Saudi physicians' awareness and practice of pulmonary rehabilitation for post-COVID 19 syndrome patients

ABSTRACT

Background: The coronavirus disease (COVID-19), caused by infection with the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus, has resulted in considerable mortality, morbidity, and unprecedented strain on healthcare systems throughout the world. As the pandemic evolves, one of those challenges has become increasingly common - the post-COVID-19 syndrome. Approximately 10-20% of SARS-CoV-2 patients who experienced an acute symptomatic phase are still experiencing some effects beyond 12 weeks. To assess knowledge, awareness and practice about effectiveness and benefits of pulmonary rehabilitation for post-covid-19 syndrome patients and their practical barriers and opportunities, and education and training needs among Saudi physicians.

Methodology: A cross-sectional online survey was held among healthcare providers in Saudi Arabia. Department of internal medicine, Heraa General Hospital, between January 2021 and November 2021. The questionnaire was sent to Saudi physicians from data collectors face-to-face through smartphone apps. The questionnaire covered the talk about pulmonary rehabilitation knowledge and familiarity among Saudi physicians, support and practice, barriers to pulmonary rehabilitation integration, and interest in learning more about pulmonary rehabilitation programs.

Results: A total of 1111 responded to the survey. The mean age of the participants was 33 years old, with mean years of experience of about 6.95 years. The majority of respondents (n=949) (85.4%) work in urban areas and come from various regions, including the west (n=407) (36.6%), east (n=195) (17.6%), north (n=150) (13.5%), south (n=150) (13.5%) and central region (n=209) (18.8%). More than half of the respondents were physicians (n=750) (67.5%) from different specialties, and the mean number of covid-19 patients seen by physicians was 5.68% per day.

Conclusion: Participants in this study showed a positive attitude toward pulmonary rehabilitation. They believe their patients would benefit from Pulmonary rehabilitation, are interested in referring post-covid-19 patients to rehabilitation providers and co-managing their care, and would like more educational opportunities in order to increase their knowledge of the safety and efficacy of pulmonary rehabilitation.

Keywords: Pulmonary Rehabilitation, COVID-19, Saudi Physicians.

UNDER PEER REVIEW

1. INTRODUCTION

Covid 19 infected people can not only show symptoms during the early attack, but they can also experience significant delays. In a recent meta-analysis of 15 studies involving 47,910 individuals, 80% of patients experience at least one symptom over follow-up periods ranging from 2 weeks to 4 months after the viral attack.[1] This long-form of COVID-19 has also received several different terms, including post-acute COVID-19 syndrome, long COVID, long-haul COVID-19, and post-acute sequelae of COVID-19 (PASC).[2] Nevertheless, Post COVID-19 syndrome should be distinguished from other consequences affecting COVID-19 survivors. For example, post-intensive care syndrome (PICS) is a new worsening physical, cognitive, or psychiatric health condition that develops after a severe illness and persists after discharge from an acute care setting.[3] On the other hand, Post COVID-19 syndrome applies to a broad spectrum of COVID-19 survivors, from those with mild acute illness who may never have required admission to ICU. Survivors of ICU admission can be considered likely to have a post-intensive care syndrome PICS and Post COVID-19 syndrome overlap as part of the spectrum of post-COVID-19 sequelae.[4]

There is a strong need to develop a safe and efficient discharge plan for post-covid-19 patients. A literature review showed a solid evidence base suggesting that a Centre based supervised outpatient program of education and physical activity, collectively termed pulmonary rehabilitation, has a significant positive outcome.[5] Pulmonary rehabilitation refers to the specialized rehabilitation therapy of individuals with persistent lung illnesses. It includes a variety of therapies in addition to physical assistance, along with knowledge and lifestyle modifications.[6] However, given that SARS-CoV-2 is highly contagious, physical distancing has still been strongly recommended. These consequences make it practically impossible to carry out traditional outpatient rehabilitation in groups.[7] Deferent choices offer pulmonary rehabilitation remotely to either eliminate or substantially decrease the risk of SARS-CoV-2 infection, a rapidly increasing evidence supporting the use of home-based and real-time, online supervised rehabilitation. In addition, pulmonary rehabilitation can be provided virtually using different online platforms such as Zoom and Microsoft Teams. Program staff must adhere to the organization's privacy and security policies related to using these services. "These platforms allow pulmonary rehabilitation staff to provide interactive education sessions, real-time or pre-recorded exercise classes, and case management." On top of that, they offer some advantages for assessing and monitoring the patient's response to exercise.[8] Telerehabilitation was published for the first time in 1998. Since then, an increasing number of articles have been devoted to this topic, probably due to people's emerging needs and to the development of exciting new communication and computer technologies.[9] Nevertheless, it can provide a safe long-distance service, adhere to the preventive measures required by the pandemic, and encompass a large geographic area. In addition, it protects clinicians from exposure to conid-19-infected individuals, and it is as efficient as in-person therapy.[10] Several telerehabilitation trials in COPD have been conducted. Tsai et al. conducted a randomized controlled trial in patients with COPD to evaluate the effectiveness of home-based telerehabilitation. This approach was found to increase exercise endurance and self-efficacy among patients substantially. Compared with usual medical care, there was also a positive trend towards improving health-related quality of life.[11] Internet-based virtual programs for self-management education might also benefit patients by increasing accessibility and providing them with tools to improve their knowledge and skills to better manage their health following pulmonary rehabilitation (Nguyen et al., 2008).[12]

Worldwide, pulmonary rehabilitation is underused despite its important benefits. Patient acceptance, adherence, and completion of pulmonary rehabilitation programs, together with the existence and accessibility of programs, and referral practices, are key to the challenges. Furthermore, healthcare providers' lack of knowledge and experience and the shortage of trained home-based pulmonary rehabilitation or telerehabilitation experts are major barriers to practice.[13] To assess knowledge, awareness and practice about effectiveness and benefits of pulmonary rehabilitation for post-covid-19 syndrome patients and their practical barriers and opportunities, and education and training needs among Saudi physicians.

2. MATERIAL AND METHODS

Study design and participants:

The study utilized a cross-sectional, questionnaire-based design among Saudi physicians. We sent the survey to healthcare providers across Saudi Arabia. Eligible providers were all physicians, physician assistants, nurse practitioners, and physiotherapists. In addition, residents, medical interns, and clinical year students were also included in the study.

Study tool: Previously conducted research was used to construct the questionnaire. [14–20] In addition, a small number of physicians carried out a pilot test before the survey distribution to ensure comprehension and ease of response. The final questionnaire covered the following topics: The socio-demographic data of the responders, Knowledge and familiarity with pulmonary rehabilitation programs, support and practice of pulmonary rehabilitation at their facilities, education and

UNDER PEER REVIEW

training in pulmonary rehabilitation, education and discussion about the benefits of pulmonary rehabilitation with post-covid 19 patients, qualified health professionals trained in home-based pulmonary rehabilitation or telerehabilitation in their facilities, and the challenges of practicing pulmonary rehabilitation during the pandemic.

Data collection:

All eligible providers received the online survey from data collectors face-to-face on their smartphone apps, and they were asked to complete the survey within three weeks.

Statistical analysis:

Data were analyzed using the Statistical Package for Social Sciences (SPSS) program and present categorical and continuous variables using descriptive statistics, such as frequencies, percentages, means, and standard deviations (SD).

3. RESULTS AND DISCUSSION

One thousand and one hundred twenty-one responded to the survey. Ten of the respondents answered no to the consent, and one thousand and one hundred eleven completed the survey. The mean age of the participants was 33 years old, with mean years of experience of about 6.95 years (figure 1). Males (n=545) (49.1%), females (n=566) (50.9%), Saudi physicians (n=943) (84.9%) and non-Saudi (n=168) (15.1%). The majority of respondents (n=949) (85.4%) work in urban areas and come from various regions, including the west (n=407) (36.6%), east (n=195) (17.6%), north (n=150) (13.5%), south (n=150) (13.5%) and central region (n=209) (18.8%). More than half of the respondents were physicians (n=750) (67.5%) from different specialties, and the mean number of covid-19 patients seen by physicians was 5.68% per day. General practitioners (n=151) (13.6%), family physicians (n=124) (11.2%), and internists (n=147) (13.2%) were the majority of the respondents (Table 1).

Table 1. Socio-demographic features of the participants (n = 1111).

Variable		N	%
Gender			
	Male	545	49.10%
	Female	566	50.90%
Nationality			
	Saudi	943	84.90%
	Non-Saudi	168	15.10%
Occupation			
	Physician	750	67.50%
	Physician assistant	69	6.20%
	Nurse	219	19.70%
	other	73	6.60%
Current specialty			
	Pulmonary	59	5.30%
	ICU	70	6.30%
	Surgery	87	7.80%
	OB/GYN	65	5.90%
	Orthopedics	34	3.10%
	General practice	151	13.60%
	Family medicine	124	11.20%
	Internal medicine	147	13.20%
	Radiology	33	3%
	Emergency medicine	75	6.80%
	ENT	30	2.70%
	Ophthalmology	12	1.10%
	Anesthesia	23	2.10%

UNDER PEER REVIEW

	Pediatric	74	6.70%
	Cardiology	28	2.50%
	other	99	8.90%
Area of practice			
	Western Region.	407	36.60%
	Eastern Region.	195	17.60%
	Northern Region.	150	13.50%
	Southern Region.	150	13.50%
	Central Region.	209	18.80%
Work location			
	Urban	949	85.40%
	Rural-serving	162	14.60%

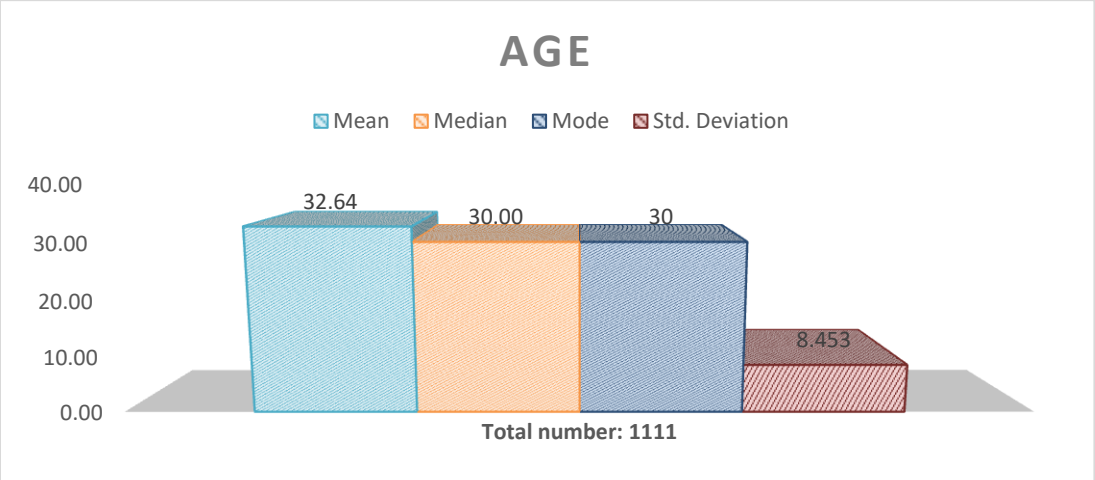

Fig. 1. Represents the age of the participants.

(Table 2) presents the level of knowledge and familiarity with pulmonary rehabilitation among participants. For the question, "how familiar are you with pulmonary rehabilitation programs?" (n=292) (26.3%) said they are familiar with the pulmonary rehabilitation program, (n=468) (42.1%) have some idea about the pulmonary rehabilitation program, and (n=351) (31.6%) said they are not familiar with the pulmonary rehabilitation program. Many respondents (n=696) (62.6%) answered correctly to the definition of the pulmonary rehabilitation program. (n=476) (42.8%) think the pulmonary rehabilitation program is multidisciplinary, and (n=455) (41%) answered the question about the essential component of the pulmonary rehabilitation program correctly.

Table 2. Knowledge of participants about pulmonary rehabilitation (n=1111).

Variable		N	%
How familiar are you with pulmonary rehabilitation programs?			
	I'm familiar with pulmonary rehabilitation programs.	292	26.30%
	I have some idea about pulmonary rehabilitation programs.	468	42.10%
	I'm not familiar with pulmonary rehabilitation programs.	351	31.60%
The definition of Pulmonary rehabilitation is?			

UNDER PEER REVIEW

	A Techniques that address the removal of secretion and improve airway clearance, thereby help to improve respiratory efficiency.	253	22.80%
	A comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies, which include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and emotional condition of people with chronic respiratory disease and to promote the long-term adherence of health- enhancing behaviors.	696	62.60%
	A group of treatments designed to eliminate secretions, thus helping to decrease work of breathing, promote the expansion of the lungs, and prevent the lungs from collapse.	162	14.60%
Pulmonary rehabilitation program is?			
	A physiotherapy based program.	282	25.40%
	A psychiatry based program.	53	4.80%
	A cardiology based program.	50	4.50%
	A chest physician based program.	250	22.50%
	A multidisciplinary program.	476	42.80%
Essential components of pulmonary rehabilitation program are?			
	The 13 components of the pulmonary rehabilitation model were identified through a Delphi process.	455	41%
	Endurance training.	102	9.20%
	Resistance training.	82	7.40%
	Team includes a health care professional with experience in exercise prescription and progression.	375	33.80%
	An initial center-based assessment by a health care professional.	97	8.70%

Although a large number of respondents have optimistic beliefs about the pulmonary rehabilitation program (n=728) (66%), believe that pulmonary rehabilitation is an effective tool in improving post-covid-19 symptoms and quality of life and (n=727) (65.4%) believe that telerehabilitation is helpful as a treatment and monitoring tool for post-covid-19 patients, only about one-third of facilities are providing the service. (n=454) (40.9%) provide pulmonary rehabilitation programs, (n=339) (30.5%) provide home-based rehabilitation programs, (n=321) (28.9%) provide telerehabilitation programs, and only (n=361) (32.5%) provide training programs. (n=393) (35.4%) of facilities provide a pulmonary rehabilitation educational program for patients, and (n=493) (44.4%) of respondents have rehabilitation centers in their area. In addition, only (n=376) (33.8%) of respondents have a course in pulmonary rehabilitation, and (n=334) (30.1%) have qualified health professionals trained in home-based pulmonary rehabilitation or telerehabilitation in their center (Table 3).

Table 3. Attitudes of responders toward pulmonary rehabilitation (n = 1111).

Variable	Yes N %	No N %	I Don't know N %
Does your facility offer a pulmonary rehabilitation program?	454 (40.9%)	295 (26.6%)	362 (32.6%)
Does your facility offer home based pulmonary rehabilitation program?	339 (30.5%)	361 (32.5%)	411 (37%)

UNDER PEER REVIEW

Does your facility offer telerehabilitation program?	321 (28.9%)	336 (30.2%)	454 (40.9%)
Does your facility provide a training program in pulmonary rehabilitation program?	361 (32.5%)	378 (34.0%)	372 (33.5%)
Did you participate in any pulmonary rehabilitation program courses?	376 (33.8%)	735 (66.2%)	
Do you have Qualified health professionals trained in home-based pulmonary rehabilitation or telerehabilitation in your facilities?	334 (30.1%)	421 (37.9%)	356 (32.0%)
Does your facility offer a pulmonary rehabilitation educational program for patients?	393 (35.4%)	338 (30.4%)	380 (34.2%)
Do you have rehabilitation center in your area?	493 (44.4%)	234 (21.1%)	384 (34.6%)
Do you think a telerehabilitation program is helpful as a treatment and monitoring tool for post covid 19 patients?	727 (65.4%)	138 (12.4%)	246 (22.1%)

According to the findings, (n=321) (28.9%) of respondents refer all post-COVID-19 patients to pulmonary rehabilitation, while (n=362) (32.6%) only refer a subset of them. The majority of respondents recommend pulmonary rehabilitation for their patients (n=503, 45.3% recommend it for selective patients, and n=393, 35.4% for all patients). Most respondents think eight weeks (n=406) (36.5%) with two sessions per week (n=349) (31.4%) is a reasonable period for a pulmonary rehabilitation program (Table 4). Many facilities do not offer telerehabilitation programs (n=295, 26.6% answered no, and n=362, 32.6% answered I do not know). However, zoom (n=319) (28.7%) was the most used platform for telerehabilitation programs in facilities that offer the service. Most of the patients were unvaccinated (n=646) (58.1%). Respondents believe that the vaccine positively affects post-covid-19 patients (n=860) (77.4%) (Table 5).

Table 4. Practice of responders toward pulmonary rehabilitation (n = 1111).

Variable		N	%
How often do you refer post covid-19 patient to pulmonary rehabilitation?			
	I refer all post covid-19 patient to pulmonary rehabilitation program.	321	28.90%
	I refer selective post covid 19 patient to pulmonary rehabilitation program.	362	32.60%
	I don't refer post covid-19 patient to pulmonary rehabilitation program.	428	38.50%
How often do you recommend pulmonary rehabilitation program to post covid-19 patient?			
	I recommend pulmonary rehabilitation program to all post covid-19 patient.	393	35.40%
	I recommend pulmonary rehabilitation program to selective post covid 19 patient.	503	45.30%
	I don't recommend pulmonary rehabilitation program to post covid-19 patient.	215	19.40%
How long do you think is a proper period for a pulmonary rehabilitation program?			
	4 weeks	315	28.40%
	8 weeks	406	36.50%
	12 weeks	294	26.50%
	One year	69	6.20%
	Two years	27	2.40%
How many sessions do you recommend per week?			
	1 session per Week	166	14.90%
	2 sessions per Week	349	31.40%
	3 sessions per Week	308	27.70%
	4 sessions per Week	168	15.10%
	5 sessions per Week	61	5.50%
	6 sessions per Week	16	1.40%
	7 sessions per Week	43	3.90%

UNDER PEER REVIEW

Table 5. Vaccin effect (n = 1111).

Variable		N	%
The majority of post-covid 19 patients who come to the clinic are...?			
	Unvaccinated.	646	58.10%
	Vaccinated after their recovery from covid 19.	307	27.60%
	Vaccinated before they get infected with covid 19.	158	14.20%
Do you think the vaccine has a positive effect on post covid 19 patient's outcomes?			
	Yes	860	77.40%
	No	104	9.40%
	I Don't know	147	13.20%

The insufficient time during office visits was cited as a barrier by nearly two-thirds of respondents (somewhat of a barrier n=559, 50.3%, and a significant barrier n=238, 21.4%). A significant number of responders do not know how to refer to pulmonary rehabilitation programs (somewhat of a barrier n=369, 33.2%, and a significant barrier n=351, 31.6%). Infectivity with COVID-19 and the necessity for social distancing were somewhat of a barrier for (n=372) (33.5%) and a significant barrier (n=308) (27.7%). Another critical barrier found among respondents was a lack of personal familiarity with pulmonary rehabilitation programs (Somewhat of a barrier n=531, 47.8%, and a significant barrier n=351, 28.4%). In addition, lack of personal knowledge of the evidence for pulmonary rehabilitation programs was somewhat of a barrier for (n=530) (47.7%) and a significant barrier for (n=335) (30.2%). Furthermore, lack of personal trust in the evidence for pulmonary rehabilitation programs was somewhat of a barrier for (n=520) (46.8%) and a significant barrier for (n=327) (29.43%). Lack of clinic leadership support for the pulmonary rehabilitation program was considered as somewhat of a barrier for (n=390) (35.1%) and a significant barrier for (n=232) (20.9%).

Table 6. Barriers faced by respondents to pulmonary rehabilitation (n=1111).

Variable	Not a barrier at all	Somewhat of a barrier	Significant barrier	Unsure/don't know
	N (%)	N (%)	N (%)	N (%)
Insufficient time during office visits to discuss pulmonary rehabilitation with patients?	314 (28.3%)	559 (50.3%)	238 (21.4%)	
Level of support among peers for pulmonary rehabilitation program?	267 (24.0%)	396 (35.6%)	234 (21.1%)	214 (19.3%)
Level of support among clinical leadership for pulmonary rehabilitation program?	273 (24.6%)	390 (35.1%)	232 (20.9%)	216 (19.4%)
Lack of personal familiarity with pulmonary rehabilitation program?	265 (23.9%)	531 (47.8%)	315 (28.4%)	
Lack of personal knowledge of the evidence for pulmonary rehabilitation program?	246 (22.1%)	530 (47.7%)	335 (30.2%)	
Lack of personal trust in the evidence for pulmonary rehabilitation program?	264 (23.8%)	520 (46.8%)	327 (29.43%)	
Lack of available local practitioners who offer pulmonary rehabilitation program?	196 (17.6%)	321 (28.9%)	397 (35.7%)	197 (17.7%)

UNDER PEER REVIEW

Don’t know who to refer to locally for pulmonary rehabilitation program?	195 (17.6%)	369 (33.2%)	351 (31.6%)	196 (17.6%)
Covid19 infectivity and the necessity for social distancing?	269 (24.2%)	372 (33.5%)	308 (27.7%)	162 (14.6%)

Discussion

Covid-19 is known to significantly impact people infected with COVID-19 in both acute and chronic settings. Post-covid-19 syndrome is defined as the persistence of symptoms beyond three months from the acute phase of the disease. Dyspnea, fatigue, mood disturbances, sleep disturbances, and anxiety were the most common post-COVID-19 reported symptoms. Some patients have even more severe symptoms with some disabilities. In addition, researchers found a statistically significant correlation between the severity of COVID-19 and post-COVID-19 symptoms.[21] Many studies revealed that pulmonary rehabilitation is highly effective for post-covid-19 patients. Therefore, these symptoms should be a key consideration for pulmonary rehabilitation for people affected with post-COVID-19 syndrome.[22]

Early comprehensive pulmonary rehabilitation for COVID-19 patients started from the acute phase of the disease is vital for significant clinical and functional improvements.[23,24] Previous research has revealed that individuals with mild to moderate COVID-19, as well as those with severe and critical COVID-19, suffer from long-term physical deficits.[25] As a result, healthcare facilities should design and implement strategies for delivering multidisciplinary rehabilitation therapies in a variety of settings in order to restore functionality and avoid the development of long-term COVID-19 illness effects.[26]

In this study, low rates of familiarity with pulmonary rehabilitation were observed among healthcare providers. In addition, most of the facilities do not have training programs, and only a small number of physicians participated in a course about pulmonary rehabilitation. These findings suggest that pulmonary rehabilitation training and educational programs for healthcare practitioners across the country are in high demand. Hence, the availability of trained and qualified healthcare professionals is key for saucerful and efficient practice. Furthermore, by approving and applying guidelines to encourage PR, we can increase awareness and acceptability of PR and increase knowledge of expected PR outcomes.[27]

As previous studies showed, pulmonary rehabilitation can help people with post-covid-19 lung disease improve their exercise performance, lung function, and quality of life.[28,29] Thus, an integrated rehabilitative approach comprising a multidisciplinary and multi-professional team should start from the first onset of the disease, followed by a well-structured follow-up program for individuals after discharge.[30,31] Furthermore, a patient and family education program is highly recommended. This educational program has several advantages, including Assisting patients and families in being actively involved in their care, making sure patients and their families gain a better understanding of rehabilitation outcomes, and ensuring patients' adherence and completion of the PR program.

Our study discovered that the majority of the post-covid-19 patient were unvaccinated. Approximately 30 to 40% of individuals who received the vaccine have shown improvements in their symptoms. An additional study showed that vaccination led to a slight improvement in long-term symptoms, with fewer worsening symptoms and more resolutions compared with not being vaccinated. Although 10% to 15% of post-covid-19 feel worse following vaccination, and some do not see any improvement, there is a strong recommendation for the post-covid-19 patient to get the vaccine. Vaccines will prevent post-covid-19 patients from re-infection with the virus, and it appears to be helping them feel better. [32–36]

UNDER PEER REVIEW

We discovered a subset of barriers for pulmonary rehabilitation practice among physicians. Healthcare providers noted lack of access to pulmonary rehabilitation providers to whom to make referrals as somewhat of a barrier in their daily practice. These findings point to the critical importance of referral networks and positive interprofessional communication as essential themes for the success of pulmonary rehabilitation integration and better post-covid-19 outcome. In addition, as shown by our results, a lack of education and awareness regarding pulmonary rehabilitation programs is a significant barrier. Therefore, it is crucial to educate professional healthcare providers and promote awareness among them in order to increase access to, knowledge about, and use of pulmonary rehabilitation.

Our study has some limitations. As there is limited data on vaccine effects on post-covid-19 people, more research about the vaccine outcome on post-covid-19 is needed. In addition, most of the respondents were residents. Although the participants could reflect the actual practice in their area, a higher number of experts respond and opinion was required. However, the study has several strengths. First, the participants were from different specialties and professions (doctors, nurses, physiotherapists, students, and others). Second, this is the first study to discuss the benefit of pulmonary rehabilitation for post covid 19 patients in Saudi Arabia.

4.CONCLUSION

Participants in this study showed a positive attitude toward pulmonary rehabilitation. They believe their patients would benefit from Pulmonary rehabilitation, are interested in referring post-covid-19 patients to rehabilitation providers and co-managing their care, and would like more educational opportunities in order to increase their knowledge of the safety and efficacy of pulmonary rehabilitation. Thus, an educational program for healthcare providers and a well-structured interdisciplinary network for patients' proper referral is highly recommended.

UNDER PEER REVIEW

ETHICAL APPROVAL

This study was approved by Ministry of interior general director of medical Services, General Directorate of Medical Security Forces Hospital Program (SFHP) - Makkah. Scientific Research Centre and Research Ethics Committee with IRB No.0437-290821. Written consent was received from all participants, after the brief demonstration about the objectives of the study and also the contents of this Questionnaire. The raw data and identity of the patients were kept confidential which include personal information.

REFERENCES

1. Stengel A, Malek N, Zipfel S, Goepel S. Long Haulers — What Is the Evidence for Post-COVID Fatigue ? 2021;12(May):10–2.

2. Ambadapoodi R, Deepti F, Anwer MBBS J, Fernandez-Botran R. Post-Acute Sequelae of COVID-19 (PASC): Association with Inflammation and Autoimmunity. Univ Louisv J Respir Infect. 2021;5(1):20.

3. Rawal G, Yadav S, Kumar R. Post-intensive care syndrome: An overview. J Transl Intern Med. 2017;5(2):90–2.

4. Vehar S, Boushra M, Ntiamoah P, Biehl M. Post-acute sequelae of SARS-CoV-2 infection: Caring for the “long-haulers.” Cleve Clin J Med. 2021;88(5):267–72.

5. Singh SJ, Barradell AC, Greening NJ, Bolton C, Jenkins G, Preston L, et al. British Thoracic Society survey of rehabilitation to support recovery of the post-COVID- 19 population. BMJ Open. 2020;10(12):1–10.

6. Yang LL, Yang T. Pulmonary rehabilitation for patients with coronavirus disease 2019 (COVID-19). Chronic Dis Transl Med [Internet]. 2020;6(2):79–86. Available from: https://doi.org/10.1016/j.cdtm.2020.05.002

7. Santana AV, Fontana AD, Pitta F. Pulmonary rehabilitation after COVID-19. J Bras Pneumol. 2021;47(1):1–3.

8. Dechman G, Aceron R, Beauchamp M, Bhutani M, Bourbeau J, Brooks D, et al. Delivering pulmonary rehabilitation during the COVID-19 pandemic: A Canadian Thoracic Society position statement. Can J Respir Crit Care, Sleep Med [Internet]. 2020;4(4):232–5. Available from: https://doi.org/10.1080/24745332.2020.1828683

9. Peretti A, Amenta F, Tayebati SK, Nittari G, Mahdi SS. Telerehabilitation: Review of the state-of-the-art and areas of application. JMIR Rehabil Assist Technol. 2017;4(2):1–9.

10. Tanguay P, Marquis N, Gaboury I, Kairy D, Touchette M, Tousignant M, et al. Telerehabilitation for Post-Hospitalized COVID-19 Patients: A Proof-of-Concept Study During a Pandemic. Int J Telerehabilitation. 2021;13(1):1–16.

11. Tsutsui M, Gerayeli F, Sin DD. Pulmonary rehabilitation in a post-covid-19 world: Telerehabilitation as a new standard in patients with copd. Int J COPD. 2021;16:379–91.

12. Marquis N, Larivée P, Dubois M-F, Tousignant M. Are Improvements Maintained After In-home Pulmonary Telerehabilitation for Patients with Chronic Obstructive Pulmonary Disease? Int J Telerehabilitation. 2015;6(2):21–30.

13. Holland AE, Singh SJ, Casaburi R, Clini E, Cox NS, Galwicki M, et al. Defining modern pulmonary rehabilitation: An official American thoracic society workshop report. Ann Am Thorac Soc. 2021;18(5):E12–29.

14. Si A, Questionnaire RN. Time of Infection.

15. a Guide To Developing Knowledge , Attitude and Practice Surveys.

UNDER PEER REVIEW

16. Scotland CSO, Locke B, Advisor AHPP, Lead C, Health D, Government S, et al. Longer-term effects of Covid (long-covid) Rehabilitation Survey v1.4 About this survey. :1–11.

17. Bowen JM, Campbell K, Sutherland S, Bartlett A, Brooks D, Qureshi R, et al. Pulmonary rehabilitation in Ontario: A cross-sectional survey. Ont Health Technol Assess Ser. 2015;15(8):1–67.

18. Rehabilitation P, Rehabilitation P, Rehabilitation P. How resources determine pulmonary rehabilitation programs : a survey among Belgian chest physicians . Supplementary material Figure S1 : Access to rehabilitation in hospital (148 / 200 physicians). Blue arrows : Convention hospitals , Red arrows : PRH w. :1–10.

19. Chest Heart & Stroke Scotland Scottish Pulmonary Rehabilitation Action Group 2017 Pulmonary Rehabilitation Survey Chest Heart & Stroke Scotland Scottish Pulmonary Rehabilitation Action Group 2017 Pulmonary Rehabilitation Survey. 2017;

20. Schwartz MR, Cole AM, Keppel GA, Gilles R, Holmes J, Price C. Complementary and Integrative Health Knowledge and Practice in Primary Care Settings: A Survey of Primary Care Providers in the Northwestern United States. Glob Adv Heal Med. 2021;10:216495612110233.

21. Iqbal A, Iqbal K, Arshad Ali S, Azim D, Farid E, Baig MD, et al. The COVID-19 Sequelae: A Cross-Sectional Evaluation of Post-recovery Symptoms and the Need for Rehabilitation of COVID-19 Survivors. Cureus. 2021;2(2).

22. O'Sullivan O, Barker-Davies RM, Thompson K, Bahadur S, Gough M, Lewis S, et al. Rehabilitation post-COVID-19: Cross-sectional observations using the Stanford Hall remote assessment tool. BMJ Mil Heal. 2021;

23. Piquet V, Luczak C, Seiler F, Monaury J, Martini A, Ward AB, et al. Do Patients With COVID-19 Benefit from Rehabilitation? Functional Outcomes of the First 100 Patients in a COVID-19 Rehabilitation Unit. Arch Phys Med Rehabil. 2021;102(6):1067–74.

24. Chikhanie Y Al, Veale D, Schoeffler M. Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19 . The COVID-19 resource centre is hosted on Elsevier Connect , the company ' s public news and information . 2020;(January):19–22.

25. Gloeckl R, Leitl D, Jarosch I, Schneeberger T, Nell C, Stenzel N, et al. Benefits of pulmonary rehabilitation in COVID-19: a prospective observational cohort study. ERJ Open Res [Internet]. 2021;7(2):00108–2021. Available from: http://dx.doi.org/10.1183/23120541.00108-2021

26. Spielmanns M, Pekacka-Egli AM, Schoendorf S, Windisch W, Hermann M. Effects of a comprehensive pulmonary rehabilitation in severe post-covid-19 patients. Int J Environ Res Public Health. 2021;18(5):1–14.

27. Farah R, Groot W, Pavlova M. Pulmonary rehabilitation in Lebanon "what do we have"? A national survey among chest physicians. PLoS One. 2021;16(7 July):1–12.

28. Zampogna E, Paneroni M, Belli S, Aliani M, Gandolfo A, Visca D, et al. Pulmonary Rehabilitation in Patients Recovering from COVID-19. Respiration. 2021;100(5):416–22.

29. Hameed F, Palatulan E, Jaywant A, Said R, Lau C, Sood V, et al. Outcomes of a COVID-19 recovery program for patients hospitalized with SARS-CoV-2 infection in New York City: A prospective cohort study. PM R. 2021;13(6):609–17.

30. Agostini F, Mangone M, Ruiu P, Paolucci T, Santilli V, Bernetti A. Rehabilitation settings during and after COVID-19: An overview of recommendations. J Rehabil Med. 2021;53(1).

31. Vitacca M, Lazzeri M, Guffanti E, Frigerio P, D Abrosca F, Gianola S, et al. An Italian consensus on pulmonary rehabilitation in COVID-19 patients recovering from acute respiratory failure: Results of a Delphi process. Monaldi Arch Chest Dis. 2020;90(2):385–93.

UNDER PEER REVIEW

32. Why Vaccines May Be Helping Some With Long COVID > News > Yale Medicine [Internet]. [cited 2021 Oct 17]. Available from: https://www.yalemedicine.org/news/vaccines-long-covid

33. COVID-19 vaccination does not worsen symptoms in ‘long-haulers’ [Internet]. [cited 2021 Oct 17]. Available from: https://www.healio.com/news/primary-care/20210527/covid19-vaccination-does-not-worsen-symptoms-in-longhaulers

34. Can Vaccination Improve Symptoms for People with Long COVID? [Internet]. [cited 2021 Oct 17]. Available from: https://www.healthline.com/health-news/can-a-covid-19-vaccine-improve-symptoms-for-people-with-long-covid#Anecdotal-evidence-suggests-vaccine-relieves-long-COVID

35. Vaccination Eases Symptoms For Some COVID Long-Haulers [Internet]. [cited 2021 Oct 17]. Available from: https://www.aarp.org/health/conditions-treatments/info-2021/vaccines-may-help-long-haulers-covid.html

36. COVID-19 Vaccine for Long-Haulers: A Surprising Benefit? - GVN [Internet]. [cited 2021 Oct 17]. Available from: https://gvn.org/covid-19-vaccine-for-long-haulers-a-surprising-benefit/

UNDER PEER REVIEW