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Telehealth program: Effect of Physiotherapy Intervention on Dyspnea, Fatigue and Functional Status of Post COVID-19 Syndrome patients

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Abstract:
Post COVID-19 syndrome, that is marked by dyspnea, fatigue, and functional impairment, is best treated with a non-pharmacologic aproach entitled a physiotherapy intervention program. **Aim:** To evaluate the effect of physiotherapy intervention program through telehealth on dyspnea, fatigue and functional status of post COVID-19 syndrome patients. **Design:** The study utilized a one-group pre and posttest Quasi experimental design with a purposive sample of 60 post Covid-19 syndrome patients. **Setting:** Isolation Medical Unit and Post Covid-19 follow up clinic in main Assiut University Hospital. **Tools:** Data were collected using a structured interview Patient's assessment questionnaire, Modified Medical Research Council Dyspnoea Scale, Chalder fatigue scale, and Post COVID-19 Functional Status Scale. **Results:** statistically extremely significant differences regarding degrees of dyspnea , extent of fatigue, and functional status of post Covid-19 syndrome patients in pre, post (8^{th} wks.), and follow up (12^{th} wk.) of program application with (p=0.001). **Conclusion:** Physiotherapy intervention program applied through telehealth had significant improvement clinically and statistically on dyspnea, fatigue, and functional status. **Recommendations:** Telehealth is especially important currently, as social distancing measures thus using this intervention program by nurses can be effective in improving post Covid-19 syndrome symptoms.

Keywords: Dyspnea, Fatigue, Functional Status, Physiotherapy Intervention, Post Covid-19 Syndrome & Telehealth.

Introduction:
A new variant of severe acute respiratory syndrome brought on by coronavirus 2 (SARS-CoV-2) was first identified in Wuhan, China, during the end of 2019. The COVID-19 virus has spread to every country in the world. The majority of nations are still battling, and some are still struggling, with the issue **(Lu et al., 2020).**

In the context of SARS-COV-2 infection, post COVID-19 syndrome is becoming more widely recognised as a novel clinical entity. It's described as manifestations or symptoms that have persisted for over 12 weeks that are the result of COVID-19 infection (**National Insitute for Health and Care Excellence**, **2020, & Shah et al., 2021).** This illness' progression through time could be categorised as either "acute COVID-19" or "long COVID-19. When symptoms first appear, the acute COVID-19 phase might last up to 4 weeks, while "Long COVID" relates to this phase if the symptoms last longer than 4 weeks **(Jennings et al., 2021).**

The term "Long COVID" was introduced in previous studies to describe those who have recovered from COVID-19 but still have its long-lasting consequences or experience symptoms far longer than would be predicted **(Mahase, 2020 & Sanchez-Ramirez et al., 2021).** These symptoms derived from cellular damage, immune response, inflammatory response, and circulatory dysregulation; such as fatigue, dyspnea, chest pain, dry and productive cough, digestive and neuropsychiatric symptoms, respiratory insufficiency, cognitive and psychoemotional disturbance. Finally, as a result of these sequelae, the patients suffer a decline in their quality of life (**Mehandru & Merad, 2022).**

Due to the significant level of disability following COVID-19 infection, up to one-third of patients hospitalised for COVID-19 reported chronic impairment in physical function, dyspnea, or fatigue at discharge. These patients required ongoing rehabilitation and they need the beginning of an early rehabilitation to contribute the overall optimization of the patient, in addition to its clinical and functional

sequelae (**Helms et al., 2020, Morin et al., 2021, & Puchner et al., 2021).**

Thus, it has been recommended to encourage and enable healthcare follow-ups and consultations via technologies like online video and phone communication rather than in-person contact, providing new frontiers for scheduling clinical meetings with the introduction of telehealth (**Fioratti et al., 2021).**

Physiotherapy intervention program for Post COVID-19 syndrome include therapeutic exercise training as; breathing exercise, chest expansion exercises, airway clearance techniques (Huff-cough technique), active mobilization, and positioning, education, and behavioral changes as fatigue management. **(Sanchez-Ramirez et al., 2021)**. Add to that the physiotherapy intervention program delivered via telehealth is the primary strategy to decrease exertional dyspnea, improve lung capacity, decrease fatigue, restore physical and psychological function, and improve quality of life in acute and long covid-19 patients as well as increase the muscle strength affected by this disease **(Liu et al., 2020, Al-Chikhanie et al., 2021, Gloeckl et al., 2021, Hayden et al., 2021, & Zampogna et al., 2021).**

These outcomes are obtained due to the physiotherapy intervention program oriented toward removing secretions in the airways and retrain the respiratory pattern (control of breathing, chest expansion, and expiration) in order to improve the fatigue and decreasing physical impairment. Therefore, it is necessary not only to recover physical exercise in the inactive patient, but also to position it as a tool in the management of patients with post-COVID-19 syndrome (**Zhu et al., 2020**).

Significance of the study:

As the pandemic progresses, post COVID-19 syndrome has emerged as one of these difficulties. According to the most recent estimates, 10 to 20% of SARS-CoV-2 patients who have an initial symptomatic phase still have symptoms 12 weeks following diagnosis **(WHO, 2021)**. The prevalence of post-COVID-19 symptoms was (87.63%) **(Abdelhafiz, et al., 2022).** The most recent guidelines also emphasize the significance of symptom titrated physical activity and customised exercise in rehabilitation. Therefore, safe, effective exercise stands out as a prospective treatment for reducing the symptoms of post COVID-19, accelerating recovery, and improving quality of life, autonomy, and functionality (**National Institute for Health and Research, 2021).** As a result, physiotherapy intervention program were viewed as crucial tools in the management of chronic disease, as compared to just acute illnesses. The goal of the study was to shed further light on how physiotherapy interventions affect dyspnea, fatigue, and functional status of patients with post-Covid-19 syndrome.

Operational definition:

- **Telehealth nursing:** it is the use of telecommunication technology like (SMS messages, virtual meetings via smartphones, and different apps) to support health information and increase health services **(Kruse et al., 2017).**
- **Physiotherapy interventions:** is defined as a 12 weeks program of therapeutic exercises as; breathing exercise, chest expansion exercises, airway clearance techniques (Huff-cough technique), active mobilization, and positioning **(Sanchez-Ramirez et al., 2021).**
- **Functional status:** is the extent to which an individual participates in activities to fulfil everyday requirements in a variety life aspects, including physical, psychological, social, spiritual, intellectual, and roles. **(American Thoracic Society, 2022).**
- **Post COVID-19 syndrome** (Post acute, or long COVID-19 syndrome) is persistent and debilitating symptoms that are still present at least 4 weeks or more after initial infection. Symptoms often occur in the absence of severe acute infection or preexisting comorbidities (**Shah et al., 2021).**

Study Aim:

The current study aimed to evaluate the effect of physiotherapy intervention on dyspnea, fatigue, and functional status of post COVID-19 syndrome delivered via telehealth program.

Study hypotheses:

- **Hypotheses:** Physiotherapy intervention program have a positive effect on dyspnea, fatigue, and **functional** status of post Covid-19 syndrome adult and elderly patients.
- **Null Hypotheses:** Physiotherapy intervention **program** have no effect on dyspnea, fatigue, and functional status of post Covid-19 syndrome adult and elderly patients.

Patients and Method

Research design:

This study used a pre-post test quasi experimental design. To examine change over time in this kind of quasi-experiment, the researcher gives a pre- and post-test. Additionally, a series of observations are made over time for one group of participants in a pre- and post-research study as the researcher can use pretest-posttest to test participants before performing the experimental manipulation, then test participants after the manipulation to evaluate what changes occurred **(Richardson, 2018).**

Setting: Isolation medical unit and post Covid-19 follow-up clinic at the main Assiut University Hospital's were the study settings. Isolation medical unit is located on the ninth floor. It consists of two large rooms divided into four sectors, each room contains 6 beds for post Covid-19 follow-up. Therefore, the study settings were selected; because of the numerous patients attending the isolation unit at Assiut University Hospital and the abundance of services that the new post covid-19 clinic affords, as well as to meet their demanding requirements.

Sample: A purposeful sample of (60) adult and elderly patients, their age ranged from (20-≥60 years) who were able to communicate, had a verified diagnosis of post COVID-19 syndrome, and agreed to take part in the study.

Exclusion criteria: Patients with recent myocardial infarction and diseases where exercise is contraindicated (e.g. unstable angina pectoris), recent pulmonary embolism, Patients who are receiving other respiratory rehabilitation programs, and without adequate technologies (Mobile,WIFI, Computer, E-mail).

Sample size: was calculated using Epi info statistical package version 7. Based on the following parameters for Pre\post test quasi experimental research design; expected Post COVID-19 cases 0.50, with acceptable margin of error 0.05, design effect 95% confidence level. The required sample size was 60 patients. The number of cases in Assiut on 2020 were 444 patients.

Tools of the study:

Tool (I): A structured interview post Covid-19 Patient's assessment questionaire:

It was designed by the researchers based on literature review to assess demographic characteristics, clinical information, and to determine the most common Post Covid- 19 syndrome symptoms. It included two parts

Part (1): Demographic characteristics of the participants: It includes (8 items) which are age, gender, occupation, marital status, residence, level of education, occupation, and smoking status.

Part (2): Clinical information of the participants:It includes (2 items) which are, oxygen saturation monitoring**,** and Post Covid 19 syndrome symptoms such as (presence of fatigue, cough, headache, shortness of breath, chest pain, joint pain, gastrointestinal issues, and loss of taste and smell, along with neuropsychiatric symptoms such as insomnia, anxiety, depression, delirium and skin manifestations).

Tool II: Modified Medical Research Council (MMRC) Dyspnea Scale:

It was adopted from **(Mahler & Wells, 1988).** It is a self-rating tool to measure the dyspnea degree that breathlessness poses on day to day activities. Patients are asked to describes their dyspnea level. The scoring range for MMRC is 0 to 4. Where (0) indicates that there is no breathlessness other than during strenuous exercise; (1) indicates that there is shortness of breath when rushing up a slight hill or walking on a level surface; (2) indicates that one walks more slowly than people their own age do when walking on a level surface due to breathlessness; (3) indicates that one stops for breath after walking for more than 100 metres or after a few minutes on a level surface; and (4) indicates that one is too breathless to leave the house, breathless when dressing.

It is considered to be a relevant tool for evaluating dyspnea in clinical practice because the Arabic Dyspnea Scale is a valid and reliable instrument in Saudi nationals (intraclass correlation coefficient = 0.94, P = 0.01) **(Alyami et al., 2015)**.

Tool III: Chalder fatigue scale (CFQ-11):

It was adopted from **(Chalder et al., 1993)**. It is a self-administered questionnaire for measuring the extent and severity of fatigue. It contains 11 items, each of the items are answered on a 4-point scale ranging from asymptomatic to maximum symptomology, such as 'Better than usual', 'No worse than usual', 'Worse than usual' and 'Much worse than usual'. For all items, the least symptomatic answers are on the left of the response-set, providing an easy-to-understand checklist for respondents. Using the Likert scoring method, responses on the extreme left receive a score of 0, increasing to 1, 2 or 3 as they become more symptomatic.

Scoring system: The respondent's global score can range from 0 to 33. On an ordinal 0 to 3 scale, the score also spans two dimensions include physical fatigue measured by items 1-7 (range 0-21), and psychological fatigue measured by items 8-11 (range 0-12).

Chalder fatigue scale seems to be a reliable and valid instrument with high internal consistency with Cronbach's α of the total scale items 0.74 by **(Mcllvenny et al., 1999)** in the United Arab Emirates setting.

Tool IV: Post covid-19 Functional Status (PCFS) scale:

It was adopted from **(Klok et al., 2020).** PCFS concentrates on changes in lifestyle and restrictions on daily activities. To quickly assess the functional status of patients who had COVID-19, an instrument was created by a group of worldwide experts using a Delphi analysis.

With examinations at 4 and 8 weeks after discharge to monitor immediate recovery and at 6 months after discharge to assess functional limits, the scale analyses patients who need short and long-term follow-up. It was classified as grade 0 if there was no

restriction on activity, grade 1 if there was a negligible impact on patients' activities, and grade 2 if the intensity of the activities was decreased. Grade 3 explained why some tasks were impossible to complete, requiring patients to structurally change them. Finally, patients with obvious functional impairments were placed in category 4.

The Post Covid-19 Functional Status (PCFS) scale appears to be a reliable and valid tool with internal consistency. According to **Kutükcü et al. (2021)**, the PCFS test and retest scores have a Cronbach's alpha value of 0.821.

Method:

1. Administrative design:

The head manager of the main Assiut University Hospitals was given an official letter requesting approval to carry out the study after describing the study's objectives to the dean of the nursing faculty.

Pilot study: It was done on 6 (10%) patients who had post Covid-19 syndrome. Prior to beginning data collection, a pilot study was conducted to evaluate the feasibility of the tools and make any necessary adjustments. There was no difficulty with the tools. The study did not include those patients. they were excluded from the total study sample.

2. Ethical Considerations:

Research proposal was approved from ethical committee in the faculty of nursing, Assiut University (7-2021). There was no risk for study subject during application of the study. The study was following common ethical principles in clinical research. Informed consent was obtained from the patients who is willing to participate in the study after explaining the nature and purpose of the study. Confidentiality and anonymity were assured. The Studied subject had the right to refuse to participate or withdraw from the study without rational at any time. Patient privacy was considered during collection of data.

Phases of physiotherapy intervention program: it was carried out into three phases:

- **Assessments and planning phase:** The researchers introduced themselves to the patients and explained the nature and goals of the study during the initial meeting. The consent of the participants was received. The researchers used **Tool I** to gather demographic and clinical data of each participant.
- Also, assessment was conceded to every patient using **Tool II** (MMRC) to measure the degree of dyspnea that breathlessness poses on day to day activities, **and Tool III (CFQ-11)** for evaluating the level and severity of fatigue.
- Then, the researchers used **Tool IV** to determine current functional limitations in post COVID-19 patients, whether or not as a result of the specific infection, and to objectively determine this degree of disability.
- Sessions of data collection were carried out in Isolation Medical Unit and Post Covid-19 follow up clinic at Main Assiut University Hospital, while the physiotherapy interventions program was completed during the follow up period through telehealth.
- The trained researchers planned a telephone interview with participants who agreed to participate.
- On the first day of the interview, Post COVID-19 patients were given information regarding the physiotherapy interventions. Researchers also kept in daily contact with participants via a smartphone app as a reminder throughout the program time and to increase adherence.
- A simple Arabic educational training booklet supplied with photos and illustration had been developed by the researchers based on determined needs, baseline assessment and relevant literatures to help the participants understand the content. On the other hand; this booklet was audio-visual recorded with illustrations to ensure that participants understood it through telehealth.

A. Implementation phase:

- The content of program and exercise, performed for three sessions per week for 12 week.
- A program of physiotherapy was implemented for all post covid-19 patients joined in the study.
- The patients were divided into small groups according to suitable time and readiness to attend sessions.
- Each group consisted of 4-5 patients suffering of post COVID-19. Topic explanations depending on the level of education of post covid participants.
- The **first session:** At the beginning of this session, the researchers made revision to the aims of the physiotherapy intervention program for post COVID-19 patients. Studied participants received the basic knowledge of post COVID-19 syndrome that included: meaning, most common symptoms, and related complications.
- **The second session:** Before any exercise, participants were informed to use a pulse oximeter to check their oxygen saturation. Oxygen saturation (SpO2) was measured using a finger pulse oximeter while the participants rested and stayed seated. The pulse oximeter was put on the index finger, which was clean and free of debris. The pulse oximeter was given enough time to measure the oxygen saturation and detect the pulse. Normal oxygen saturation ranges are between 96% and 100%.
- The patients were taught how to perform breathing exercise which included five exercises; breathing control, diaphragmatic breathing exercise, deep

breathing exercise, chest expansion exercise and huffing -cough technique.

- **Breathing control:** patients were instructed to take slow, deep breaths through their noses in order to manage their breathing. It was advised that they breathe through their mouths if they were unable to do that. Counseling was offered to patients on how to try to release any tension or stress from their bodies with each exhalation, while also maintaining relaxed shoulders and progressively trying to slow down their breathing. The patients often continued breathing for six breaths at a time until they were ready to move on to the next step.
- **Diaphragmatic breathing:** Patients are instructed to complete ten diaphragmatic breathing exercises while sitting comfortably. In this position, they sat with their knee bent, shoulders relaxed, and one hand on the upper chest wall and the other just below the ribs; afterward, take a breath in through the nose for 3 seconds and out through the mouth for 3 seconds, and take a normal breath between two consecutive sessions.
- **The deep breathing exercise:** patients were told to inhale slowly, deeply, and for a long time via their nose. They were then told to hold the breath for two to three seconds before softly exhaling. The patients then let out a sigh without exhaling forcefully.
- **Chest expansion exercises procedure:** patients instructed to bring hands up to shoulders, placing fingertips at the top of shoulders, elbows pointing forward keep breathing at a normal pace, and move elbows out to sides in a horizontal plane, at the end of the motion bring the elbows back to starting position.
- At the termination of this session, the researchers instruct the patient how to perform **Airway clearance techniques:** as Huff-cough technique. By instructing patients to sit up straight with chin tilted slightly up and mouth open. Take a slow deep breath to fill lungs about three quarters full. Hold breath for two or three seconds. Exhale forcefully, but slowly, in a continuous exhalation to move mucus from the smaller to the larger airways. Repeat this maneuver two more times and then follow with one strong cough to clear mucus from the larger airways. Do a cycle of four to five huff coughs
- After each breathing exercise session, the patients were instructed to stay in a prone position for at least 30 minutes. Each session lasted roughly 15 minutes and was conducted at least 1.5 hours after a meal.
- **Third session:** At this time, the researchers instruct patients to perform **Active mobilization exercises:** as sitting at edge of bed, active upper and lower limbs range of motion exercises and strength exercises for lower limb as (straight leg raise exercise, hip extension in prone position, hip abduction in side lying, inner range quads, knee extension in sitting, heel raises, step ups, sit to stand exercises).
- **Positioning:** The patients were instructed to avoid lying down in supine position and to maintain a prone position for at least 6 to 8 hours (but not for the entire day) to improve saturation (gas exchange) and optimize ventilation perfusion matching. For the remainder of the time, a lateral side-lying position was kept in accordance with the most recent recommendations**.**
- The researchers provided a summary at the close of each session, highlighting the important themes.
- These sessions were repeated for every new group of studied participants.
- This period lasts 3 months.
- **Teaching methods and materials:** The researchers utilized straightforward teaching methods like lectures, discussions, role plays, and demonstrations. The researchers developed coloured handouts, a PowerPoint presentation, and videos on the physiotherapy program and distributed these to each participant as part of the used media.
- The implementation of the program took one year from the start of August 2021 to the end of April 2022.

B. Evaluation phase:

It was conducted at post COVID-19 outpatients' clinics in Assiut University Hospital and through phone for follow up, this phase was performed two times, first evaluation was after the 8^{th} weeks (posttest) and the second evaluation follow-up was after the12^{th} week from program implementation. Post COVID-19 patients were evaluated by using the **Tool II** to measure the degree of dyspnea, Chalder fatigue scale **(Tool III)** for measuring the extent and severity of fatigue, and post COVID-19 Functional Status scale (**Tool IV**) to determine current functional limitations in COVID-19 patients.

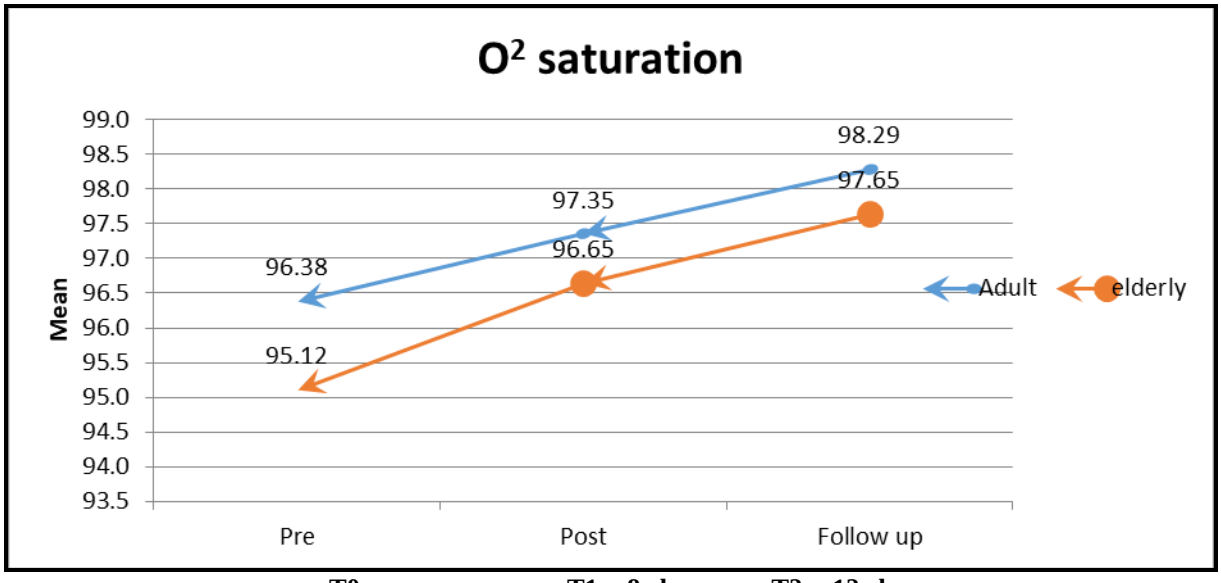
Statistical analysis:

The gathered information was analyzed, prepared for computer entry, coded, examined, and tallied. Using SPSS version 22 and Excel 2016, descriptive statistics (frequency, percentage, mean, and standard deviation) were calculated. Chi-square test with a P-value of 0.05 was used for the analysis of variance. T-test used to compare between categorical variables where compare between continuous variables, Correlation Co-efficient test to examine the association between scores; Statistical significance was determined as a two-tailed p 0.05. The IBM SPSS 20.0 software was used for all analyses.

Results:

Table (1): Percentage and frequency distribution of enrolled patients regarding to their demographic characteristics (n=60).

Characteristics and category	N.	%
Age/ year		
• 20>60 years	34	56.7
• ≥60 years	26	43.3
Mean±SD (range)	**49.37±16.65 (20-80)**	
Gender		
• Male	35	58.3
• Female	25	41.7
Marital		
• Single	18	30.0
• Married	38	63.3
• Divorced	2	3.3
• Widow/ widower	2	3.3
Residence		
• Urban	31	51.7
• Rural	29	48.3
Education		
• Illiterate	8	13.4
• Read and write	3	5.0
• Secondary school	20	33.3
• University	29	48.3
Occupational status		
• Employer	39	65.0
• Not work	21	35.0
Smoking status		
• Yes	20	33.3
• No	40	66.7



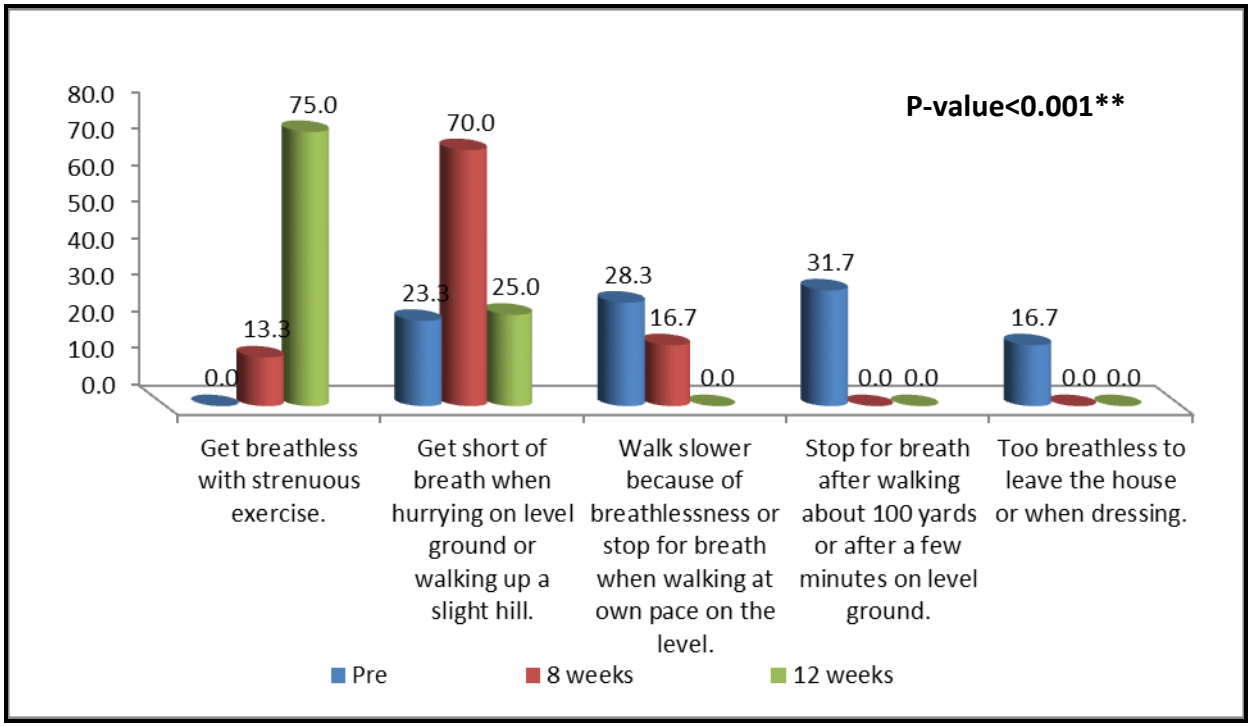
T0: pre T1: 8wks T2: 12wk

Figure (1): Oxygen Saturation readings plotted over the three phases of program between adult and elderly patients.

Table(2): Percentage and frequency distribution of enrolled patients regarding to their Post Covid 19 syndrome symptoms in pre, post and follow-up of the program (n=60).

Post Covid-19 Syndrome Symptoms	Pre		Post (8th Wks.)		Follow-up (12th Wk.)		P. value
	No	%	No	%	No	%	
Fatigue							
• No	0	0.0	22	36.7	54	90.0	<0.001**
• Yes	60	100.0	38	63.3	6	10.0	
Cough.							
• No	17	28.3	52	86.7	58	96.7	<0.001**
• Yes	43	71.7	8	13.3	2	3.3	
Headache							
• No	13	21.7	44	73.3	54	90.0	<0.001**
• Yes	47	78.3	16	26.7	6	10.0	
Shortness of breath							
• No	10	16.7	24	40.0	52	86.7	<0.001**
• Yes	50	83.3	36	60.0	8	13.3	
Chest pain							
• No	12	20.0	25	41.7	48	80.0	<0.001**
• Yes	48	80.0	35	58.3	12	20.0	
Joint pain							
• No	23	38.3	33	55.0	42	70.0	0.002**
• Yes	37	61.7	27	45.0	18	30.0	
Brain fog							
• No	47	78.3	57	95.0	58	96.7	0.001**
• Yes	13	21.7	3	5.0	2	3.3	
Gastrointestinal issues							
• No	48	80.0	60	100.0	60	100.0	<0.001**
• Yes	12	20.0	0	0.0	0	0.0	
Loss of taste and smell							
• No	27	45.0	57	95.0	60	100.0	<0.001**
• Yes	33	55.0	3	5.0	0	0.0	
Neuropsychiatric symptoms such as insomnia, anxiety, depression, delirium							
• No	22	36.7	35	58.3	47	78.3	<0.001**
• Yes	38	63.3	25	41.7	13	21.7	
Skin manifestation							
• No	52	86.7	54	90.0	59	98.3	0.059
• Yes	8	13.3	6	10.0	1	1.7	

- Chi square test for qualitative data between the two groups or more
***Significant level at P value < 0.01*



T0: pre T1: 8wks T2: 12wk

Figure (2): Changes in mMRC dyspnoea scale through three phases of program among patients with post covid syndrome.

Table (3): Comparison between physical and psychological fatigue questions based on Chalder Fatigue Scale among patients with post covid-19 syndrome throughout program phases (n=60).

Questions	Pre		Post (8 Wks.)		Follow-up (12 Wk.)		P. value
	N.	%	N.	%	N.	%	
• Have problems with tiredness							
Less than usual	1	1.7	6	10.0	34	56.7	<0.001**
No more than usual	4	6.7	29	48.3	23	38.3	
More than usual	27	45.0	25	41.7	3	5.0	
Much more than usual	28	46.7	0	0.0	0	0.0	
• Need to more rest							
Less than usual	0	0.0	4	6.7	36	60.0	<0.001**
No more than usual	1	1.7	34	56.7	21	35.0	
More than usual	33	55.0	22	36.7	3	5.0	
Much more than usual	26	43.3	0	0.0	0	0.0	
• Feel sleepy or drowsy.							
Less than usual	3	5.0	18	30.0	53	88.3	<0.001**
No more than usual	15	25.0	34	56.7	5	8.3	
More than usual	29	48.3	8	13.3	2	3.3	
Much more than usual	13	21.7	0	0.0	0	0.0	
• Have problems when starting things.							
Less than usual	4	6.7	15	25.0	51	85.0	<0.001**
No more than usual	12	20.0	37	61.7	8	13.3	
More than usual	30	50.0	8	13.3	1	1.7	
Much more than usual	14	23.3	0	0.0	0	0.0	

Questions	Pre		Post (8 Wks.)		Follow-up (12 Wk.)		P. value
	N.	%	N.	%	N.	%	
• Lack energy							
Less than usual	0	0.0	3	5.0	34	56.7	<0.001**
No more than usual	2	3.3	32	53.3	23	38.3	
More than usual	30	50.0	25	41.7	3	5.0	
Much more than usual	28	46.7	0	0.0	0	0.0	
• Having less strength in muscles.							
Less than usual	0	0.0	1	1.7	19	31.7	<0.001**
No more than usual	0	0.0	18	30.0	32	53.3	
More than usual	19	31.7	41	68.3	9	15.0	
Much more than usual	41	68.3	0	0.0	0	0.0	
• Feel weak							
Less than usual	0	0.0	3	5.0	35	58.3	<0.001**
No more than usual	3	5.0	35	58.3	22	36.7	
More than usual	30	50.0	22	36.7	3	5.0	
Much more than usual	27	45.0	0	0.0	0	0.0	
Total physical fatigue (Mean±SD)	16.07±3.13		8.68±2.87		3.03±2.48		<0.001**
• Having difficulties concentrating.							
Less than usual	8	13.3	34	56.7	49	81.7	<0.001**
No more than usual	25	41.7	18	30.0	11	18.3	
More than usual	16	26.7	8	13.3	0	0.0	
Much more than usual	11	18.3	0	0.0	0	0.0	
• Make slips of the tongue when speaking.							
Less than usual	27	45.0	50	83.3	57	95.0	<0.001**
No more than usual	27	45.0	10	16.7	3	5.0	
More than usual	4	6.7	0	0.0	0	0.0	
Much more than usual	2	3.3	0	0.0	0	0.0	
• Find it more difficult to find the right word.							
Less than usual	30	50.0	54	90.0	59	98.3	<0.001**
No more than usual	26	43.3	5	8.3	1	1.7	
More than usual	1	1.7	1	1.7	0	0.0	
Much more than usual	3	5.0	0	0.0	0	0.0	
• How is your memory?							
Less than usual	11	18.3	40	66.7	52	86.7	<0.001**
No more than usual	29	48.3	18	30.0	8	13.3	
More than usual	17	28.3	2	3.3	0	0.0	
Much more than usual	3	5.0	0	0.0	0	0.0	
Total Psychological fatigue (Mean±SD)	4±2.53		1.22±1.52		0.38±0.76		<0.001**
Total fatigue score (Mean±SD)	20.07±5.18		9.9±3.79		3.42±2.76		<0.001**

- Chi square test for qualitative data between the two groups or more
***Significant level at P value < 0.01*

Table (4): Distribution of functional status grades among Post Covid-19 Syndrome patients throughtout Program Phases (n=60).

Parameters	Grades	Pre		Post (8 Wks.)		Follow-up (12 Wk.)		P-value
		No	%	No	%	No	%	
No limitation	0	0	0.0	6	10.0	29	48.3	<0.001**
Negligible limitation	1	7	11.7	25	41.7	23	38.3	
Slight limitation	2	19	31.7	21	35.0	6	10.0	
Moderate limitation	3	20	33.3	7	11.7	2	3.3	
Severe limitation	4	14	23.3	1	1.7	0	0.0	

- Chi square test for qualitative data between the two groups or more
***Significant level at P value < 0.01*

Table(5): Correlation Co-efficient between Degree of Dyspnea, Fatigue Chalder Scale and Functional Status scale among patients with Post Covid-19 Patients according to age groups Throughout Program Phases, (n=60).

Correlations[a]	Age(Adult=1/elderly=2)					
	Pre		8th wks.		12th wk.	
	R	P	r	P	r	P
The degree of dyspnea (Council Dyspnea Scale)	.269*	0.038	.254*	0.050	-0.039	0.768
O2 saturation	-.255-*	0.049	-0.220	0.091	-.296-*	0.022
Chalder fatigue scale	0.187	0.153	0.157	0.230	-0.035	0.792
Post-covid-19 functional status scale	.289*	0.025	.385**	0.002	.310*	0.016

Table (6): Correlation Co-efficient between Degree of Dyspnea, Fatigue Chalder Fatigue Scale and Functional Status scale among patients with Post Covid-19 Patients Throughout Program Phases, (n=60).

		Pre		Post (8th Wks.)		Follow-up (12 Wk.)	
		mMRC	Fatigue	mMRC	Fatigue	mMRC	Fatigue
• **Degree of Dyspnea.**	R	1		1		1	
	P						
• **Fatigue.**	R	.340**	1	.339**	1	0.233	1
	P	0.008		0.008		0.073	
• **Functional status.**	R	.431**	.335**	.517**	.326*	0.183	0.117
	P	0.001	0.009	0.000	0.011	0.162	0.373

**statistically Significant Correlations at P. value <0.05*
***statistically Significant Correlations at P. value <0.01*

Table (1): The demographic characteristics of post-covid-19 syndrome patients are listed in The percentage of the male patients was (58.3%) and (41.7%)corresponded to the female gender, (63.3%) of them were married, more than half (56.7%) were adult patients, their age ranged from 20 to less than 60 yrs with a mean age of (**49.37±16.65)** (Minimum 20 years, Maximum 80 years). Less than half (48.3%) of patients had university education, and (33.3%) had secondary school education. Among the recruited patients 51.7% resided in urban areas versus (48.3%) lived in rural areas. Two thirds (66.7%) of patients were nonsmokers, (33.3%) were smokers.

Figure (1): Clarifies a clinically significant improvement in oxygen saturation readings over the three phases of program between adult and elderly participants with post-COVID-19 syndrome.

Table (2): Shows post Covid 19 syndrome symptoms in Pre, Post and follow-up of the program; a highly statistically significant difference was found regarding the post Covid-19 syndrome among studied patients include fatigue, cough, headache, shortness of breath, chest pain, brain fog, gastrointestinal issues, loss of taste and smell and neuropsychiatric symptoms with P-value<0.001 at pre, post and follow up test. While regarding skin manifestation no

significant difference was observed with P-value=0.059 at pre, post and follow up test.

Figure (2): Display that there were highly statistically significant differences between all grades of dyspnea throughtout the three phases of program among patients with post covid syndrome at P-value-0.001

Table (3): Reflects a highly statistically significant difference in physical and psychological fatigue among patients with post covid-19 syndrome throughout program phases (P-value<0.001**).

Table (4): Summaries functional status grades among patients with Post Covid-19 Syndrome throughtout Program Phases, it found that pre program (20) patients (33.3%) showed moderate functional limitation (Grade 3), while (25) patients (41.7%) showed negligible limitation (Grade 1) at 8 weeks of program application, and (29) patients (48.3%) showed no limitation at 12 week of program application with highly significant difference (P <0.001**).

Table (5): Reflects that there was a significant positive correlation between adult and elderly patients as regard degree of dyspnea throghtout two phases of program application (pre , & 8 weeks (r= .269$^{*, \&}$.254* respectively). Regarding oxygen saturation, it was found from this table that there was a negative correlation between adult and elderly patients over pre and post follow up (12 weeks) (r= -.255-$^{*, \&}$.-.296-* respectively) of program application. As regard Post-covid-19 functional status scale, it was found that there was a significant positive correlation between adult and elderly patients throghtout the three phases of program application (r= .289*, .385**,& .310* respectively).

Table (6): Shows that there was a significant positive correlation between degree of dyspnea, fatigue and functional status of patients with post covid-19 over three phases of program intervention**.**

Discussion:

Nearly 90% of COVID-19 hospitalised patients have post acute COVID-19 sequelae **(Nasserie et al., 2021 & Paneroni et al., 2022)**. As a result, even individuals who did not require medical attention following the acute phase of the disease may still endure varying degrees of respiratory and functional impairment, highlighting the significance of physical and respiratory rehabilitation. Dyspnea was the most often reported symptom, followed by fatigue and intolerance to physical activity **(LaVergne et al., 2021)**.

In light of the social isolation brought on by the pandemic, telehealth-delivered physical therapy interventions may therefore be a great therapeutic option for encouraging early intervention to restore pre-infection respiratory and functional status. Telehealth can also increase patient adherence, due to its convenience and accessibility **(Werneke et al., 2021).** Therefore, the aim of the current study is proposed to evaluate the physiotherapy intervention program via telehealth effects on dyspnea, fatigue and functional status of adult and elderly patients with post COVID-19 syndrome.

In respect to demographic and clinical information; our study foun a male was predominance among the studied patients, more than half of patients, their age ranged from 20>60yrs, with a mean age of (**49.37±16.65**). Less than half of patients had university versus one third of them had secondary school education.

Our fndings are in line with the study conducted by **Ali & Hasan, (2022)** at Faculty of Nursing, Helwan University who verified that a slightly more than half of patients were in the age group 50 years or more with a mean age of (47.19 + 9.34). Also they added about two thirds of the study patients were male and married. As well, about half of them had university educational level.

In addition, Our data are in agreement with **Okan, et al., (2022)** who conducted a study entitled as "Evaluating the Efficiency of Breathing Exercises via Telemedicine in Post-Covid-19 Patients: Randomized Controlled Study" and their study findings reported that mean age of intervention group was 48.85± 10.85, more than half of patients were male.

Moreover **Arab-Zozani et al., (2020)** in their study about "Health-Related Quality of Life and its associated factors in COVID-19 Patients", they mentioned that about half of the study patients were from 51-60 years, were male and married.

On the other hand, **Huang et al., (2021) & Gamal et al., (2022)** revealed contradictory results, where the proportion of female with COVID-19 in their study was higher than that of male and the mean age of the patients was 55 years. This could be explained that this age group is more vulnerable due to an antibody-mediated process or dysregulated immune response **(Halpin et al., 2021).** As for the interpretation of gender, It has been hypothesized that the X chromosome and female sex hormones are essential for females' intrinsic immunity to SARS-CoV-2 **(Kadel, & Kovats, 2018).**

The study finding denoted also that more than half of the recruited patients resided in urban areas, and two thirds of them were non smokers. This finding was supported with prior study by **Barakat, & Awad., (2022)** who cleared that most of the study participants live in the urban areas.This could be explained by overcrowded and inadequate sun exposure for urban residents. In addition, This result of study coincided with the study of **Abdelhafiz et al., (2022) & Okan**

et al., (2022) who mentioned that regarding smoking habits over than two thirds of patients were non smokers.

With regard to oxygen saturation readings, the findings of the current study indicated a clinically significant improvement in oxygen saturation readings over the three phases of nursing physiotherapy program via telehealth. This finding was similar with the study conducted by Daswani**, & Bhatia., (2021)** who mentioned that respireatory rehabilitation delivered to COVID-19 patients showed that SPO2- saturation levels were monitored pre and post every session. Whereas, average saturation for patients in week 0 was 93-94% without O2 support; which had shown significant improvement in week 4 i.e. the average saturation of 98-100% without O2 support.

In accordance with the previous findings another study conducted by **Kokhan et al., (2021)** clarified that after engaging in physical activity, the dynamics of blood oxygen saturation and lung vital capacity enhancement existed. Following physical rehabilitation, there is an upward tendency in the dynamics of the indicators of external respiratory function. Individual physical activity significantly increased blood oxygen saturation in post covid patients, SpO2 > 97, 2%. From the researchers point of view this could be contributed to the effect of telehealth physiotherapy program which included exercises as breathing control, pursed lip breathing, diaphragmatic breathing which helped in the improvement of gas exchange.

In the current study results showed that most of patients suffered from one or more of post covid 19 syndrome symptoms. Nevertheless, the frequency of post-COVID symptoms was significantly higher among participants pre application of teleheleath program. This coincides with a study conducted by **Abdelhafiz et al., (2022**) who reported that a prevalence of post-COVID syndrome symptoms were (87.63%), where the most frequent symptom was fatigue (60.86%). Also the present study revealed that there was highly statistically significant difference regarding the post Covid-19 syndrome among studied patients with P-value<0.001 at pre, post and follow up from application of telehealth physiotherapy intervention program. This finding supported by **Garfan et al., (2021)** who cleared that the use of telehealth during epidemic conditions of the COVID-19 pandemic has the potential to control disease and management of clinical cases. From the researchers points of views, the possible explanation was that a good telehealth nursing program may scale up patients' insight and awareness which led to improvements of symptoms.

Interestingly; in this study there was highly statistically significant differences between all grades of dyspnea throughtout the three phases of program among patients with post covid syndrome at P-value-0.001. Similar finding was revealed by **Daswani & Bhatia, (2021)** as they observed an improvement in MMRC Dyspnea score of minimum 2 grades amongst all patients which is clinically significant.

This study finding also was congruent with **Rodriguez-Blanco et al., (2022)** who stated that the analysis shows significant differences in dyspnea grade. Furthermore, the study done by **Li et al., (2021)** who conducted telerehabilitation program for Covid-19 (TERECO) and their findings at post-treatment endorsed a favourable outcome for mMRC dyspnea in the TERECO group 90.4% vs. 61.7% in control (adjusted RR 1.46, 1.17-1.82, p=0.001).

Moreover, the study finding was in line with another study done in Spain by **Gonzalez-Gerez et al., (2021)** who proved the clinical applicability of the respiratory telerehabilitation programme intervention by demonstrating that subjects belonging to the experimental group achieved statistically significant changes in the type of dyspnea in the study group compared to the control group and with size effects much higher than those generated in the control group. It may be attributed that the decrease in dyspnea might be due to physiological adaption to therapeutic exercise training **(Ahmed et al., 2021).**

According to fatigue among our studied patients; it was found a highly statistically significant difference in physical and psychological fatigue throughout program phases. In accordance with a study done by **Rodriguez-Blanco et al., (2022)** who reported that Telerehabilitation programs focused on respiratory and strength training significantly improved patients with post-COVID-19 physical health and lowered fatigue, dyspnea, and perceived effort. Furthermore, it was reported by **Dalbosco-Salas et al., (2021)** that fatigue improved significantly after the intervention. These effects could be attributed to the various approaches of Physicotherapy interventions given to the patient **studied (Zhu et al., 2020).**

Concerning functional status grades among patients with Post Covid-19 Syndrome throughtout Program Phases, it found that pre program nearly one third of patients showed moderate functional limitation (Grade 3), while nearly more than fourth of them showed negligible limitation (Grade 1) at 8 weeks of program application, and less than half of them showed no limitation at 12 week of program application with statistically significant difference.

This finding is consistent with prior study by **Spielmanns et al., (2021)** who clarified that the pulmonary rehabilitation to post covid 19 syndrome

patients showed significant improvements in all parameters of measurements in the form of functional independence measures and 6-min walk test. As a consequence, health facilities should create and carry out plans for comprehensive rehabilitation treatment in settings to restore functioning and stop the progression of long-term COVID-19 syndrome effects.

In agreement with the previous findings that telehealth physiotherapy program had a positive effect of dyspnea level, fatigue and post covid functional status a study conducted in Community Based Nursing Research Center in Iran by Kalantari, **et al., (2021)** reported that home-based pulmonary rehabilitation improved patients with COVID-19's daily living abilities by reducing fatigue and dyspnea. As a result, the intervention group's levels of fatigue and dyspnea decreased. Additionally, compared to the control group, the intervention group reported considerably greater levels of daily living activities.

In relation to correlation co-efficient between degree of dyspnea, fatigue and functional status among patients with post Covid-19 syndrome and their age group throughout Program Phases, the results of the present study demonstrated that significant positive correlation between adult and elderly patients as regard degree of dyspnea throghtout phases of program application. This is consistent with the findings of **Hussein et al., (2021)**, who revealed that the majority of recovered COVID-19 cases have varying degrees of functional restrictions ranging from negligible to severe depending on Post covid-19 Functional Status (PCFS). These restrictions were influenced by ageing.

On the other hand; this in contrast with the results by **Izquierdo et al., (2020)** as they stated that there were no relations between long COVID symptoms or long-haulers symptoms with basic demographic characteristics, for example, age, sex, body weight, initial SpO2, as well as few affordable laboratory parameters.

Regarding Correlation Co-efficient between degree of dyspnea, fatigue and functional status among patients with Post Covid-19 Patients throughout program phases, the results of the present study revealed a positive correlation between degree of dyspnea, fatigue and functional status of patients with post covid-19 over three phases of program intervention.

This was consistent with a study conducted in Community Based Nursing Research Center in Iran by **Kalantari, et al.,(2021)** who recorded that three indices of dyspnea, fatigue, and physical activity were interrelated; thus, higher fatigue and lower physical activity were reported in patients. And also reported that patients had more difficulty breathing with increasing dyspnea, leading to fatigue and decreased activity levels.

Added to that, the current findings is similar to a study by Leite et al. (2022), who found that participants with a PCFS (post-covid functional status) grade 3–4 displayed greater symptoms of fatigue, had a worse HRQoL, and worse functionally than those with a PCFS grade 0. Participants with PCFS grades 1-2 also reported worse HRQoL than those with PCFS grades 0 and better functional performance than participants with PCFS grades 3–4.

Conclusion:

The study concluded that: Physiotherapy intervention program applied through telehealth proved its effectiveness in improving dyspnea, fatigue and functional status among patients with post Covid-19 syndrome. In light of this, Physiotherapy intervention program seems to be useful in the management of post covid syndrome sequale. These findings justified the research hypotheses.

Recommendations:

In the light of the study findings, the following recommendations are suggested:

Covid-19 patients should receive physiotherapy intervention program through telehealth as part of their post-discharge care for minimizing the effects of post COVID-19 symptoms, promoting recovery, and boosting patient's functional status.

Further research:

The late functional problems and the efficacy of physiotherapy intervention in lowering dyspnea, fatigue and enhancing functioning in post-COVID 19 patients require more research with larger samples.

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