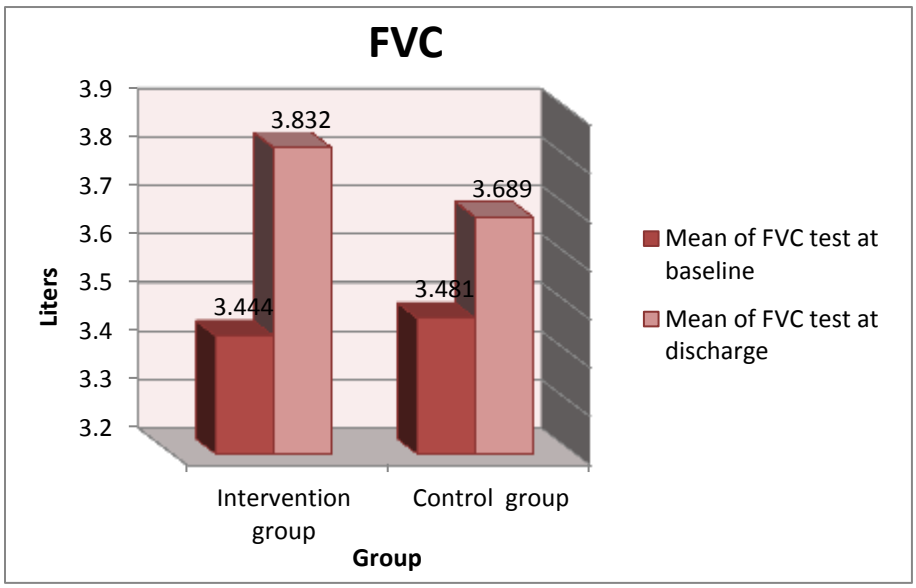


**Figure 0-12 illustrates Mean variations of FVC of both groups at baseline and discharge.**

### *4.1.4.5 Difference between baseline and discharge mean of Forced Vital Capacity (FVC) in the intervention and control groups*

Table 4.6 Shows the mean and SD at baseline and post-test for FVC in the intervention and control groups. This demonstrates that there is no significant difference between the intervention and control group at baseline, while there is a significant difference between both groups at post-test. Statistical significance for α was set at (P<0.05).

**Table 4.8: Testing FVC Mean at baseline and post-test for both groups**

| Test | Mean of FVC at baseline | STD | Mean of FVC at discharge | STD | Difference | df | t test | Sig (2 tailed). |
|---|---|---|---|---|---|---|---|---|
| FVC test intervention group | 3.444 | .558 | 3.832 | .634 | .388 | 29 | -9.130 | .000 |
| FVC test control group | 3.481 | .660 | 3.689 | .655 | .208 | 29 | -8.935 | .000 |

### *4.1.4.6 Difference of mean Forced Vital Capacity FVC posttests In intervention and control groups*

Table 4.7 shows that there is no mean difference between the control and intervention group at discharge P value .402> .05. but there is around .1433 litter differences in both group, from mathematics point of view this difference is not statistically significant as Table 4.7 showed but clinical wise this will be very important.

**Table 4.9 Forced Vital Capacity FVC test (Post the treatment in 2 groups).**

| Test | Mean posttest Intervention | STD | Mean post Control | STD | Mean Difference | T test | df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| FVC | 3.8323 | .66089 | 3.6890 | .65500 | .-03667 | .844 | 58 | .402 |

**Fourth Test: Forced Expiratory Volume in one second FEV**

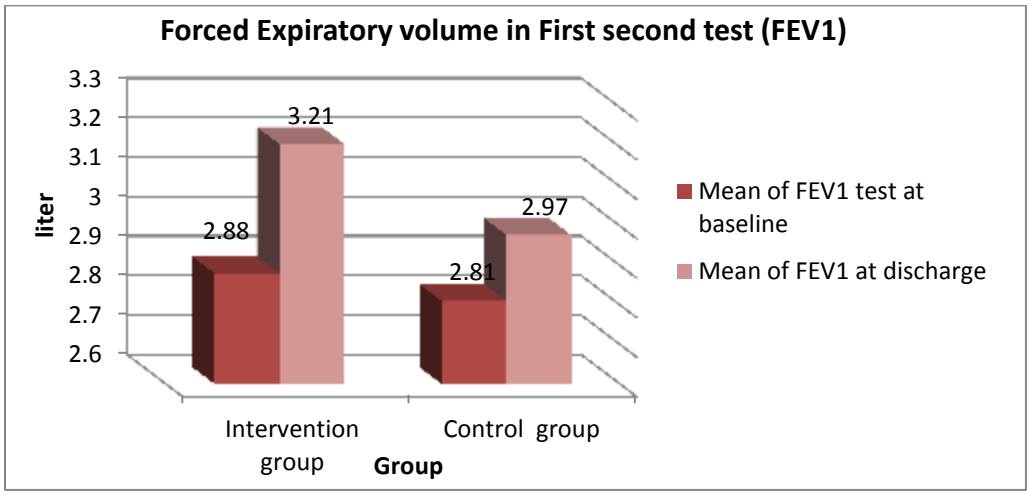


**Figure 0-13 illustrates FEV1 in both groups at baseline and discharge.**

### *4.1.4.7 Difference between baseline and discharge mean of Forced Expiratory Volume in first second Test FEV1 in the intervention and control groups*

Table 4.8 Shows the mean and SD at baseline and post-test for FEV1 in the intervention and control groups. This demonstrates that there is no significant difference between the intervention and control group at baseline, while there is a significant difference between both groups at post-test. The intervention group improves from 2.88 liter to 3.21 liter in forced Expiratory volume in contrast with the control group which improves from 2.8 liter to 2.97.Statistical significance for α was set at ($P<0.05$).

**Table 4. 10: Testing FEV1 Mean at baseline and post-test for both groups**

| Test | Mean of FEV1 at baseline | STD | Mean of FEV1 at discharge | STD | Difference | df | t-test | Sig. |
|---|---|---|---|---|---|---|---|---|
| FEV1 test in intervention group | 2.88 | 0.513 | 3.207 | 0.533 | .328 | 29 | -11.45 | .000 |
| FEV1 test in control group | 2.81 | .542 | 2.977 | 0.577 | .167 | 29 | -10.15 | .000 |

### *4.1.4.8 Difference of mean Forced Expiratory Volume in first second FEV1 posttests In intervention and control groups*

Table 4.9 shows that there is no mean difference between the control and intervention group at discharge P value .114> .05. but there is around .23 litter differences in both group, from mathematics point of view this difference is not statistically significant as Table 4.9 showed but clinical wise this will be very important.

**Table 4. 11: Forced Expiratory Volume in first second FEV1 (Post the treatment in 2 groups).**

| Test | Mean posttest intervention | STD | Mean post control | STD | Mean Difference | T test | Df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| FEV1 | 3.207 | .53372 | 2.977 | .577 | .230 | 1.604 | 58 | .114 |

**Fifth Test: 2MWT.**

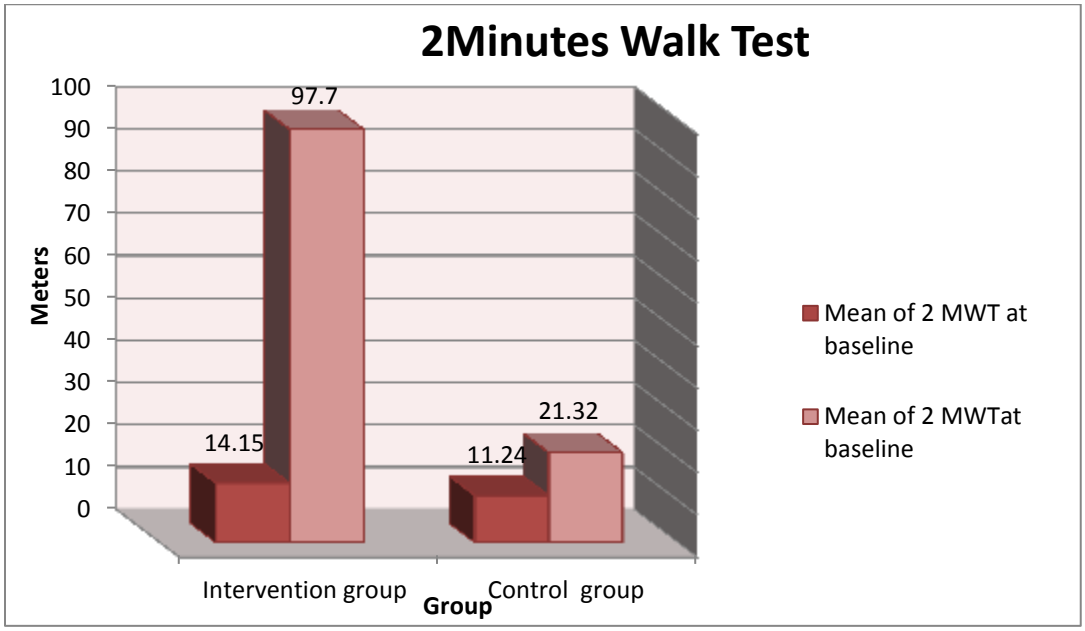


**Figure 0-14 illustrates 2MWT mean variation of both groups at baseline and discharge.**

### *4.1.4.9 Difference between baseline and discharge mean of 2MWT in the intervention and control groups*

Table 4.10 Shows the mean and SD at baseline and post-test for 2MWT in the intervention and control groups. This demonstrates that there is no significant difference between the intervention and control group at baseline, while there is a significant difference between both groups at post-test. Statistical significance for α was set at (P<0.05).

**Table 4.12: Difference between baseline and discharge mean of 2MWT in the intervention and control groups**

| Test | Mean of MWT at baseline | STD | Mean 2 MWT at discharge | STD | Difference | df | T | Sig. |
|---|---|---|---|---|---|---|---|---|
| 2 MWT Intervention group | 14.15 | 22.460 | 97.73 | 47.200 | -83.583 | 29 | -12.24 | .000 |
| 2MWT control group | 11.24 | 13.29 | 21.3 | 17.450 | -10.083 | 29 | -5.18 | .000 |

### *4.1.4.10 Difference of mean 2 Minutes' Walk posttests In intervention and control group.*

Table 4.11 Shows the mean and SD at post-test for 2MWT in the intervention and control groups, the intervention group improves in 2 Minutes' Walk test from 14.15 meters at baseline to 97.7meters at discharge. This demonstrates that there is a significant difference between the intervention and control group at discharge point in favor of the intervention group (P<0.05).

**Table 4. 13: Difference of mean Forced Expiratory Volume in first second FEV1 posttests In intervention and control groups**

| Test | Mean posttest intervention group | STD | Mean posttest control group | STD | df | T test | Sig. |
|---|---|---|---|---|---|---|---|
| 2MWT | 97.7333 | 47.200 | 21.32 | 17.450 | 58 | 8.317 | .000 |

**Sixth: Length Of Stay (LOS)**

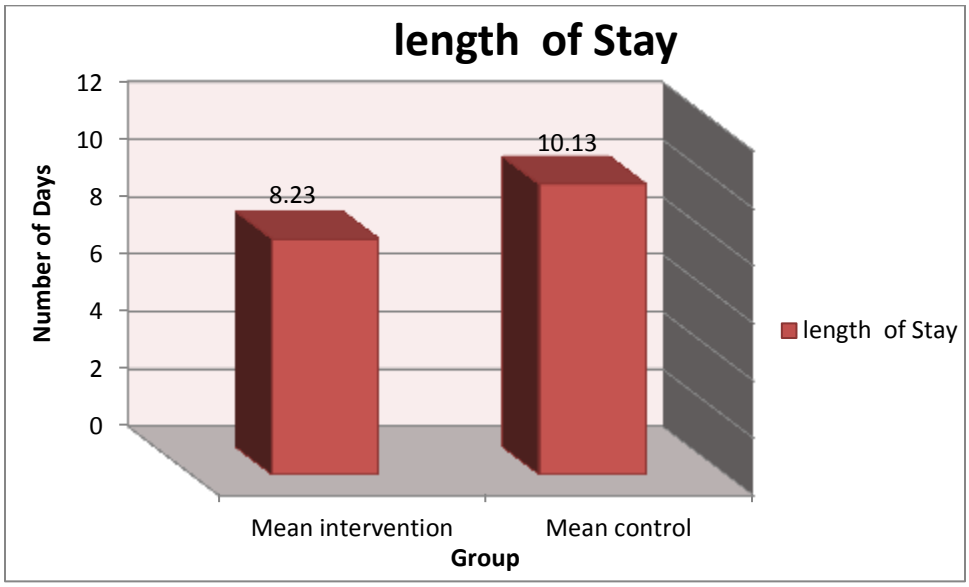


**Figure 0-15 illustrates Length Of Stay in both groups.**

### *4.1.4.11 Difference of mean LOS In intervention and control group.*

Table 4.12 Shows the mean and SD at post-test for LOS in the intervention and control groups. the intervention group discharged from hospital earlier than the control group, intervention group mean length of satay is 8.23 days, while control group mean length of satay is10.13 days, (P<0.05).

**Table 4.14: length of Stay (Post the treatment in 2 groups).**

| Test | Mean intervention | STD | Mean control | STD | Mean Difference | T test | df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| LOS | 8.23 | 2.67 | 10.13 | 3.73 | -1.90 | -2.268 | 58 | .027 |

Seventh: Dyspnea.

### *4.1.4.12 Difference of mean dyspnea posttests In intervention and control groups*

Results in the table (Table 4.13) shows that there is no mean difference in dyspnea at baseline between the two groups, P value = .309 > .05, while there is a significant improvement in dyspnea rate in the intervention group at discharge , P-value = 0.000 < 0.05.

**Table 4.15: Wilcoxon Signed Ranks Test of Dyspnea**

| Test | Mean Rank of dyspnea baseline | Mean Rank of dyspnea at discharge | Z | Sig. |
|---|---|---|---|---|
| Dyspnea Rate of intervention group | 32.43 | 21.85 | -1.018 | .309 |
| Dyspnea Rate of control group | 28.57 | 39.15 | -4.301 | .000 |

### *4.1.4.12 Difference of mean using ventilation at posttests In intervention and control groups*

**Table 4.16: Mann-Whitney Test of using Ventilation (Post the treatment in 2 groups).**

| Test | Mean Rank of using Ventilation | Sum of Ranks | Z | Sig. |
|---|---|---|---|---|
| intervention group | 35.5 | 1065 | -2.566 | 0.010 |
| control group | 25.5 | 765 | | |

### *4.1.4.13 Differences of mean among two groups in improvements of all study variables:*

Table 4.15 shows the results of all the study variables improvement in both groups, as the table illustrates that there was improvement in both groups (intervention and control), but the more improvements was in favor of the intervention group.

O2 saturation improved significantly in intervention group by an increase of 15.13 units on the baseline measurements, but the control group O2 saturation increased 10.50 units on the baseline measurements.

2MWT improved by 83.58 meters in intervention group, in contrast to 3.90 meters in the control group. In addition dyspnea was significantly improved in favor of the intervention group. The intervention group showed more improvements in the FVC and FEV1, these improvements were statistically significant, but respiratory rate improvements was not statistically significant = .064.

**Table 4. 17: Mean improvements in all study variables**

| Test | Mean improvement intervention | STD | Mean improvement control | STD | Mean Difference | T test | df | Sig.(2 tailed) |
|---|---|---|---|---|---|---|---|---|
| O2 Saturation | 15.13 | 6.52 | 10.50 | 3.97 | 4.63 | 3.32 | 4.63 | .02 |
| 2MWT | 83.58 | 37.4 | 3.90 | 3.84 | 79.7 | 11.61 | 29.6 | .00 |
| Dyspnea | 2.17 | .698 | 1.29 | 1.29 | .875 | 4.233 | 58 | .00 |
| RR | 10.73 | 4.23 | 8.80 | 3.66 | 1.93 | 1.89 | 56.81 | .064 |
| FVC | .388 | .233 | .208 | .128 | .180 | 3.715 | 44.97 | .001 |
| FEV1 | .328 | .157 | .167 | .090 | .160 | 4.855 | 46.33 | .00 |

### 4.1.5 Correlations between Study variables:

Table 4.18 showed that Age was not significantly correlated with any of the dependent variables (BMI, LOS, 2MWT, FVC, FEV1), as it did not show any statistically significant correlation ($p>0.05$), while , BMI was significantly correlated with ( LOS, 2MWT, FVC, FEV1Statistical significance for α was set at ($P<0.05$).

**Table 4.18: Person correlation between BMI, Length of stay, , Age and tests of lung capacities:**

| Pearson Correlation | Body Mass Index | Length of Stay | Pre- 2MWT | Post- 2 MWT | Pre FVC | Post FVC | Pre FEV1s | Post FVC1 |
|---|---|---|---|---|---|---|---|---|
| BMI | 1 | .357** | -0.242 | -0.123 | -.325-* | -.355-** | -.364-** | -.361-** |
| | | 0.005 | 0.063 | 0.35 | 0.011 | 0.005 | 0.004 | 0.005 |
| Pre- 2 MWT | -0.242 | -0.214 | 1 | .495** | 0.1 | 0.181 | 0.118 | 0.121 |
| | 0.063 | 0.101 | | 0 | 0.449 | 0.166 | 0.37 | 0.358 |
| Post- 2 MWT | -0.123 | -.316-* | .495** | 1 | 0.028 | 0.212 | 0.134 | .256* |
| | 0.35 | 0.014 | 0 | | 0.829 | 0.103 | 0.307 | 0.049 |
| Pre FVC | -.325-* | -.270-* | 0.1 | 0.028 | 1 | .950** | .879** | .847** |
| | 0.011 | 0.037 | 0.449 | 0.829 | | 0 | 0 | 0 |
| Post FVC | -.355-** | -.355-** | 0.181 | 0.212 | .950** | 1 | .885** | .899** |
| | 0.005 | 0.005 | 0.166 | 0.103 | 0 | | 0 | 0 |
| Pre FEV1 | -.364-** | -.374-** | 0.118 | 0.134 | .879** | .885** | 1 | .964** |
| | 0.004 | 0.003 | 0.37 | 0.307 | 0 | 0 | | 0 |
| Post FEV1 | -.361-** | -.426-** | 0.121 | .256* | .847** | .899** | .964** | 1 |
| | 0.005 | 0.001 | 0.358 | 0.049 | 0 | 0 | 0 | |
| Age | .083 | .007 | .007 | .073 | -.138 | -.109 | -.163 | -.124 |
| | .527 | .956 | .956 | 0577 | .293 | .406 | .213 | .346 |

Table 4.19 showed that Age was not significantly correlated with any of the dependent variables (BMI, LOS, O2, RR), as it did not show any statistically significant correlation ($p>0.05$), while , BMI was significantly correlated with ( LOS, O2, RR) Statistical significance for α was set at ($P<0.05$).

**Table 4.19: Person correlation between BMI, Length of stay, Age, and tests of respiratory function:**

| Pearson Correlation | Body Mass Index | Length of Stay | O2 At admission | O2 At discharge | Respiratory Rate at Admission | Respiratory Rate at Discharge |
|---|---|---|---|---|---|---|
| BMI | 1 | .357** | -0.156 | -.385-** | .396** | 0.215 |
| | | 0.005 | 0.234 | 0.002 | 0.002 | 0.099 |
| | 0.005 | 0.001 | 0.399 | 0.027 | 0.009 | 0.029 |
| O2 At admission | -0.156 | -0.22 | 1 | .369** | -.438-** | -0.064 |
| | 0.234 | 0.092 | | 0.004 | 0 | 0.629 |
| O2 at discharge | -.385-** | -.418-** | .369** | 1 | -.495-** | -.553-** |
| | 0.002 | 0.001 | 0.004 | | 0 | 0 |
| RR at Admission | .396** | .450** | -.438-** | -.495-** | 1 | .495** |
| | 0.002 | 0 | 0 | 0 | | 0 |
| RR at Discharge | 0.215 | .422** | -0.064 | -.553-** | .495** | 1 |
| | 0.099 | 0.001 | 0.629 | 0 | 0 | |
| Length of Stay | .357** | 1 | -0.22 | -.418-** | .450** | .422** |
| | 0.005 | | 0.092 | 0.001 | 0 | 0.001 |
| Participant's Age | .083 | -.201 | -.159 | .011 | .003 | -.155 |
| | .527 | .124 | .225 | .935 | .984 | .236 |

Table 4.18, shows the positive significant correlation between BMI Categories and dyspnea rating according mMR at discharge , P value = .002 < .05.

**Table 4.20: Association between Body Mass Index and dyspnea rating at discharge.**

| Spearman's rho | | Body Mass Index Categories | dyspnea rating at discharge according to mMRC |
|---|---|---|---|
| Body Mass Index Categories | Correlation Coefficient | 1.000 | .387** |
| | Sig. (2-tailed) | | 0.002 |
| | N | 60 | 60 |

**Correlation is significant at the 0.01 level (2-tailed).**

### 4.1.6 Bivariate Difference of mean :

#### *4.1.6.1: Differences according to Gender:*

Independent sample t-test done in pre and post (2Minutes' Walk , Oxygen saturation, Respiratory Rate, length of stay) among gender, showed that there is no mean differences in the tested item among different gender, p value > .05.

Table 4.19 exhibits there is a statistically significant mean differences between male and female in the pre and post forced vital capacity, pre and post Forced expiratory volume in one second in favor of males,  p value = 00 < 005.

**Table 4:21 Differences of FVC and FEV1 among Gender**

| Tested items | Gender | Mean | STD | T | df | Mean differences | Sig (2 tailed) |
|---|---|---|---|---|---|---|---|
| Pre FVC | Male | **3.74** | .364 | 9.854 | 26.395 | 1.054 | .00 |
| | Female | 2.69 | .368 | | | | |
| Post FVC | Male | **4.08** | .407 | 10.207 | 58 | 1.179 | 00 |
| | Female | 2.90 | .361 | | | | |
| Pre FEV1 | Male | **3.09** | .311 | 10.239 | 58 | .9435 | .00 |
| | Female | 2.15 | .328 | | | | |
| Post FEV1 | Male | **3.37** | .332 | 10.032 | 58 | 1.007 | .00 |
| | Female | 2.3544 | .37564 | | | | |

### *4.1.6.2: Differences according to smoking:*

Independent sample t-test done in pre and post (2Minutes' Walk , Oxygen saturation, Respiratory Rate, length of stay) among smoking variable, showed that there is no mean differences in the tested item in smoker or not, p value > .05

Table 4.20 exhibits there is a statistically significant mean differences between smoker and non-smoker in the pre and post forced vital capacity, pre and post Forced expiratory volume in one second p value =00 <005.

**Table 4.22 Differences of FVC and FEV1 among Smoking or not smoker:**

| Tested items | Smoking | Mean | STD | t | df | Mean differences | Sig(2 tailed) |
|---|---|---|---|---|---|---|---|
| Pre FVC | Yes | 3.691 | .384 | 3.447 | 39.038 | .509 | .001 |
| | No | 3.182 | .684 | | | | |
| Post FVC | Yes | 4.019 | .427 | 3.537 | 39.329 | .595 | .001 |
| | No | 3.444 | .751 | | | | |
| Pre FEV1 | Yes | 3.089 | .339 | 4.425 | 40.939 | .544 | .00 |
| | No | 2.546 | .560 | | | | |
| Post FEV1 | Yes | 3.350 | .351 | 4.279 | 39.295 | .572 | .00 |
| | No | 2.778 | .618 | | | | |

### *4.1.6.3: Differences according to Diabetes variable:*

Independent sample t-test done in pre and post (2Minutes' Walk , Oxygen saturation, Respiratory Rate, length of stay) among Diabetes variable, showed that there is no mean differences in the tested item in smoker or not, p value > .05.

Table 4.21 exhibit that there is a statistically significant mean differences between who having diabetes and or who don't have diabetes in 2 Minutes' Walk test at admission, oxygen saturation at admission, and respiratory rate at admission, p value <005.

**Table 4.23 Differences of variables according to Diabetes variable.**

| Tested items | Having Diabetes | Mean | STD | T | Df | Mean differences | Sig(2 tailed) |
|---|---|---|---|---|---|---|---|
| 2MWT at discharge | Yes | **72.55** | 55.656 | 4.189 | 57.888 | 43.409 | .001 |
| | No | 29.14 | 24.600 | | | | |
| O2 at admission | Yes | 78.64 | 6.269 | 2.116 | 58 | 3.634 | .039 |
| | No | **82.278** | 5.665 | | | | |
| RR at discharge | Yes | 17.976 | 3.467 | 2.024 | 58 | 1.912 | .048 |
| | No | **19.889** | 3.065 | | | | |

Independent sample t-test done in pre and post (2Minutes' Walk at admission, forced vital capacity at admission and discharge, forced expiratory volume at admission and discharge) in using O2 at discharge variable, showed that there is no mean differences in the tested item which was using O2 at discharge or not, p value > .05.

Table 4.24 exhibit that there is a statistically significant mean differences between 2 MWT at discharge, O2 at admission, O2 at discharge, RR at admission, RR at discharge, and length of stay with the variable using O2 discharge, in favor to the people who don't use oxygen at discharge, p value =00 <005.

**Table 4.24 Differences of variables according to Diabetes variable.**

| Tested items | Using O2 at discharge | Mean | STD | T | df | Mean differences | Sig(2 tailed) |
|---|---|---|---|---|---|---|---|
| 2 MWT at discharge | Yes | 44.14 | 49.50 | 2.202 | 58 | 28.842 | .032 |
| | No | **72.98** | 51.57 | | | | |
| O2 at Admission | Yes | 77.89 | 6.27 | 2.192 | 58 | 3.451 | .032 |
| | No | **81.34** | 5.91 | | | | |
| O2 at discharge | Yes | 91.32 | 3.12 | 3.270 | 44.64 | 2.241 | .002 |
| | No | **93.56** | 1.98 | | | | |
| RR at Admission | Yes | 30.28 | 3.64 | 3.630 | 58 | 3.845 | .001 |
| | No | **26.43** | 4.46 | | | | |
| RR at Discharge | Yes | 20.04 | 3.51 | 3.396 | 58 | 2.786 | .001 |
| | No | **17.25** | 2.48 | | | | |
| Length of stay | Yes | **10.42** | 3.61 | 2.84 | 58 | 2.335 | .006 |
| | No | 8.09 | 2.74 | | | | |

### 4.1.7 Multivariate Regression:

Running an improvement (change between baseline and posttest) regression analysis, with a suggested model of all pre outcome measures values represented in ( Pre Forced Vital Capacity, Predicted Value of FVC, Forced Expiratory Volume in one second at admission( FEV1), and Predicted Value of FEV1 at admission, Oxygen Saturation at admission, FEV1% at admission} in addition to the Participant's Age, Patient Group, Gender, Smoking, and pre-existing comorbidity, the following predictors were identified for the improvement in the different outcome measures.

#### *4.1.7.1 O2 Saturation improvement:*

As shown below in table 4.25 the regression model indicates that 0.93 of the O2 improvement variation is explained by the below regression model (R2 = 0. 880). (P =012), the variation in the O2 improvement is predicted significantly by 3 independent variable, O2 at admission(B= -.798), patient group ( B=- -3.244), and Pre Predicted Value of FEV1 at admission (B=.046).

**Table 4.25 Multivariate Regression of O2 Saturation improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 3 | .938[c] | .880 | .873 | 2.07846 | .015 | 6.789 | 1 | 56 | .012 |

a. Predictors: (Constant), Oxygen Saturation pre the First session

d. Dependent Variable: O2.imp

**ANOVA[a]**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 3 | Regression | 1771.063 | 3 | 590.354 | 136.656 | .000[d] |
| | Residual | 241.920 | 56 | 4.320 | | |
| | Total | 2012.983 | 59 | | | |

a. Dependent Variable: O2.imp

d. Predictors: (Constant), Oxygen Saturation pre the First session, Patient Group, Pre Predicted Value of FEV1

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 3 | (Constant) | 77.691 | 3.585 | | 21.672 | .000 |
| | Oxygen Saturation at admission | -.798 | .044 | -.860 | -18.254 | .000 |
| | Patient Group | -3.244 | .554 | -.280 | -5.853 | .000 |
| | Pre Predicted Value of FEV1 | .046 | .018 | .123 | 2.606 | .012 |

a. Dependent Variable: O2.imp

### *4.1.7.2 RR rate at improvement:*

As shown below in table 4.26 the regression model indicates that 0.412 of the RR improvement variation is explained by the below regression model (R2 = .170). (P =001), the variation in the RR improvement is predicted significantly by 1 independent variable, O2 saturation at admission (B.265).

**Table 4.26 Multivariate Regression of RR improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .412[a] | .170 | .155 | 3.71641 | .170 | 11.849 | 1 | 58 | .001 |

a. Predictors: (Constant), Oxygen Saturation pre the First session

b. Dependent Variable: RR. Improvement

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 163.655 | 1 | 163.655 | 11.849 | .001[b] |
| | Residual | 801.078 | 58 | 13.812 | | |
| | Total | 964.733 | 59 | | | |

a. Dependent Variable: RR. Improvement

b. Predictors: (Constant), Oxygen Saturation pre the First session

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -30.853 | 6.145 | | -5.021 | .000 |
| | Oxygen Saturation at admission | .265 | .077 | .412 | 3.442 | .001 |

a. Dependent Variable: RR. Improvement

### *4.1.7.3 2MWT*

As shown below in table 4.27 the regression model indicates that 0.836 of the 2MWT improvement variation is explained by the below regression model (R2 = 0. 699). (P =0.00), the variation in the 2MWT improvement is predicted significantly by 1 independent variable, Patient group (B= .-79.683).

**Table 4.27 Multivariate Regression of 2MWT improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .836[a] | .699 | .694 | 26.58452 | .699 | 134.762 | 1 | 58 | .000 |

a. Predictors: (Constant), Patient Group

b. Dependent Variable: MWT. Improvement

**ANOVA[a]**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 95241.504 | 1 | 95241.504 | 134.762 | .000[b] |
| | Residual | 40990.742 | 58 | 706.737 | | |
| | Total | 136232.246 | 59 | | | |

a. Dependent Variable: MWT .improvement

b. Predictors: (Constant), Patient Group

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 163.267 | 10.853 | | 15.043 | .000 |
| | Patient Group | -79.683 | 6.864 | -.836 | -11.609 | .000 |

### *4.1.7.4 FVC Improvement*

As shown below in table 4.28 the regression model indicates that .515 of the FVC improvement variation is explained by the below regression model (R2 = 0. 265). (P =0.021), the variation in the FVC improvement is predicted significantly by 2 independent variables, Patient group (B=-.180), and Gender (B=-.125).

**Table 4.28 Multivariate Regression of FVC improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 2 | .515[b] | .265 | .239 | .18060 | .073 | 5.631 | 1 | 57 | .021 |

b. Predictors: (Constant), Patient Group, Gender

c. Dependent Variable: FVC. Improvement

**ANOVA[a]**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 2 | Regression | .670 | 2 | .335 | 10.266 | .000[c] |
| | Residual | 1.859 | 57 | .033 | | |
| | Total | 2.529 | 59 | | | |

a. Dependent Variable: FVC . improvement

c. Predictors: (Constant), Patient Group, Gender

**Coefficients**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 2 | (Constant) | .726 | .099 | | 7.303 | .000 |
| | Patient Group | -.180 | .047 | -.438 | -3.860 | .000 |
| | Gender | -.125 | .053 | -.270 | -2.373 | .021 |

a. Dependent Variable: FVC. Improvement

### *4.1.7.6 FEV1 Improvement*

As shown below in table 4.29 the regression model indicates that .538 of the FEV1 improvement variation is explained by the below regression model (R2 = 0. 289). (P =0.00), the variation in the FEV1 improvement is predicted significantly by 1 independent variable which is Patient group (B= -.160).

**Table 4.29 Multivariate Regression of FEV1 improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .538[a] | .289 | .277 | .12791 | .289 | 23.569 | 1 | 58 | .000 |

a. Predictors: (Constant), Patient Group

b. Dependent Variable: FEV1.imp

**ANOVA[a]**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .386 | 1 | .386 | 23.569 | .000[b] |
| | Residual | .949 | 58 | .016 | | |
| | Total | 1.335 | 59 | | | |

a. Dependent Variable: FEV1.imp

b. Predictors: (Constant), Patient Group

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | .488 | .052 | | 9.345 | .000 |
| | Patient Group | -.160 | .033 | -.538 | -4.855 | .000 |

### *4.1.7.7 FEV1 Ratio Improvement*

As shown below in table 4.30 the regression model indicates that .329 of the FEV1 Ratio improvement is explained by the below regression model (R2 = 0. 329). (P =0.011), the variation in the FEV1 ratio is predicted significantly by 1 independent variable which is FEV1 Ratio at admission (B= -.-3.733).

**Table 4.30 Multivariate Regression of FEV1 Ratio improvement**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .329[a] | .108 | .092 | .86551 | .108 | 6.905 | 1 | 57 | .011 |

a. Predictors: (Constant), FEV1 Ratio at admission

b. Dependent Variable: FEV1FVC.impRatio

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5.173 | 1 | 5.173 | 6.905 | .011[b] |
| | Residual | 42.699 | 57 | .749 | | |
| | Total | 47.872 | 58 | | | |

a. Dependent Variable: FEV1FVC.impRatio

b. Predictors: (Constant), FEV1 Ratio at admission

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4.162 | 1.174 | | 3.544 | .001 |
| | FEV1 Ratio at admission | -3.733 | 1.421 | -.329 | -2.628 | .011 |

a. Dependent Variable: FEV1FVC.impRatio

## 4.2 Discussion

The average age of the intervention group was **51.13 years**, while the average age of the control group was **48.93** years, which was expected as the range of the inclusion criteria was between 18-60. People in advance age usually have weaker immune system, and since it was approved that B and T lymphocytes are vital constituents of adaptive immune responses to any infections, Older people may have age-related dysfunction that includes a decreased production of B ad T lymphocytes (Bektas et al. 2017), so they will be more vulnerable to infection than younger people

In terms of gender male was the predominance gender in both groups, male constitutes **73.3%** in each group, Previous clinical trials showed that females are less susceptible to acquire viral infections, and production of cytokine storm. From biology aspect female patients have a higher macrophage, neutrophil activity, antibody production, and antibody response (Kopel et al. 2020). Moreover, in-vivo studies of (ACE2) the angiotensin-converting enzyme 2 , which is the COVID-19 virus receptor, showed a higher expression in the kidneys of male than female patients (Haber et al. 2014), but there is no information about converting enzyme in the lung. according to COVID19 epidemiology, it isn't known if the male or female more susceptible to COVID19 infection, the first report from Wuhan indicated gender differences in favor for males (Li et al. 2020), another study from Zhongnan -a large hospital in Wuhan-, suggested that 56% of the patients were males, and male gender was a risk factor for sever COVID-19 (Mo et al. n.d.), while in the other reports male gender was more susceptible to COVID19 infection, The Korean Society of Infectious Diseases analyzed data of 4,212 COVID-19 patients, which illustrated that 62.3% of the patients were female while 37.7% were males, they explain these differences by the impact of socioeconomic and cultural factors (Communication 2020).

In terms of patient's weight, BMI in general showed that the participants were slightly overweight in both intervention and control groups, the mean of BMI was **28.60 in the** intervention group, while **28.13** in the control group, which means that participants were **overweight** as reported by the National Collaborating Centre for Primary Care((UK and (UK 2006).

**Around 88.4%** of intervention group in this study had overweight or obesity, compared with **74.3** in the control group who were suffering from overweight or obesity, suggesting that adults with COVID-19– had obesity might commonly receive acute care in hospitals and might need ICU admission.

This study findings are similar to the previous findings of Anderson et al (2020) (Anderson et al. 2020) and Tartof et al.(2020) (Tartof et al. 2020), who concluded that increased BMI was associated with preexisted illness as a very important indicator of COVID19 severity, hospitalization, invasive mechanical ventilation and death. Kompaniyets et al (2021) confirmed in their study that BMI is a risk factor that indicates COVID19 severity, hospitalization, Intensive Care Unit Admission, and even death particularly among adults aged <**65** years (Kompaniyets et al. 2021). This results were logic, as the obesity is a common metabolic disease known to cause impaired lung function, and a risk factor for other chronic diseases, including type 2 diabetes Mellitus, heart disease, and types of cancers (Kompaniyets et al. 2021).

According to comorbidity prevalence in this study, Diabetes Mellitus 2 was the most prevalent comorbidity among the participants **90%**, followed by hypertension around more than **half** of the participants, then, heart disease **35.65%**. This fits well with the risk profile in the literature, in multi-country study conducted at European regions, China, and North America, they analyzed a 568 survivors and 507 non-survivors from a cohort Elderly males ≥70 years, who didn't receive dexamethasone or remdesivir, showed that the mortality rate was higher in males with COVID19 and have cardiac problems, they concluded that the cardiovascular disease, cerebrovascular disease, and COPD are the main leading death among COVID19 patient, pre-existing comorbidities may decrease the survival time in non-survivors and increase hospital length of stay among COVID-19 survivors (Li et al. 2021), that explains why cardiac disease forms only 35.65% of our sample, as mostly they die . Moreover Wang et.al.2020 confirmed these results in their meta-analysis as they concluded that hypertension, diabetes, COPD, cardiovascular disease, and cerebrovascular disease are the most prevalent risk factors for COVID-19 patients (B. Wang et al. 2020).

One of the core findings in this study was that there is a significant improvement of oxygen saturation SpO2 in between pre and posttest in both groups compared to baseline, with statistically significant more improvement in the intervention group compared with the control. This result is consistent with the findings of other studies, such as Wakde et al. 2021 (Wakde et al. 2021), in addition, moreover, many studies success in proving that chest physiotherapy is a vital treatment aiming to improve oxygen saturation among COVID-19 patients (Kachpile et al. 2020), improving functional outcomes, as well as decrease the hospital length of stay (Battaglini et al. 2020) (Javaherian et al. 2021), this improvements in oxygen saturation because chest physiotherapy could prevent the pathological progression of the lung disease, prevent lung atelectasis, and promote efficient gas exchange(Abdullahi 2020) .

In terms of Respiratory Rate, the intervention group showed more improvements than the control group which is a very good results this finding is similar to Kader (2021) (Kader et al. 2021) findings, who studied 110 COVID-19 hospitalized patients in acute stage, the intervention group received respiratory exercises program while the control group received standardized medical care, They showed a significant improvements in oxygen saturation and respiratory rate in the intervention group. All these results may be attributed to the respiratory rehabilitation, since it improved respiratory muscle function, the flexibility of ribcage, and stimulate gas exchange (Lazzeri et al. 2020) (Abdullahi 2020), consequently it aids COVID-19 patients to manage their respiratory symptoms (Shenoy, Luchtel, and Gulani 2020).

Another finding in this study was dyspnea, it is usually the out product of respiratory rate, it fits well with the patient's respiratory rate, when patient's respiratory rate got worse the dyspnea increased, and vice versa (Marciniuk et al. 2011), so when the respiratory rate improves we can expects the dyspnea improvement. Dyspnea which is defined as subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity, it is also proved that deep breathing exercises can decrease the feeling of dyspnea as it decrease the feeling of anxiety and stress, which are familiar for patients who have severe respiratory

distress symptoms when admitted to the hospital, this what was also confirmed in Hanada, et al (2020) in their meta-analysis, where dyspnea was measured by modified medical research scale (mMRC) in 5 studies, and showed significant improvement in intervention group who had idiopathic pulmonary fibrosis and received aerobic and breathing exercise compared with no intervention (Hanada et al. 2020).

Gait endurance as measured by 2MWT improved significantly at posttest in both groups, with more statistically significant improvement of 2MWT in the intervention group (97.73 meters) compared to the control group (21.3) meters. This agrees with the RCT of Javaherian(2021), in which the intervention group received pulmonary physiotherapy program while the control received medical primary care only, post 6 sessions, both groups were evaluated on oxygen saturation, 3MWT, and mortality rate. Intervention group had significant improvement in 3 minutes- walk test p value .01 compared with the control group, in addition the author reported significant improvement in oxygen saturation, and mortality rate in favor of the intervention group P-value < .05 (Javaherian et al. 2021).

Explanation of the improvement sustained in walking as outcome measures of this study, may be explained in literature, Pulmonary rehabilitation is a core constituent in the treatment of chronic lung disease (Polastri and Nava 2020), because pulmonary rehabilitation is a cost-effective and most efficient intervention (L. L. Yang and Yang 2020). Patients received pulmonary rehabilitation may demonstrate improvements in the lung capacities, that in turn improves the gas exchange, increase the oxygen saturation, reduces dyspnea and fatigue feeling, promoting patients' return to his/her occupations, and improve quality of life (L. L. Yang and Yang 2020). All of these factors may play a vital role in improving walking distance in lung disease patients (Haukeland-Parker et al. 2021).

In terms of forced vital capacity, while both groups had no significant difference at the baseline, in post - test there was around **0.1433** liters difference for the favor of the intervention group, but

this difference was no statistically significant, despite that , this increase is a clinically significant improvement, that may help and augment the patient's ability to perform the above mentioned tests, this vital capacity is representing potential less secretions in the lug, and better extensibility of the lung parenchyma, it is also a reflection of better breathing function, and at the same time, it represents less dyspnea, as with dyspnea the main manifestation is loss of deep breathing that is both contributing to the increased vital capacity, and the potential use of oxygen reached to the respiratory segments of the respiratory system, the things that was showed above in better saturation results, help the patient to be independent in walking without using ventilation, this what was reported by Nolan (2019), walking speed is the best predictor of mortality, as it express the lung physiology and capacities. (Nolan et al. 2019)

Forced expiratory volume in one second (FEV1), was more in the intervention group, however this increase in the FEV1 was not statistically significant and again this highlights the importance of clinical quantification of improvement in medical studies rather than the statically significance of variation between groups or even in pre and post designs. In addition, the intervention group mean of forced expiratory volume was 3.2 liters illustrates the normal range, while the control group was 2.9 that means less than the normal. on the other hand FEV1 is a manifestation of airway obstruction and the ability of the lung to exhale a certain amount of air at the first second, and the challenge of COVID-19 is more in the extensibility of lungs due to potential fibrosis leading to less vital capacity represented here in decreasing FVC which is the major manifestation of clinical lung tests affected by COVID-19, rather than challenges in the FEV1 which is mathematically a byproduct of the FVC (Thomas, Price, and Hull 2021)

Despite that both groups improved, they need advance pulmonary rehabilitation post hospitalization to normalize the whole body parameters, which support the findings of Andrade-Junior (2021) who conducted a research on severe COVID-19 underwent physiotherapy sessions till the discharge, reported several impairments that includes musculoskeletal and respiratory functions, they reported in the previous study, all body functions were better but not as the previous level before COVID-19 (Andrade-Junior et al. 2021).

Length of stay in the control group (**8.23 days**) was significantly decreased compared with the intervention group (**10.13 days**), This also confirmed the findings of Kader et al(2021) as the intervention group of pulmonary rehabilitation had less length of stay than the control group of primary medical care only (Kader et al. 2021).

length of stay is an important indicator of the efficacy of the treatment, in addition, in the pandemic situation all hospitals are searching for any intervention that may help in decreasing the length of patient' stay at hospital, to give the chance for more patients with urgent medical needs to be hospitalized, at the same time, this will also decrease the medical cost of COVID-19 patients' hospitalization (Hong et al. 2020).

In the multivariate regression analysis the effect of the independent variables in the variation of the dependent variables is presented in both magnitude and direction in presence of a set of other independent variables, and in this study multivariate regression analysis clearly identify the positive effect and favorable outcome of the physiotherapy intervention on the rehabilitation outcome in COVID-19 patients represented in better function highlighted in better 2MWT, improved vital capacity represented in better FVC, which is considered a common major challenge in COVID-19 patients, at the same time a suggest physiotherapy intervention showed to be effective in improvement of the FEV1, which represents a more clear airways in the intervention group which may have contributed to have better FEV1.

## 4.3 Study Limitations

There were a several limitations to the present study that the researchers recommend that they may be taken into consideration in any further research:

- The study design, despite that quasi-experimental design can establish the causal-association between the intervention and the results of outcomes used, randomized control trails are stronger, but in this setting it wasn't ethically to use RCT design since we couldn't deprive a certain group from a crucial intervention as PT.

- Follow - up measures were not within the scope of this study, as for example to follow up on patients progression after certain period of time, from their discharge to investigate the long term effect of the physiotherapy intervention.

- Finding of the present study cannot be generalized to all COVID-19 patients, the study excluded cancer, kidney failure, ventilated patients, from the study.

- The scarce similar studies in literature review.

# Chapter Five

5.1 Conclusion

5.2 Recommendations

## 5.1 Conclusion

The present study recruited 60 severe COVID-19 patients 54 male (**73.3%** ) and 6 female (**26.7%**) patients with severe COVID-19, and all the patients in this study were hospitalized in Alia or Dura governmental hospital. Patients were allocated to either the intervention or control group based on location of treatment (Qusai - experimental design). The aim of this study was to investigate the effect of respiratory physiotherapy intervention on functional and respiratory outcome of COVID19 patients.

After conducting this study , the researcher concluded the following

- Physiotherapy sessions demonstrated to be more efficient in improving O2 saturation in the intervention group compared with the control group.
- Suggested Physiotherapy respiratory intervention improves Respiratory rate in COVID-19 hospital admitted severe patients.
- Physiotherapy intervention improves dyspnea in COVID-19 hospital admitted severe patients.
- The functional activity exercises provided for severe COVID-19 hospitalized patients improves the functional ability represented in better 2 MWT.
- Suggested Physiotherapy respiratory intervention improves lung function tests as compared to a control group.
- Length of stay is significantly less in the intervention group than the control group.
- Older Age, gender (being a male), higher BMI, and pre-existing comorbidities are associated with more severe COVID-19 respiratory symptoms

## 5.2 Recommendations

Based on the findings of the present study, the researcher recommends the following :

Recommendations for physiotherapists:

- ✓ Considering the implementation of the documented Physiotherapy intervention in this study in COVID19 hospitalized patients

- ✓ Promoting the use of Unified the outcome measure at physiotherapy departments at national hospitals, to be able to compare between the results of this study and potential future studies.

- ✓ To promote the respiratory rehabilitation program for patients with COVID19 after discharge from the hospital setting.

- ✓ Refer the COVID-19 patients post discharge to outpatient that offer pulmonary rehabilitation sessions.

Recommendations for Researchers: The researcher suggest the following recommendations for further researchers

- ✓ To investigate longer term effect of physiotherapy intervention, after wash out period.
- ✓ To investigate the effect of the suggested protocol on older ages over 61.
- ✓ To investigate the effect of certain component of suggested program on relevant outcomes.

- ✓ Management for a health care system are overwhelmed by COVID-19 pandemic.
- ✓ Investigating the effect of this intervention on the patients were excluded from this study.
- ✓

Recommendations for Ministry of health:

- To consider the results of this study as an evidence on the effectiveness of PT intervention with COVID19 patients
- To disseminate the results of this study at the ministry of health and different Palestinian hospitals level

Recommendations for Patients with COVID-19

- To Adopt the proposed exercises as a part of the self-management of COVID-19
- To seek help by the nearest licensed Physiotherapist as part pf their CPVID-19 management team

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## Appendixes:

### Appendix 1: Data Collection Sheet.

**Al – Quds University**

**Faculty of health professions**

**Physiotherapy department**

# The Effect of Physiotherapy intervention on Functional Outcomes among COVID19 patients at Governmental Hospitals in Hebron/Palestine.

تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كورونا في المستشفيات الحكومية في مدينة الخليل/فلسطين.

**الدراسة تخص رسالة ماجستير للطالبة اثار ابوفارةمن دائرة العلاج الطبيعي في جامعة القدس.**

| | |
|---|---|
| | **Participant Name:** |
| | **Participant Code:** |
| | **Date of Signature:** |

## Section I: Personal Data

1. Name of participant: ……..
2. Phone number: …….
3. Gender : ■ Female ■ Male
4. Date of birth: ……..
5. Age category (in years)
    - (18-24)
    - (25-31)
    - (32-38)
    - (39-45)
    - (46-52)
    - (53-60)
6. Education
    - None
    - Special education
    - Primary education
7. Occupation ----------
8. BMI (Body Mass Index) ----------

## Section II: Medical History

1. Other Diseases:_____
2. Current Medications :_____
3. Previous Surgery:_____
4. Previous injuries :_____
5. Previous ivestigation(s):_____

## Section III: Outcome Measures

| Outcome measures | Pre | Post |
|---|---|---|
| 2 minutes- walk<br><br>Plus- Oximeter Scores | | |
| Respiratory Rate | | |
| Modified Medical Research dyspnea scale | | |
| Incentive Spirometer scores | | |
| 2 Minutes- Walk Test scores | | |

## Appendix 2: Electronic  Spirometer.

## Appendix 3: 2MWT Instructions.

### 2 Minute Walk Test Instructions

General Information:

- individual walks without assistance for 2 minutes and the distance is measured
  - start timing when the individual is instructed to "Go"
  - stop timing at 2 minutes
  - assistive devices can be used but should be kept consistent and documented from test to test
  - if physical assistance is required to walk, this should not be performed
  - a measuring wheel is helpful to determine distance walked
- should be performed at the fastest speed possible

Set-up and equipment:

- ensure the hallway free of obstacles
- stopwatch

Patient Instructions (derived from references below):

*"Cover as much ground as possible over 2 minutes. Walk continuously if possible, but do not be concerned if you need to slow down or stop to rest. The goal is to feel at the end of the test that more ground could not have been covered in the 2 minutes."*

# 2 Minute Walk Test

Name:_____

Assistive Device and/or Bracing Used:_____

Date:_____

Distance ambulated in 2 minutes: _____

Date:_____

Distance ambulated in 2 minutes: _____

Date:_____

Distance ambulated in 2 minutes: _____

Date:_____

Distance ambulated in 2 minutes: _____

## Appendix 4: Dyspnea Scale(mMRC).


Modified Medical Research Council Dyspnoea Scale

| | |
|---|---|
| 0 | "I only get breathless with strenuous exercise" |
| 1 | "I get short of breath when hurrying on the level or walking up a slight hill" |
| 2 | "I walk slower than people of the same age on the level because of breathlessness or have to stop for breath when walking at my own pace on the level" |
| 3 | "I stop for breath after walking about 100 yards or after a few minutes on the level" |
| 4 | "I am too breathless to leave the house" or "I am breathless when dressing" |

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## Appendix 5: Ethical Committee Approval.

Al-Quds University
Jerusalem
Deanship of Scientific Research

بسم الله الرحمن الرحيم

جـامـعـة الـقـدس
القدس
عمادة البحث العلمي

**Research Ethics Committee**
**Committee's Decision Letter**

Date: March 13, 2021
Ref No: 175/REC/2021

**Dear Dr. Akram Amro,**

Thank you for submitting your application for research ethics approval. After reviewing your application entitled "Stroke patients' use of care and functional outcome predictors after discharge from the in-patient rehabilitation settings", the Research Ethics Committee confirms that your application is in accordance with the research ethics guidelines at Al-Quds University.

We would appreciate receiving a copy of your final research report/ publication.

Thank you again and wish you a productive research that serves the best interests of your subjects.

PS: This letter will be valid for two years.

Sincerely,

Suheir Ereqat, PhD
Associate Professor of Molecular Biology

Research Ethics Committee Chair

Cc. Prof. Imad Abu Kishek - President
Cc. Members of the committee
Cc. file

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## Appendix 6: Information sheet.

**نموذج تعريف ومعلومات عن البحث**

**اسم البحث:**تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كورونا في المستشفيات الحكومية في مدينة الخليل/ فلسطين.

**اسم الباحثة :** اثار خالد ابوفارة.

تحية طيبة وبعد

نشكر لكم استعدادكم للمشاركة بهذا البحث، الذي هو جزء من دراسة الماجستير في العلاج الطبيعي في جامعة القدس. هذا البحث يهدف إلى التعرف تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كرونا في المستشفيات الحكومية في مدينة الخليل.

**معلومات عن دور العلاج الطبيعي مع مرضى كورونا**

هو علاج يقوم به اخصائي العلاج الطبيعي بهدف تحسين مستوى التنفس عند المرضى من خلال بعض الوضعيات الخاصة التي تساعد على التخلص من البلغم و زيادة مستوى الأكسجين في الدم ، بالإضافة لذلك يقوم الأخصائي بعمل ضربات متوسطة القوة بيده على منطقة الصدر والظهر كي يساعد المريض على تحفيز الكحة المصحوبة بالبلغم واخراجه عن طريق الفم , ومن ثم يقوم الاخصائي باعطاء تعليمات للمريض لعمل تمارين خاصة لتحريك الأطراف العلوية والسفلية كل مريض حسب قدرته , وسيكون المؤشر على استمرار التمرين او ايقافه هو معدل نبضات القلب بحيث لا يزيد عن 130 ضربة في الدقيقة.

تدخل العلاج الطبيعي ليس له اي آثار جانبية او تعريض المريض للخطر .

ومن المهم أن تقوم بالتمارين وأن تتبع النصيحة التي يمنحك إياها المعالج الخاص بك من أجل الشفاء الأمثل.

تم تدريب المعالج الخاص بك على وجه التحديد في مختلف التقنيات الخاصة في تقييم الحالة وعلاجها . وسيقوم المعالج بدوره عل اكمل وجه.

إذا كنت سعيدًا بمتابعة العلاج على النحو الذي اقترحه اخصائي العلاج الطبيعي ، واجابك على الأسئلة التي ترغب في معرفة اجابتها ، و موافقا على المشاركة في الدراسة يرجى التوقيع على نموذج الموافقة المرفق وتسليمها إلى أخصائي العلاج الطبيعي. والاحتفاظ بهذه النشرة بسجلاتك الخاصة

- طبيعة الفحوصات التي سوف تستخدم في هذا البحث هي فحوصات أمنة ولا يوجد منها اي ضرر على المريض.
- سيكون هناك فحص قبل التدخل العلاجي و بعده.
- تحدث إلى عائلتك وأصدقائك حول هذا الموضوع وخذ وقتك لاتخاذ القرار. إذا قررت المشاركة ، يجب عليك

توقيع هذا النموذج لإظهار رغبتك في المشاركة.

إن قرار عدم المشاركة أو قرار مغادرة الدراسة لاحقًا لن يؤدي إلى أي عقوبة أو يؤثر على الرعاية الصحية الحالية أو المستقبلية .

إن اشتراككم في هذا البحث هو طوعي و مرتبط بتوقيعكم على نموذج موافقة بالمشاركة وتصريح بفهمكم لطبيعة البحث، فحوصاته، والتدخل العلاجي فيه. وفي حال وجود اي استفسار عن البحث او اي شيء متعلق بهذه الدراسة، يرجى التواصل مباشرة مع الباحث ( أ. اثار ابو فارة ) على الرقم التالي 0598466694

**شاكرين لكم حسن تعاونكم**

**اثار ابوفارة**
**اخصائية علاج طبيعي**
**طالبة ماجستير علاج طبيعي**
**جامعة القدس**

## Appendix 7: Consent Form.

## Informed consent to participate in Research

## نموذج الموافقة على المشاركة في البحث

**اسم البحث:** تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كورونا في المستشفيات الحكومية في مدينة الخليل/فلسطين.

**اسم الباحث** : اثار ابوفارة.

**Patient name:**

**Patient code:**

**Evaluator name: _____**

**Date of evaluation and signature: _____**

**عزيزي المشارك /المشاركة**:

توقيعك ادناه على نموذج الموافقة هذا هو بموجب موافقة مكتوبة وموقعة على المشاركة في دراسة بحثية التي تقوم بها الباحثهاثار ابوفارة " تأثير تدخل العلاج الطبيعي على مستوى الأداء الوظيفي لمرضى كرونا في المستشفيات الحكومية في مدينة الخليل ". و هو إقرار بإنه قد تم شرح أهداف البحث و طريقة الفحص و التدخل العلاجي للبحث، وانه قد تم شرح حقوقك المتضمنة:

- سرية المعلومات التي تصرح بها وعدم إطلاع اي شخص عليها و تخزينها في مكان امن لا يصل اليه سوى الباحث.
- إخفاء هوية المشارك في تحليل البحث والنتائج.
- استخدام المعلومات للاغراض العلمية فقط.
- حرية إنسحابك في اي وقت من الدراسة ومن دون الحاجة لإبداء الأسباب ودون اية عواقب شخصية او مالية.
- حقك في الإطلاع على نتيجة فحوصاتك ونتائج البحث النهائية.

**وأنه في حال كان لديك أسئلة حول الدراسة او حول اي معلومة متعلقة بها, يرجى الاتصال بالباحثة:** اثار ابوفارة على رقم التلفون :0598466694

**موافقة المشارك**

لقد تم وصف الدراسة البحثية لي شفهيا، وبما فيه المعلومات المدرجة أعلاه، وأوافق على المشاركة بهذه الدراسة البحثية.
سوف أحصل على نسخة موقعة من هذا النموذج للاحتفاظ بها في سجلاتي، أوافق على المشاركة بهذة الدراسة.

**اسم المشارك الرباعي**: _____

**توقيع المشارك**:_____ **التاريخ**:_____

**اسم وتوقيع الشاهد**:_____ **التاريخ:**_____