Original Article

Mobile Phone App-Based or Face-to-Face Pulmonary Rehabilitation in COVID-19 Survivors

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Abstract

Background: Pulmonary Rehabilitation (PR) is recommended as a standard, effective, and important treatment for COVID-19 survivors who remain symptomatic after the acute phase. Therefore, we aimed to compare the effect of mobile phone-based PR application with face-to-face PR on the quality of life, anxiety, depression, and daily life activities of COVID-19 survivors. **Materials and Methods:** A quasi-experimental was conducted on 65 COVID-19 survivors during 2022. Convenient sampling was done based on the inclusion criteria. The intervention group (n = 31) received PR through a mobile phone application, and the control group (n = 34) received face-to-face PR. Data were collected before and after the intervention in both groups using a demographic information questionnaire, SF-12, the hospital anxiety and depression scale, and Barthel scale. For all tests, a maximum error of 5% was considered. **Results:** The two studied groups had no statistically significant difference with respect to all the investigated variables at baseline ($p > 0.05$). After the intervention, the mean anxiety and depression score of the patients in the control group was significantly lower than the intervention group ($t = -3.46$, $f = 63$, $p = 0.01$). After our intervention, there was no statistically significant difference in the mean quality of life and daily life activity scores between the two groups ($t = -0.68$, $f = 63$, $p > 0.05$). **Conclusions:** The application of PR does not show a statistically significant difference in terms of improving the quality of life and daily activities compared with the face-to-face method; we suggest that the PR application be used as a cost-effective method when face-to-face PR is not possible.

Keywords: *Activities of daily living, anxiety, COVID-19, depression, quality of life, rehabilitation, smartphone*

Introduction

The outbreak of COVID-19 infection started in December 2019 in Wuhan, China.[1] Due to the global spread of this virus, this disease has become a global epidemic and a great challenge for the health system in Iran. COVID-19 has resulted in 7,562,998 confirmed cases and 144,728 deaths so far.[2] This virus is a new member of the coronavirus family. It often causes an infection in the respiratory mucosa and reveals symptoms similar to a cold. Sometimes this virus may lead to more severe diseases such as terminal bronchial infection and chronic bronchitis and even pneumonia in adults,[3] as well as physical disorders including fatigue, reduced physical capacity, and daily life activities in both acute and subacute stages.[4] In addition to physical problems, mental disorders such as anxiety and depression are also common problems associated with this virus[5] with a prevalence of 63% and 31% in survivors, respectively.[6] Since there is no effective treatment for COVID-19, pulmonary rehabilitation, as one of the basic components of treatment, is recommended for improving the quality of life after the acute phase.[7]

Face-to-face pulmonary rehabilitation is among the common methods of pulmonary rehabilitation, but it has some limitations such as being time-consuming and forgetting information, and it also leads to spending more time and money and interferes with daily life activities.[8] Among other methods of pulmonary rehabilitation are mobile applications, which are considered an effective tool for increasing adherence to physical activity and enabling people to attain the health information and guidance they need at any time.[9] Moreover, to reduce the spread of the coronavirus, remote rehabilitation strategies should be

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adopted as an alternative method to provide rehabilitation services at the community level. The main advantage of electronic rehabilitation is that it provides clinical support to the target community by overcoming geographical barriers through electronic communication.[10] Various studies have been conducted to assess the effects of face-to-face and virtual pulmonary rehabilitation. The results of these studies have shown that mobile-based pulmonary rehabilitation application for patients with Chronic Obstructive Pulmonary Disease (COPD) can reduce mental pressure and symptoms of depression and anxiety,[11] as well as increase the quality of life and daily physical activities of patients and reduce shortness of breath in patients with COVID-19 and COPD.[12-14] Also, face-to-face pulmonary rehabilitation reduces anxiety and depression[15,16] and improves the patients' quality of life and physical performance.[17]

Considering the high prevalence of COVID-19, pulmonary rehabilitation is recommended as one of the essential components of treatment. On the other hand, considering the geographical limitations of isolated groups, it seems necessary to use aids such as rehabilitation software to provide them with appropriate services. Although many studies have confirmed the significant benefits of these software such as reducing the level of anxiety and depression, improving the quality of life and physical performance, as well as reducing treatment costs in different patients, its impact on patients who have recovered from COVID-19 as well as its effectiveness compared with face-to-face pulmonary rehabilitation programs, has not been studied in Iran yet. Therefore, we aimed to compare the effect of a mobile phone-based pulmonary rehabilitation application with face-to-face pulmonary rehabilitation on quality of life, anxiety, depression, and daily life activities of COVID-19 survivors.

Materials and Methods

The present study was a quasi-experimental that was conducted in 2022. The research population was all COVID-19 survivors who were referred to the comprehensive respiratory clinic of Khorshid Hospital in Isfahan province. Sixty-five of them who met the inclusion criteria were selected as the study sample. Because of the reduced prevalence of COVID-19, the control group (n = 34 patients with face-to-face rehabilitation) was randomly selected from 156 patients who had previously visited the comprehensive respiratory clinic for pulmonary rehabilitation and their data were registered in the system, and the intervention group (31 patients, mobile-based pulmonary rehabilitation application) was selected from the patients who referred during this period. The inclusion criteria in both control and intervention groups were willingness to participate in the study, completion of the informed consent form, age of 18–60 years, having minimum literacy rate, not having any vision and hearing problems, and a time elapsed from the beginning of the symptoms of COVID-19 of at least 21 days. Also, in the intervention group, access to the Internet and having a smartphone and being able to use a mobile phone-based pulmonary rehabilitation application were among the inclusion criteria. In both groups, we excluded patients with acute and complex problems such as venous and pulmonary thromboembolism, heart disease class 2–4, ischemic or hemorrhagic stroke, neurodegenerative diseases, severe mental disorder, active cancer, and patients with mobility restrictions. Also, in the control group, patients who were absent for more than two sessions in pulmonary rehabilitation programs, or in the intervention group, patients who did not answer the nurse's phone follow-up more than twice, were excluded from the study. To determine the sample size, the following formula was used (Z confidence coefficient 95%, Z2 test power coefficient 80%, and D the minimum difference of the mean variable score equal to 0.71) and 31 samples were determined in each group, and taking into account a 10% dropout rate, 34 participants were considered for each group.

Outcomes were measured using the following instruments at baseline and six weeks after completion of the intervention in both groups; for quality of life, we used SF-12 which has 12 items measuring two subscales, as follows: 1) physical: physical function, role limitation due to physical problems, perception of general health, physical pain, and 2) psychological: role limitation due to psychological problems, energy and vitality, mental state and social performance. The total score ranges from 12 to 48, with higher scores indicating a better quality of life. A score of 12–24 indicates a poor quality of life, 25–36 indicates an average quality of life, and 37–48 indicates a good quality of life. The validity of the questionnaire was checked by Montazeri and colleagues using the convergence method. A high correlation was observed between the questions of the four subscales of the physical component with the total score of the physical component and the questions of the three subscales of the psychological component with the total score of the psychological dimension. The reliability of the instrument was reported to be 0.73 and 0.72 in physical and mental dimensions, respectively, using the test–retest method.[18] Also, for evaluating anxiety and depression, used Hospital Anxiety and Depression Scale, which has 14 items, with 7 items in each subscale. A four-point Likert scale (0 to 3) was used to score the items. Total scores range from 0 to 42, with higher scores indicating higher anxiety/depression. A score of 0 to 7 is considered as normal, 8 to 10 as mild, and 11 to 21 as severe. The validity of the tool was confirmed using the convergence method (r = 0.70 for depression and r = 0.72 for anxiety). The overall reliability of the questionnaire was 0.7 (anxiety subscale: HAD-A = 0.78-0.93, depression scale: HAD-D = 0.82-90).[19] People's performance in daily

activities and their movement was checked by Barthel scale. This scale has 10 parts that include questions about eating (score 0–10), bathing and cleaning (score 0–5), personal hygiene (score 0–5), dressing (score 0–10), urinary control (score 0–10), defecation (score 0–10), using the toilet (score 0–10), transferring from bed to chair and vice versa (score 0–15), mobility (score 0–15), and using the stairs (0–10). The final score of the patients ranged from 0 to100, where a score of 100 indicated complete independence and a score of 0 indicated a person's complete dependence on others with respect to daily activities. The validity of the questionnaire was confirmed with a Kappa coefficient of 0.99 and its reliability with a Cronbach's alpha coefficient of 0.96–0.99.[20]

The control group received the clinic's routine and standard rehabilitation program in person, face-to-face, and in the form of groups of five people during 12 sessions (twice a week for 90 minutes during six weeks), which included two parts: 1) The first 30 min: Self-care and disease self-management training, how to use the spray and any educational needs of patients related to their disease, 2) the second 60 min: consisting of sports exercises, the type of exercises was determined based on the patient's ability and orthopedic limitations, and included 5 min of stretching exercises to warm up, 30 min of aerobic exercises (such as treadmill, stationary bike, and manual ergometer), 20 min of resistance exercises depending on the patient's conditions and according to the existing guidelines, which were performed with free weights, body weight, and stretching bands. The final 5 min was the final cool down. In addition to face-to-face meetings, the patients walked twice a week for 30 min, which they received the necessary training on how to do it.[21] In the control group, compliance with the treatment was checked by phone by a nurse twice a week one day before a certain date to remind them to attend the center for rehabilitation. Patients in the intervention group were trained on how to work with the pulmonary rehabilitation application in a short 15–10-min face-to-face introductory meeting by the nurse. It should be noted that the main components of the application were extracted by reviewing the texts and opinions of experts in the field of pulmonary rehabilitation and needs assessment from the relevant patients and their families, and finally, it was again evaluated and approved by experts in the field of pulmonary rehabilitation and the application was designed. Then, the application that can be installed on the Android operating system was installed on the patients' mobile phones or tablets. The application has different parts: 1) management of software users (for entering personal information and editing it from the management side), 2) educational content in the field of pulmonary rehabilitation, 3) sending notifications to users (such as daily reminder messages to do exercises sports), and 4) the possibility of question and answer (possibility of sending the required files). The educational content in the field of pulmonary rehabilitation was similar to the face-to-face training group and was designed in the form of video and text including the following topics: self-care training, instructions for the use of different inhalation sprays, clearing the airways, chest physiotherapy, training in exercises to improve lung function (including stretching, aerobic, and strength exercises), and relaxation methods to control anxiety and stress.

The patients of the intervention group were encouraged to perform rehabilitation activities using the application for 6 weeks at home; they were advised to do the exercises five times a week and each time for 30 min in the morning and 30 min in the evening, when they feel their energy level is at its best. Each training day started with a full body warm-up and ended with two to three stretching exercises. During the program, the intensity of the exercises was dynamically increased based on the feedback recorded by the patient through the program at the end of each training session. To check treatment compliance during this period, the nurse of the rehabilitation unit called the patient three times a week in the first and second week and then once a week until the sixth week to remind the patient of the exercises and training through the application. In the application, the participants were given instructions about repetition, intensity, duration, and how to perform each exercise, as well as advice on when to stop exercising in case of pain or feeling unwell in the application. The weekly visit of all patients in both groups was done in person by the doctor and nurse according to the usual routine in the clinic.

Data were analyzed in SPSS-16 software (SPSS Inc., Chicago, Ill., USA). Initially, normality was tested by the Kolmogorov–Smirnov test. Then, independent *t* (for quantitative variables), Chi-square, Fisher's exact, and Kruskal–Wallis tests (for qualitative and rank variables) were used to compare demographic and clinical variables between the groups. To compare the variables in each group before and after the intervention, paired *t* test was used. Also, independent *t* test and ANCOVA were used for intergroup comparisons in terms of main variables. The significance level was determined to be less than 0.05.

Ethical considerations

This study was approved by the Ethics Committee of Isfahan University of Medical Sciences with code IR.ARI.MUI.REC.1400.105. At the beginning of the study, informed consent was obtained from the patients of both groups, and they were emphasized about the confidentiality of their information and having full authority and freedom to withdraw from the study at any time.

Results

In this study, 65 patients were included. In the control group, there was no sample loss, and in the intervention group, 34 people were included in the study, one person

was excluded because of not performing sports exercises, and one person because of not answering phone calls and one person because of hospitalization. The control (34 people) group participated in the pulmonary rehabilitation program. The mean (SD) ages in the control and intervention group were 50.71 (12.60) and 58.58 (12.60) years, respectively. Other demographic characteristics of the studied groups are described in Table 1. The results of the independent *t* test showed that the patients of the two control and intervention groups were homogeneous in terms of body mass index ($p > 0.05$). Also, the Chi-square test showed that the frequency distribution of sex, marital status, education, and coexistence of other diseases in the two groups was homogeneous ($p > 0.05$). However, the results showed that there was a significant difference between the intervention and control groups in terms of age, employment status, and oxygen therapy status ($p < 0.05$).

ANCOVA showed that there was no statistically significant difference between the two study groups in all the investigated variables (anxiety, depression, quality of life, and daily life activities) before the intervention ($p > 0.05$). However, 6 weeks after the intervention, ANCOVA showed that the mean anxiety and depression score of the control group was significantly lower than the intervention group ($p = 0.01$). Also, 6 weeks after the intervention, ANCOVA showed no statistically significant difference between the mean score of the physical dimension of quality of life and daily activities of patients in the intervention and control groups [$p > 0.05$, Table 2].

In the control group, which received the clinic's routine and standard face-to-face rehabilitation, the mean anxiety score was 4.97 (3.59) before the intervention, which reduced to 3.10 (1.95) after the intervention. Also, the depression score decreased from 4.64 (3.60) to 2.97 (2.56) after the intervention. With respect to the physical dimension of quality of life, the score increased from 12.81 (2.13) before the intervention to 13.14 (2.11) after the intervention, and the score of daily life activity before the intervention was 90.58 (12.04) which rose to 96.17 (6.03) after the intervention. The results of the paired *t* test showed a significant difference in anxiety, depression, and the physical dimension of quality of life and daily life activities [$p < 0.05$, Table 2].

In the intervention group that received the rehabilitation program using a mobile-based pulmonary rehabilitation application, the mean anxiety scores before and after the intervention were 6.19 (3.92) and 5.22 (2.26), respectively. The depression scores before and after the intervention were 6.41 (4.97) and 5.64 (2.92), respectively. The mean scores related to the physical aspect of the quality of life before and after the intervention were 11.00 (2.64) and 12.58 (2.87), respectively. The mean scores related to the daily life activities before and after the intervention were 90.00 (16.07) and 95.80 (6.72), respectively. The results of the paired *t* test showed a significant difference in the

Table 1: Comparison of demographic characteristics of the two group

Characteristics	Intervention (*n*=31)	Control (*n*=34)	*t*-df	*p*
Age (year) Mean (SD)	58.58 (−12.60)	50.71 (−12.60)	−2.33-63	0.02*
BMI (kg/m^2) Mean (SD)	27.62 (6.30)	27.82 (4.60)	0.64-63	0.91*
Sex (*n* %)				
Male	18 (58.10)	23 (67.60)	0.63-1	0.42**
Female	13 (41.90)	11 (32.40)		
Comorbidity (*n* %)				
No disease	9 (29)	7 (20.60)	4.88-2	0.87**
1	13 (41.90)	8 (23.50)		
≥2	9 (29)	19 (55.90)		
Employment status (*n* %)				
Employed	9 (29.00)	21 (61.80)	6.99-1	0.008**
Unemployed	22 (71.00)	13 (38.20)		
Education status (*n* %)				
Illiterate	6 (19.40)	3 (8.80)	4.99-2	0.83**
Diploma	21 (67.70)	19 (55.90)		
University	4 (12.90)	12 (35.30)		
Marital status (*n* %)				
Single	1 (3.20)	6 (17.60)	4.60-1	0.10**
Married	30 (96.80)	27 (79.40)		
Oxygen therapy (*n* %)				
Yes	7 (22.60)	28 (82.40)	23.31-1	0.00**
No	24 (77.40)	6 (17.60)		

*Calculated using independent *t*-test (*t*-df). **Calculated using Chi-square test (value – df)

Table 2: Comparison of patients' outcome before and after intervention in and between the two groups

Outcomes	Control Means (SD)	Intervention Means (SD)	Mean difference Means (SD)	*t* - df	*p***	*p*-adjusted***
HADS total						
Before intervention	9.94 (6.83)	12.61(8.00)	-2.67 (1.06)	-1.45-63	0.15	
After intervention	6.38 (3.92)	10.87 (4.51)	-4.48 (1.05)	-4.28-63	0.00	0.01
*p**	0.00	0.23				
Mean difference Means (SD)	3.55 (5.9)	1.74 (8.06)			0.31	
HADS. stress						
Before intervention	4.97 (3.59)	6.19 (3.92)	-1.22 (0.93)	-1.31-63	0.19	
After intervention	3.10 (1.95)	5.22 (2.26)	-1.81 (0.52)	-3.46-63	0.00	0.01
*p**	0.01	0.20				
Mean difference Means (SD)	1.55(3.48)	0.96 (4.15)			0.53	
HADS. Depression						
Before intervention	4.64 (3.60)	6.41(4.97)	-1.77 (1.06)	-1.65-63	0.10	
After intervention	2.97 (2.56)	5.64 (2.92)	-2.67 (0.68)	-3.92-63	0.00	0.01
*p**	0.00	0.37				
Mean difference Means (SD)	1.67 (3.09)	0.77 (4.82)			0.37	
SF total						
Before intervention	27.85 (3.56)	27.83 (5.87)	0.01 (1.19)	0.01-63	0.99	
After intervention	28.32 (5.61)	29.19 (4.55)	-0.87 (1.27)	-0.68-63	0.49	0.40
*p**	0.64	0.17				
Mean difference Means (SD)	-0.47 (5.87)	-1.35 (5.45)			0.53	
SF physical						
Before intervention	12.81 (2.13)	11.00 (2.64)	1.08 (0.60)	1.83-63	0.07	
After intervention	13.14 (2.11)	12.58 (2.87)	0.56 (0.62)	0.91-63	0.37	0.28
*p**	0.01	0.007				
Mean difference Means (SD)	-1.05 (2.39)	-1.58 (3.03)			0.44	
SF psychological						
Before intervention	15.76 (2.92)	16.83 (4.53)	-1.07 (0.93)	-1.12-50	0.26	
After intervention	15.17 (4.76)	16.61 (3.14)	-1.43 (1.01)	-1.41-63	0.16	0.36
*p**	0.50	0.78				
Mean difference Means (SD)	0.58 (5.13)	0.22 (4.63)			0.76	
BARTEL						
Before intervention	90.58 (12.04)	90.00 (16.07)	0.58 (3.50)	-0.16-63	0.86	
After intervention	96.17 (6.03)	95.80 (6.72)	0.37 (1.58)	0.23-63	0.81	0.68
*p**	0.01	0.016				
Mean difference Means (SD)	-5.58 (11.98)	-5.80 (12.65)			0.94	

*Calculated using paired sample *t*-test. **Calculated using independent *t*-test. ***Calculated using ANCOVA, adjusted for the age, employment status, and oxygen therapy

score of the physical dimension of quality of life and daily life activities [$p < 0.05$, Table 2].

Discussion

The findings showed the improvement of the physical dimension of the quality of life and daily physical activity of COVID-19 survivors in both types of mobile phone-based pulmonary rehabilitation program and face-to-face pulmonary rehabilitation during 6 weeks. It should be noted that the patients who received face-to-face pulmonary rehabilitation had a significant improvement in depression and anxiety, but the intervention group that received the mobile phone-based pulmonary rehabilitation application did not show improvement in this regard.

We found that the mobile phone-based pulmonary rehabilitation application and face-to-face pulmonary

rehabilitation improved the physical dimension of quality of life and daily life activities. Studies have shown that natural recovery will happen much later with the passage of time and usually takes a year or more, and studies have also shown that pulmonary rehabilitation improves the quality of life in patients with COVID-19 undergoing pulmonary rehabilitation compared with the control group that received no treatment.[16,17,22] Two other studies also confirmed the positive effect of telephone pulmonary rehabilitation on the quality of life and daily physical activity in patients with COPD.[12,13] The effectiveness of smartphone-based pulmonary rehabilitation on quality of life may be attributed to the fact that these interventions fulfill the educational needs of patients, improve their disease-related knowledge and their ability to manage challenges related to the disease, and thereby, increase their quality of life. However, the results of one study showed that the application of pulmonary rehabilitation did not have a positive effect on the quality of life of patients with lung cancer.[11] The quality of life in patients with lung cancer is lower than those with chronic respiratory disease and patients suffering from other malignancies. It is affected by the severity and the number of symptoms such as fatigue, loss of appetite, dyspnea, cough, pain, and blood in sputum, which are specific for lung tumors.[23] Considering the incurable nature of the disease, patients with lung cancer face many problems in all physical, mental, social, and spiritual dimensions and will have a very poor quality of life and physical performance. Therefore, in justifying this result, we can point to the different samples studied and the difficult treatment of lung cancer and its destructive and progressive effect on the quality of life of these patients. Also, the results of many studies confirm the positive effect of face-to-face pulmonary rehabilitation on improving the quality of life and physical performance of the survivors of COVID-19.[24,25] The main component of face-to-face pulmonary rehabilitation programs was exercise training, which includes aerobic and resistance training, and these exercises have been demonstrated to decrease the negative effects that prolonged sedentary behavior and inactivity during a hospitalization period have on physical function. Pulmonary rehabilitation has also been shown to increase exercise capacity, muscle strength, and health-related quality of life.[26]

Also, we found that mobile phone-based pulmonary rehabilitation application and face-to-face pulmonary rehabilitation were equally effective in improving the physical dimension of quality of life and daily life activities. In this regard, the results of one study confirmed the positive effect of the virtual pulmonary rehabilitation program on the physical performance of patients with COPD as much as the face-to-face program.[8] However, the results of another study showed that face-to-face pulmonary rehabilitation program had a better effect on the physical activity of patients with COPD compared to virtual pulmonary rehabilitation.[27] The reason for this difference can be attributed to the physical presence in the treatment environment and encouraging the person to adhere to treatment by observing the patients in the same condition and also the absence of problems using the application. Chen and colleagues also found that the combination of virtual and face-to-face pulmonary rehabilitation program was more effective in improving physical activity, quality of life, and shortness of breath than the face-to-face program alone.[28]

Also, the results showed that face-to-face pulmonary rehabilitation had a positive effect on reducing the anxiety and depression of COVID-19 survivors. Many studies confirm the positive effect of face-to-face pulmonary rehabilitation on reducing the anxiety and depression of COVID-19 survivors.[15,29] Since face-to-face therapy programs provide question and answer opportunities for the patient and the patient can raise any question and any worrying issue with the therapist and dispel false beliefs and information about the course of the disease and treatment, the patient's worries are reduced and the patient and the treatment team have the opportunity to interact and receive feedback. As a result, it has a better effect on the improvement of emotional and psychological problems.[27] However, one study showed that face-to-face pulmonary rehabilitation intervention was not effective on the depression of elderly COVID-19 survivors.[15] Contradictory results with the present study can be caused by the different tools used to investigate depression, the different context of the study, and the different types of samples (elderly). Most of the depressed elderly, for various reasons, including worry and fear of being labeled as "mentally ill", complain less about the feeling of sadness and longing caused by depressed mood and sometimes even deny its existence, and this can affect the results of the studies.[30] Also, the results showed that the mobile phone-based pulmonary rehabilitation application did not affect the anxiety and depression of the survivors of COVID-19. In mobile-based interventions or the web, patients experienced higher levels of anxiety and depression due to limited access to psychologists and the influence of peer groups.[31]

However, Park and co-workers found that the mobile-based pulmonary rehabilitation program had a significant effect on improving anxiety and depression in patients with lung cancer.[11] This discrepancy may be related to the new nature of COVID-19 disease, uncertain prognosis, fear of the disease, stigma, and social isolation that patients experience during the disease.[21,32] In addition, disorders caused by the infection in the immune system can specifically strengthen mental injuries,[33] and all of these affect the effectiveness of the program. One study showed that telephone pulmonary rehabilitation along with face-to-face pulmonary rehabilitation compared to face-to-face pulmonary rehabilitation alone had a better effect on anxiety and depression in patients with COPD.[12]

This difference may be related to the continuity of attention and care received from admission to home after discharge in the group receiving telephone pulmonary rehabilitation. The limitations of the present study were the small sample size, intervention being done in a single center, and the lack of random allocation of samples. Also, since the control group was sampled first and then the intervention group, the researchers faced a decrease in the prevalence of COVID-19 at the time of sampling the intervention group, so the number of samples in the intervention group was less than the control group, which could have affected the results. The limitation of this study is that, despite the telephone follow-up of the nurses to increase treatment compliance in the pulmonary rehabilitation application group, due to the offline and absent nature of the program, it was not fully under the researchers' control.

Conclusion

Considering that the effectiveness of the pulmonary rehabilitation application compared to the face-to-face method did not show a statistically significant difference in improving the quality and daily activities of life, and since there are currently potential opportunities to provide pulmonary rehabilitation in the form of virtual applications, to increase capacity, reduce costs, and have wide availability for socially or geographically isolated patients, it is suggested that the pulmonary rehabilitation application be used to improve the quality of life and daily activities of these patients. Also, due to the better impact of face-to-face pulmonary rehabilitation on patients' mental status compared with the application, it is recommended to use a combination of face-to-face and virtual rehabilitation sessions to achieve more effective results.

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Conflicts of interest

Nothing to declare.

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