Effect of Multidisciplinary Rehabilitative Interventions on Fatigue, Kinesiophobia, and Shortness of Breathing among Post-COVID-19 Patients

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Abstract

Background: Post-COVID-19 patients suffer from numerous psychological and physical problems that interfere with normal functioning and need rehabilitation services to overcome these problems. Aim: Determining the effect of multidisciplinary rehabilitative interventions on fatigue, dyspnea, and kinesophopia, among post-COVID-19 patients. **Subjects and Methods**: A quasi-experimental design was conducted on a sample of 100 adult patients who were admitted to the COVID-19 isolation department in a university hospital in the Menoufia governorate, Egypt. They were randomly assigned into two equal groups: The study group received multidisciplinary rehabilitative interventions, and the control group received usual hospital care. The following instruments were employed to gather data: A structured interview questionnaire, a knowledge assessment questionnaire, the Chalder Fatigue Scale (CFS), The Modified Medical Research Council Dyspnea Scale, and a shortened version of the Kinesiophobia Tampa Scale for 11 items (TSK-11). **Results**: A highly significant diffriences was found between the two groups as regards the mean score of knowledge after the intervention (p= 0.000). Also, highly Significant statistical differences were found in the mean scores of CFS, the dyspnea scale and TSK-11 in favor of the study group when comparing the results of the two groups at three weeks and at six weeks after the intervention (p value < 0.001). **Conclusion**: The study has concluded that implementing multidisciplinary rehabilitative interventions have a significant role in lowering fatigue, dyspnea and kinesiophobia post-COVID-19. **Recommendations**: Comprehensive rehabilitative intervention shoulde be offered by a multidisciplinary team to improve patients' outcomes post-COVID-19.

Keywords: Multidisciplinary Rehabilitative Intervention, Fatigue, Kinesophopia, Dyspnea, Post-COVID-19

Introduction

The World Health Organisation (WHO) officially identified SARS-n-CoV-2 on December 31, 2019. It originated in the Chinese city of Wuhan and swiftly expanded over the world (2020). On March 11, 2020, WHO confirmed that the disease caused by the new coronavirus has become a pandemic. WHO reports that COVID-19 has affected countries all over the world, irrespective of location, population, or climate **(WHO, 2022).**

Following a severe COVID infection, many patients will face a variety of difficulties with normal functioning and will require rehabilitation treatments to address these issues **(Wade, 2020).** As a result, rehab has grown in importance since the worldwide pandemic began. The COVID-19 environment has presented a number of issues to the rehabilitation community **(Besnier et al., 2020, Scherrenberg et al., 2020).** It includes: (1) treating the multiple functional impairments that COVID survivors endure as a result of the disease's effects on their lungs, hearts, kidneys, vascular endothelium, muscles, and central nervous systems; (2) controlling the infection to prevent the virus from spreading to medical personnel and other patients; and (3) providing acute and post-acute rehabilitation **(Levi et al., 2020; Salawu et al., 2020).**

After the patient leaves inpatient acute care, the post-acute phase begins. **Amenta et al. (2020)** divided post-acute COVID-19 manifestations into three categories: (1) organ dysfunction that continues after the initial recovery from acute infection; (2) residual manifesteations that remain after acute infection's recovery; and (3) new disorders or manifesteations that appear after the first absence of symptoms or mild infection. The cornerstone of managing the effects of COVID-19 is rehabilitation, with its interdisciplinary approach that comprises medical, physical, occupational, psychological and social rehabilitation, as well as dietetics. Essential rehabilitation goals include reducing the negative effects of prospective long-term limitations on participation, such as resumed employment, leisure pursuits, social interactions, and health related quality of life (HRQoL) **(Huang et al., 2021; Nasserie et al., 2021).**

Recommendations for rehabilitation are thus urgently needed, with the goal of guiding rehabilitation facilities and experts on safe and

efficient procedures during the COVID-19 outbreak, along with the entire system of rehabilitation care **(Thornton, 2020).** Early interventions based on therapeutic exercise must be carried out to avoid and treat all of these sequelae following the post-acute period **(Leochico, 2020; Ceravolo et al., 2020).** Even for individuals with respiratory disorders, this may result in enhanced performance, which could lessen symptoms like fatigue and dyspnea **(Jimeno-Almazan et al., 2022).**

Kinesiophobia is a widespread psychological problem among post-COVID-19 patients. In a trial to examine variables linked with the existence of kinesiophobia admitted COVID-19 patients with post-COVID pain were shown to have kinesiophobia levels of 10.9% high, 21.3% moderate, and 24.6% mild **(Herrero-Montes et al., 2023)**. Rehabilitation treatments have been shown to improve both physical and cognitive performance **(Zhang et al., 2019).** As a result, a lack of rehabilitation therapy may endanger patients with needless hospitalizations (such as those caused by trauma from falls), a worsening of their condition, an increased load on their caregivers, and a reduced quality of life **(Hosey and Needham, 2020).**

Lifestyle is now thought to be a multifaceted concept that encompasses behaviours such as nutrition, physical activity and outside pursuits **(European Lifestyle Medicine Organization, 2021).** Dietary adherence to the Mediterranean diet should be increased compared to before the pandemic **(Rodrguez-P'erez et al., 2020).** The majority of researchers have found that the post-COVID-19 participants were less active during the quarantine, which has been connected to reduce subjective well-being and a lower life quality that is associated with one's health **(Suzuki et al., 2020).**

One of the essential aspects of rehabilitation after COVID-19 is physical therapy, which includes a variety of breathing exercises that can help reduce dyspnea and tiredness, improve lung capacity, reduce anxiety and tension, and restore disease-related muscular weakness **(Zhu et al., 2020).** These exercises targeted to remove secretions from the airways and retrainin the pattern of respiration (regulation of respiration, expansion of the chest, and exhalation) to increase respiratory volume and oxygen saturation, which lowers fatigue **(Barker-Davies et al., 2020).** Aerobic and strengthening exercises are also important because they were important in improving patient health **(Craciun, 2021; Fontana et al.,2023).**

The comprehensive rehabilitation program positively affects the functional status of the patients, which provides a benchmark for the rehabilitation of COVID-19 in acute care hospitals **(Wada et al., 2024).** A multidisciplinary team should be included in the rehabilitation program for patients with COVID-19, since the disease causes chronic symptoms in multiple body systems. To encourage recovery and enhance the quality of life for those affected by disease, a comprehensive strategy that includes behavioral components of self-care, physical rehabilitation, emotional support, and health education should be employed **(Felisbino et al., 2024).** In the recent study, the researchers try to evaluate the influence of a multidisciplinary rehabilitative intervention on fatigue, kinesiophobia, and shortness of breath among post-Covid-19 patients.

Significance of the study

The World Health Organization has recorded 446, 308 confirmed instances of COVID-19 in Egypt **(Saied et al., 2021).** These cases required rehabilitation services to lessen disability and restore patients' normal capabilities, with very little and restricted evidence; analyzing the effects of rehabilitation on typical post-COVID-19 disorders such as fatigue, kinesiophobia, and shortness of breath. This study, on the other hand, will broaden the field of COVID-19 nursing rehabilitation

Aim of the study

The current study aim was to determine the effect of a multidisciplinary rehabilitative intervention on fatigue, kinesiophobia, and shortness of breath among patients after COVID-19.

Research questions:

- Does the knowledge score improve among patients engaged in a multidisciplinary rehabilitative intervention compared to those who are not engaged?
- Is the mean fatigue score lower among patients who receive a multidisciplinary rehabilitative intervention than among those who don't?
- Does the mean score of dyspnea decrease among patients who receive a multidisciplinary rehabilitative intervention than among those who don't?
- Does the mean score of kinesiophobia decrease among patients who receive a multidisciplinary rehabilitative intervention compared to those who don't (the control group)?

Operational definitions:

- **Rehabilitative interventions** referes to multiple, coordinated interventions and patient education consist of pulmonary rehabilitation, breathing and coughing exercises, use of incentive spirometry, body posture to improve breathing during sleeping. Supervised physical activity to manger fatigue and dietary recommendations after COVD-19..
- **Fatigue** is operationaly defined as physical and psychological tiredness and measured in the recent study by instrument 3: (CFS).
- **Kinesiophobia** is operationaly defined in the recent study as fear of movement, avoidance of

physical activity,and measured by instrument 5 (TSK-11).

- **Shortness of Breathing** is operationally defined as self rating the degree of dyspnea and measured by instrument4(MMRC dyspnea scale).
- **COVID -19** is an infectious disease caused by the SARS-CoV-2 virus.

Subjects and Method

Research design :

The research design was quasi-experimental because this was most suitable to fulfil the study purpose .

Setting:

The recent study was conducted at the COVID-19 isolation department and COVID-19 at Menoufia University Hospital, Menoufia, Governorate, Egypt.

Subjects

A purposive sample of 100 Post-COVID-19. Patients in the aforementioned setting who had the inclusion criteria

Sampling technique and follow-up of the study participants:

Atotal of 171 adult patients with COVID-19 were admitted to the isolation department at Menoufia University Hospital from the beginning of January 2022 until March 30, 2022. When they were screened, only 141 patients met the inclusion criteria of the study, while ten patients died before discharge. So, 131 patients were randomly assigned to receive either usual routine hospital care or a multidisciplinary rehabilitative intervention for a duration of six weeks after discharge. Of the 131 patients, 100 (study = 50 and control =50) completed the period of study, including a response rate of 76.3%. Of the participants, 31 (study = 15; control =16) dropped out. See the flow chart of the sample (Figure 1). The most common reasons for dropout included a loss of follow-up and poor compliance. Other participants dropped out (did not respond to the phone call) and lost follow-up in the outpatient clinic. If the patient lost more than 25% of follow-up outpatient clinic visits or phone calls, or if he/she didn't complete the questionnaire at any phase of the study, he/she was removed from the sample.

Inclusion criteria :

Post-COVID-19 patients, 18 years of age or older of both genders, accepted for participation in the study. They were able to understand and follow intervention instructions, and were taken one week before discharge from the COVID-19 department.

Exclusion criteria :

Patients had severe cognitive impairment or intellectual disability preventing them to understand or respond effectively to program instructions.

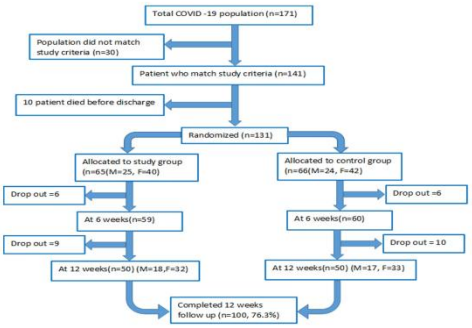


Figure (1)

Instruments for data collection:

Five instruments were used for collection of the necessary data as follows:

Instrument 1: Structured interview questionnaire:

It was constructed by the researchers to collect baseline demographic and medical characteristics. It covers the following two distinct sections; 1) Demographic data such as age, sex, marital status, educational level, and occupation; 2) Medical data: such as patient history of chronic diseases, current health status, smoking, and activity.

Instrument 2: Knowledge Assessment Sheet:

The researchers reviewed the literature before creating this instrument, and it consisted of 10 questions to assess the patient's knowledge about the following: COVID-19 information, recommended lifestyle modifications such as nutrition regimen, activity, exercises, and smoking

Scoring system:

Every question scored two marks if the patient answered a completely accurate answer, one mark if the subject provided an incompletely correct answer, and zero if the answer was erroneous or the patient stated, "I don't know." All questions were added up to produce a score ranging from 0 to 20. Percentage of score = obtained score / total score x 100. The score was divided into three categories as follows: a score less than 60% denoted poor knowledge, a score from 60% to 75% denoted fair knowledge, and a score greater than 75% denoted good knowledge. These are standardized categories that were mentioned by **(Richardson& Belanger, 2021).**

Instrument 3: Chalder Fatigue Scale (CFS):

It is a self-administered questionnaire created by Trudie Chalder at King's College, London to measure the extent and severity of fatigue in fatiguing illnesses (Chalder et al., 1993). It uses Likert scoring rated from Zero to three; answers on the extreme left gained a score of 0, increasing to one, two or three as they become more symptomatic. The scale includes two subscales or dimensions: physical fatigue (measured by items 1–7) and psychological fatigue (measured by items 8–11). The Likert

scoring system allows for means and distributions to be calculated for both the global total and the two sub-scales. The total score ranging from zero to thirtythree; a higher total score shows more severe fatigue symptoms.

Ahn & Lee (2020) examined the questionnaire reliability and dedicated that it contain good internal consistency. Cronbach's alpha coefficient was 0.967 for all items, 0.963 for physical fatigue, and 0.958 for mental fatigue. Based on these results, it is a valid and reliable tool.

Instruments 4: Modified Medical Research Council (MMRC) Dyspnea Scale:

It was developed by **Mahler et al., (2009).** It is a self-rating instrument used by the researchers to measure the degree of dyspnea in day-to-day activities. Furthermore, it is a five-point Likert scale ranging from 0 to 4: 0, no breathlessness and 1 representing mild shortness of breath when rushing on a level or walking up a slight hill; 2 representing walking slower on a level than people of the same age due to breathlessness; 3 representing ceasing for breath after a few minutes on the level (severe); and 4 representing too much breathlessness to leave the house or to dress or undress (very severe).

Validity and reliability:

Mahler et al., (2009) indicate that the scale had acceptable test-retest reliability and the scale reliability was determined with Cronbach's alpha coefficient equal to 0.82.

Instrument 5: The shortened version of the Tampa Scale for Kinesiophobia 11 items (TSK-11).

It was created from the original version of TSK-17 items by **Woby et al., (2005).** It is a self-reporting questionnaire that assesses fear of movement, physical activity, and avoidance. Likewise, it is composed of 11 questions where the patient indicates their level of agreement or disagreement with each topic (four signifying "complete agreement," and one indicating "complete disagreement"; total score range: 11 to 44). While there isn't a definitive cutoff score for the TSK-11, we have embraced Nicholas et al.'s score for the TSK-17 across a range of chronic pain syndromes **(Nicholas et al., 2008).** There were four categories for kinesiophobia: minimum (TSK-11 score 11–22), low (TSK-11 score 23–28), moderate (TSK-11 score 29–35), and high (TSK-11 score ≥36).

Validity and reliability:

The TSK-11 exhibits high reliability when assessing kinesiophobia, and it could serve as a valuable tool for assessing kinesiophobia resulting from fatigue. According to **Kese et al. (2023)**, the TSK-F 11's Cronbach's α was 0.89.

Procedure:

following the explanation of the study's purpose, consent was obtained from the hospital director and the head nurses of the COVID-19 outpatient clinics and COVID-19 isolation wards in the above-mentioned setting.

Prior to collecting data on ten patients, **pilot study** was conducted to assess the objectivity, clarity, application, and feasibility of each instrument. In addition, it was used to gauge how long it took to collect data and find any issues related to using the instruments. The appropriate adjustments were then made.

Data collection were over a period of 6-months, beginning in January 2022 and ending in June 2022. **Step 1**: The eligible study participants were chosen one week before discharge to undertake the multidisciplinary rehabilitative intervention. **Step 2:** The patients were selected and divided randomly or alternatively into two equal groups: The intervention group received rehabilitative interventions (detailed information about recommended lifestyle modifications, physical activities, breathing exercises, and a dietary regimen that they should follow post-COVID-19) to get rid of dyspnea and fatigue and improve health status, while the control group received the routinely hospital care and directions that were provided by the hospital. For the purpose of randomization, each participant took a number, and the odd number was assigned to the study group and a double number to the control group. **Step 3:** Each participant underwent an individual interview, and baseline demographic and medical data were obtained by instrument 1. Knowledge level, fatigue, shortness of breath, and kinesiophobia were examined using the study instruments 2, 3, 4, and 5, respectively. The average time spent completing questionnaires was between 25 and 35 minutes. The obtained data was used as a baseline assessment. **Step 4:** The researchers developed an instructional Arabic booklet guided by pictures to clarify breathing and coughing exercises, an incentive spirometer use, and recommended physical activities. It also contained complete information about recommended lifestyle modifications and dietary regimens. The booklet was designed based on baseline data obtained, participants' needs, and related recent literature based on **(Saha & Sharma 2022; Kader et al., 2022; and Tozato et al., 2021). Step 5:** Three educational sessions were conducted for the participants of the study group, each session lasting around 15 to 20 minutes and involving a face-to-face interview

with each patient to aid in reinforcing the learned knowledge and increasing their performance. The study group patients selected the time slot for each session, which was between 9:00 and 10:00 a.m. each day.

In the first session, researchers gave advice to all study participants regarding post-COVID-19 food modifications, exercise regimens, and lifestyle changes. Additionally, it is taught the value of not smoking and the impact that it has on the health of its patients.

The second session: At this session, the researcher provided an introduction about the rehabilitative interventions which includes pulmonary rehabilitation (breathing and coughing exercises, use of incentive spirometer, body posture during sleep to improve breathing) and provide full explanations for the steps of these interventions. Based on the needs of the participants, the researchers revised and reinforced the information presented at the conclusion of the session. The participants were also given the opportunity to re-perform all of the previously taught exercises by the researchers.

Third session: Redemonstration was emphasized where the researchers allowed participants to redemonstrate all the exercises they had learned until competent performance, then gave them the opportunity to ask questions about any information that wasn't obvious. During this session, reinforcement was carried out according to the subject's needs. At the end, each patient in the intervention group obtained a copy of the Arabic booklet, which included all the educational contents to be used as a reference to remind and help participants in the application of rehabilitative interventions. Participants were phoned or came to outpatients every week for follow-up throughout the study period.

The time frame of the study (Figure 2) indicated that the total study duration started one week before discharge and ended six weeks after discharge. Each participant was assessed for their knowledge twice through the study period via instrument 2: at the beginning of the study (pre-intervention) and immediately after the intervention, but fatigue, dyspnea, and kinesiophobia were assessed via instruments 3, 4, and 5, respectively, three times: at the beginning of the study, after six weeks, and after twelve weeks of discharge to examine the effect of multidisciplinary rehabilitative interventions on fatigue, kinesiophobia, and shortness of breath among post-COVID-19 patients. The obtained data were analyzed by using Statistical Package for the Social Sciences (SPSS) version 25. The comparison between the intervention group and the control group was done to examine the effect of a multidisciplinary rehabilitative intervention on fatigue, shortness of breath, and kinesiophobia, among patients post-COVID-19.

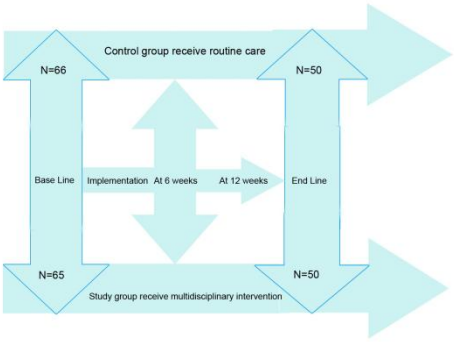


Figure (2)

Rehabilitative interventions for study group:

Dietary recommendations:

Vegetarian diets, which include fruits, vegetables, lentils, whole-grain products, medicinal plants, nuts, and the seeds are high in phytochemicals, fiber, and antioxidants. Such diets have reduced saturated fat, inflammatory components generated from animals, and no cholesterol **(Saha & Sharma, 2022).**

Exercises and positioning:

Some gentle movement to get the blood flowing again as a steady walk, some gardening, or a stretching routine that feels restorative, then transfer to more movement, such as static cycling or speed walking, the participants do that for 30 minutes per day for two days and increase gradually, according to tolerance, to be at least 4 days per week. A high-sided lying position is recommended to support the head and neck **(Saha & Sharma, 2022).**

Coughing and deep breathing exercise:

The patients were trained to take a deep, long, and slow nose breath and hold air for 2–3 s before exhaling from the mouth. For a repetition of 10 breaths at a time, three times per day. Coughing exercises are done for 2 sets, each set composed of two active coughs after a deep breathing exercise, with a 1-minute rest between the two sets **(Kader et al., 2022).**

Ethical considerations

A written approval was obtained to apply for this study from the Ethical and Research Committee of the Faculty of Nursing, Menoufia University, Menoufia Governorate, Egypt, (Approval number (872) / Date: 15/5/2021). All participants signed a formal consent to participate in the study, and they were guaranteed that all acquired data would be kept strictly confidential and used solely for research purposes. The nature of the instruments will cause no harm to study participants. Moreover, participation in the study is

fully voluntary, as confirmed by the researchers, and the patients' privacy was ensured by scoring all data and storing all papers in a locked cabinet. Subjects were also told that refusing to participate in the study would have no impact on their care.

Statistical analysis:

SPSS software version 25 was used to analyze the data. The range, mean, and standard deviation of quantitative data were computed. The Chi-square test (X2) was used to compare two groups of qualitative data, which characterize a categorical set of data by frequency, percentage, or proportion of each category. Student's t-test was used to compare the means of two groups of parametric data from independent samples. A paired t-test and a repeated measures ANOVA were used to compare quantitative data for related groups according to the numbers of measurements. For the interpretation of test results, significance was set at p value ≤0.05 (Dawson and Trapp, 2001).

Results

Table (1): It is evident from the table that the dominant gender in both groups was female, representing 64% of the intervention group and 66% of the control group. Nearly half of the participants in the two groups were between 40 and 55 years old, with a mean age of 49.35 and 50.11, respectively. Furthermore, the majority of the subjects in both groups were widowed, educated, unemployed and non-smokers,. As regards medical data, the mean ± SD of BMI was (31.71 ± 5.33 and 32.21 ± 4.21), respectively, for the study and control groups. All participants in both groups suffered from difficulty in breathing, and nearly half of the studied subjects suffered from loss of smell, but fatigue was present in one-third of the subjects in the study sample.

Table (2) presents statistically significant differences between baseline and post-intervention knowledge scores in both groups, where p values were 0.000 and 0.002, respectively for the study and control groups. It is obviously noted that there is no significant statistical difference between both groups before the intervention as regards the knowledge score (p = 0.16). Conversely, a highly significant difference was found between the two groups in favor of the study group regarding the mean score of knowledge after intervention (p value = 0.000)

Figure (3): It was found from the figure that 90% and 92% of the intervention group and the control group, respectively, had poor knowledge before the intervention, compared to the post-intervention, where 82% and 5% of the study and control groups, respectively, had good knowledge.

Table (3) demonstrates statistically significant differences in the fatigue score among all study phases (baseline at 6 weeks and 12 weeks after intervention) in both groups, where the p values for the study and control groups were 0.000 and 0.003, respectively. The table also revealed a highly significant lowering of the score of the Chalder Fatigue Scale for the intervention group compared to the control group when comparing the Chalder Fatigue Scale score in both groups after intervention at six weeks and at 12 weeks, where the p value was equal to 0.000.

Figure (4): It was found from the figure that 12% and 10% of the study group and the control group, respectively, had high kinesiophobia before the intervention, compared to 0% and 8% of the intervention and control groups, respectively had high kinesiophobia at the 12 week,.

Table (4): Obviously, the table revealed statistically significant differences in kinesiophobia scores among all study phases (baseline at six weeks and 12 weeks post-intervention) in both groups, with p values of 0.000 and 0.003, respectively, for the study and control groups. When comparing the dyspnea degrees in both the study and control groups in each phase of the study, we found that no statistically significant difference was found between the two groups before the intervention with respect to the Tampa Scale mean score for kinesiophobia. After the intervention, a highly significant difference was found between the two groups at six and 12 weeks after the rehabilitative interventions, where the P value was equal to 0.000, respectively.

Table (5) displays that no statistically significant difference was found between the two groups before the intervention, but after the intervention, a highly significant difference was found between the two groups at the sixth and twelveth week, where the p values were 0.047 and 0.000, respectively. There were 70% and 66% of both the intervention and control groups, respectively, with a moderate degree of dyspnea before the intervention. In contrast, post-intervention, at the third week, 40% of the study group and 62% of the control group had moderate dyspnea. But at the twelveth week, 70% and 22% of intervention group and control group participants, respectively, had no dyspnea except during exertion.

Table 1: Distribution of both groups regarding demographic and medical data (n = 100)

Variables	Study group (I) (No = 50)		Control group (II) (No = 50)	
	No.	%	No.	%
Age (years)				
• 25-40	16	32	14	28
• 40-55	24	48	23	46
• 55+	10	20	13	26
X ± SD	49.35. ± 12.2		50.11 ± 11.12	
Sex				
• Male	18	36	17	34
• Female	32	64	33	66
Marital status				
• Single	9	18	7	14
• Married	12	24	11	22
• Widow	29	58	32	64
Educational Levels				
• Illiterate	9	18	8	16
• Read and write	20	40	18	36
• Secondary education	15	30	17	34
• High education	6	12	7	14
Occupation				
• Work	31	62	36	72
• Not work	19	38	14	28
Smoking				
• Smoker	14	28	16	32
• Non-smoker	36	72	34	68
Body mass index (X ±SD)	31·71± 5·33		32.21± 4.21	
History of chronic diseases				
• Hypertension	6	12	5	10
• Diabetes	4	8	2	4
• Both hypertension and diabetes	3	6	3	6
Clinical symptoms				
• Difficult breathing	50	100	50	100
• Loss of smell	23	46	26	54
• Palpitation	18	36	29	58
• Fatigue	35	70	39	78
• Headache	31	62	26	52

Table 2: Differences in mean knowledge scores among the study and control groups regarding lifestyle modifications and post-care before and after education phases (n =100)

Variables	study group N = 50 X± SD	control group N = 50 X± SD	Student-t test t & P value
Mean score of knowledge before intervention	4.64 ± 0 .63	4.88± 0.63	t = 1.91 p = 0.16
Mean knowledge score after the intervention	17.68 ± 1.77	6.02 ± 0.88	t =4 4.02 p = .000**
Paired-t test			
t	t =45.65	t =7.98	
p value	p = .000**	p = .0002*	

(*) Statistically significant at P < 0.05 (**) High significant at P value <0.001

Figure 3: Knowledge levels among study and control groups in regard to COVID 19 and post-care before and after intervention (n =100).

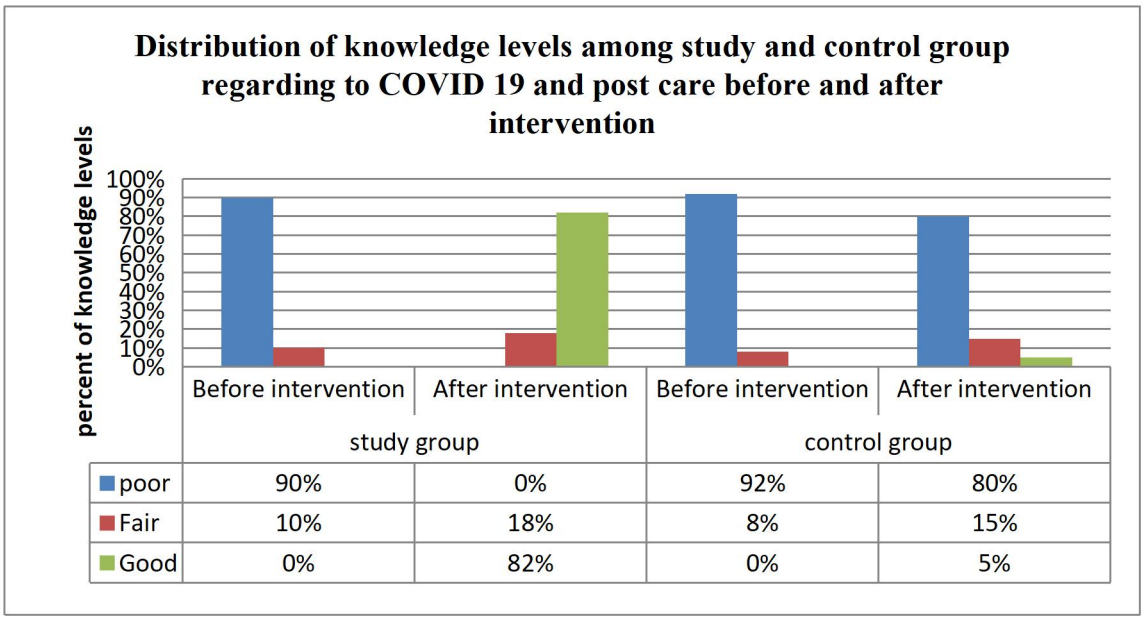
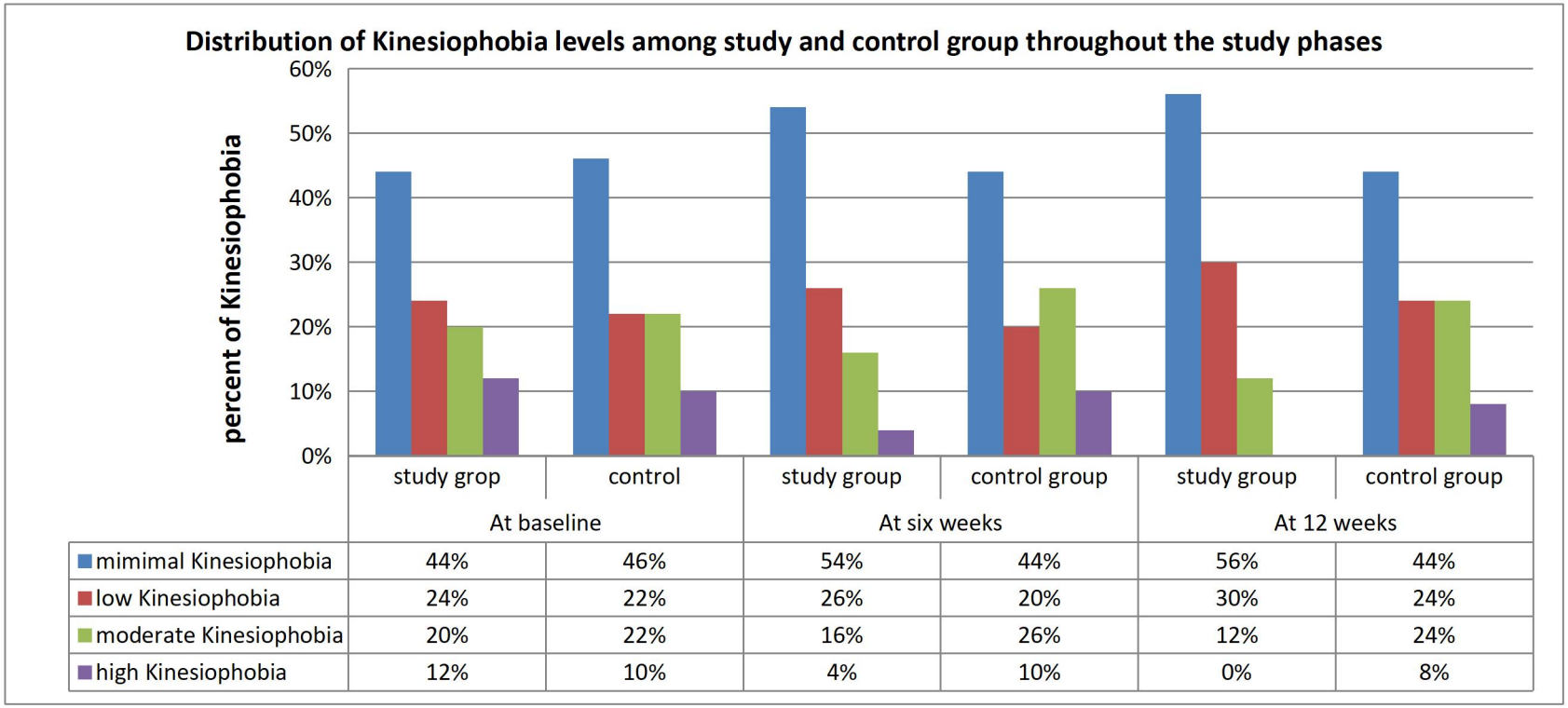


Table 3: The differences in the mean score of the Calder Fatigue Scale among the study and control groups throughout the study phases (n = 100)

Groups	Baseline	6 weeks after intervention	12 weeks after intervention	ANOVA-test F & P-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Study (N = 50)	29.62 ± 0.97	15.72 ± 1.46	6.64 ± 1.14	4614.19 0.000
Control (N = 50)	29.54 ± 1.07	26.64± 3.55	23.32 ± 1.73	38.13 0.003
t & P value	0.392 0.696	20.09 0.000*	56..92 0.000*	

(*) Statistically significant at P < 0.05 (**) High significant at P value <0.001

Figure (4): Distribution of kinesiophobia levels among study and control groups throughout the study phases



	At baseline		At six weeks		At 12 weeks	
mimimal Kinesiophobia	44%	46%	54%	44%	56%	44%
low Kinesiophobia	24%	22%	26%	20%	30%	24%
moderate Kinesiophobia	20%	22%	16%	26%	12%	24%
high Kinesiophobia	12%	10%	4%	10%	0%	8%

Table 4: The differences in the mean scores of the Tampa Scale of Kinesiophobia (TSK) among the study and control groups throughout the study phases (n = 100)

Variables	study group N = 50 X± SD	control group N = 50 X± SD	t & P value
Mean score of TSK before the intervention.	29.13. ± 8.14	28.21 ± 7.98	t = 1.31 p = 0.192
Mean score of TSK at six weeks after the intervention.	21.40 ± 9.73	26.38 . ±9.30	t =28.05 p = .002**
Mean score TSK at 12 weeks after the intervention	15.26 ± 8.41	24.45 ± 8.79	t =26.40 p = .001**
F & P-vaue	F=1581.41 P = 0.000	F= 98.58 P = 0.003	

(*) Statistically significant at P < 0.05 ** High significant at P value <0.001

Table (5): The relationship between study and control groups concerning degrees of dyspnea according to the MMRC dyspnea scale throughout the study phases (n =100).

Variables	study group N = 50		control group N = 50		X^2 P value
	No	%	No	%	
Dyspnea degrees at baseline					
• Moderate	35	70	33	66	X^2 = 1.84
• Mild	15	30	17	34	P = 0.668
Dyspnea degrees at six weeks after intervention					
• Moderate	20	40	31	62	X^2 = 34.86
• Mild	19	38	15	30	P = .0.047*
• No dyspnea	11	22	4	8	
Dyspnea degrees 12 weeks after intervention					
• Moderate	5	10	19	38	
• Mild	10	20	20	40	X^2 =24.02
• No dyspnea	35	70	11	22	P = .000**
Friedman Test(X^2) p-value	X^2 = 39.12 P= 0.000**		X^2 = 75.64 P= 0.006*		

(*) Statistically significant at P < 0.05 ** High significant at P value

Discussion

A multidisciplinary rehabilitative intervention has been applied to post-COVID-19 patients measuring its effect on dyspnea, fatigue, and kinesiophobia. The study group displayed a significant increase in knowledge level with regard to COVID-19 and post-intervention care. Also, significant improvements were observed in fatigue, dyspnea, and kinesiophobia after intervention in favor of the study group. The discussion of the study results will be as follows:

Effect of multidisciplinary rehabilitative intervention on knowledge level

According to findings of a recent study, there was an improvement in the two groups score of knowledge; this reflected the effect of care that was provided for each group. The results of the independence test indicate there was an extremely substantial variace identified between the two groups in terms of the mean score for total knowledge after the intervention in favor of the intervention group. The results were similar to the findings of **Li et al., (2021).** They reported that the intervention group has improved in knowledge post-intervention compared to the control group. Also, this finding was corresponding to **Nambi, et al. (2022),** who stated similar findings. From the researcher's point of view, knowledge is improved by implementing multidisciplinary rehabilitative nursing interventions.

Effect of multidisciplinary rehabilitative intervention on fatigue

The current study reported that the the score of fatigue in the two groups improved ; this reflected the result of care that was delivered for each group, but the improvement in the study group was greater than that in the control group, where the findings showed a highly significant lowering of the the CFS score for the patient of intervention group compared to the control group when comparing the CFS scoring after the intervention at six weeks and at twelve weeks. These findings align with **Jimeno-Almazan et al., (2022),** who found less fatigue and improved functional status post-rehabilitative interventions in the intervention group in a clinical trial to compare the outcomes of post-COVID-19 patients with conditions after performing directed therapeutic exercise interventions. Also, according to study done by **Bompani et al., (2023),** about the prediction of fatigue and neuropsychological components on functional results in COVID-19 after multidisciplinary rehabilitation interventions, they reported that post rehabilitation, the sample showed a substantial decrease in the level of fatigue.

Moreover, these results are similar to those of a study conducted by **Ferraro et al., (2020) and De Sire et al., (2022),** who proved that rehabilitation played a role in the reduction of fatigue in post-COVID-19 syndrome patients and supported the significance of a timely rehabilitation intervention. From the researcher's point of view, these relate to highly effective pulmonary rehabilitation exercises and educational guidance used during the rehabilitative interventions..

Baseline kinesiophobia among studied patients

Findings of the recent study revealed that at baseline assessment, 20 and 12% of the patients in intervention group had moderate and high kinesiophobia, respectively, and 22% and 10% of the patients in control group had moderate and high kinesiophobia, respectively. This is similar to **Herrero-Montes et al., (2023)**, who assessed kinesiophobia post-COVID-19 and found that patients had high kinesiophobia levels, where, 21.3% had moderate levels, and 10.9% had high levels.

Effect of multidisciplinary rehabilitative intervention on kinesiophobia score

The study findings point out an improvement in the Kinesiophobia score after intervention, but the study group improvement was greater than the control group. As to the differences in the mean scores of TSK among the study and control groups throughout the study phases, the current study displayed a highly statistically significant difference between the two groups in favor of the study group after the intervention, at six weeks and twelve weeks after the intervention. These findings supported those of **(Kamonseki et al., 2021),** who found that physical therapy techniques could be as effective as other cognitive interventions in the management of inappropriate cognitive behaviors like fear, kinesiophobia, and severe pain in people with conditions of musculoskeletal pain. Our findings are also consistent with those of **Houben, & Bonnechere (2022),** who noted that numerous rehabilitation treatments offered to improve the functions and quality of the COVID-19 infection patients' life in both the acute and chronic phases. Rehabilitation helped to alleviate dyspnea, anxiety, and kinesiophobia during the acute phase. Furthermore, according to **Jimeno-Almazan et al., (2022)**, exercise is the most suggested therapeutic strategy for the therapy of people with long COVID, especially those with pain symptoms. Besides, our findings were consistent with **Halle et al., (2022),** who reported improved outcomes for kinesiophobia after rehabilitation with COVID-19. We can stress that it may be subjected to the effects of the multidisciplinary Rehabilitative Intervention and nursing interventions implemented post-COVID-19.

Effect of multidisciplinary rehabilitative intervention on dyspnea

The recent findings showed that both groups' dyspnea scores improved following the intervention; this was a result of the care that was given to each group. However, when comparing the two groups' outcomes post intervention, a highly significant improvement was found between the two groups as regards dyspnea, in favor of the study group at six weeks and 12 weeks post-intervention. These results agreed with **Rodriguez-Blanco et al. (2022),** who conducted a clinical trial to assess the impact of two different exercise-based interventions through telerehabilitation on clients with coronavirus disease and showed that the intervention group achieved a substantial reduction in fatigue, dyspnea, and perceived effort distinct from the control group. Also, the findings of recent study are in accordance with **Fugazzaro et al., (2022),** who proved that dyspnea appeared to improve after rehabilitation in post-COVID-19 patients. Moreover, findings are in line with **Calvo-Paniagua et al., (2022)**, who reported improvement in dyspnea and fatigue post-rehabilitation intervention for the patients. Also, the results were supported by **Ahmed et al., (2022) and Soril et al., (2022)**, who proved that multi-disciplinary rehabilitation reported improvements in patients' outcomes post-COVID-19, such as dyspnea and fatigue. This may be explained as it may be allied to different respiratory rehabilitation and recovery strategies used during the multidisciplinary rehabilitative interventions

Strengths and limitation of the study:

The randomized controlled trial design, in which the ndings are attributed to the multidisciplinary habilitative intervention is a strength. This is one of the w studies in Egypt that concentrated on the patients' habilitation after COVID-19. The study results could ave a significant impact on improving patient outcomes ter COVID-19 through offering a multidisciplinary habilitation program. However, the results should be terpreted with some limitations. The sample size was nall, and all the participants were recruited from Shebin l-Kom city, Menoufia governorate in Egypt, so the

findings may have limitations in generalizing to other communities. For future studies, the researchers recommend the use of a larger sample and a multi-centered study design to include different communities .

Conclusion

Implementing the multidisciplinary rehabilitative intervention program over six weeks for patients post-COVID-19, which includes recommended lifestyle modifications, physical activities, breathing exercises, and a dietary regimen, resulted in highly significant statistical differences between the two groups as regards the knowledge score about post-care. After COVID, fatigue, dyspnea and kinesiophobia mean score post-COVID in favor of the study group were the p values (0.000). Given that the intensity and incidence of post-COVID symptoms in the general population remain high, identifying interdisciplinary rehabilitation strategies seemed to be critical in lowering symptoms.

Recommendations for clinical practice:

The study recommends that a comprehensive rehabilitation program should be planned and offered by a multidisciplinary team as routine care after patients discharge to improve post-COVID-19 patients' outcomes.

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