CHEST

Evaluation of an In-Home Virtual Pulmonary Rehabilitation Program for Respiratory Patients Delivered in Response to the COVID Pandemic

To the Editor:

The 2019 SARS-CoV-2 pandemic mandated shutdown of in-person pulmonary rehabilitation (PR), necessitating a shift to in-home virtual/telehealth platforms to maintain PR access. Data evaluating the effectiveness of PR delivered virtually are lacking. Furthermore, to optimize health resources and outcomes, understanding which patients are best suited for virtual PR is essential. Our group helped develop a structured PR program with enhanced disease management tools that could be delivered across multiple platforms.[1] This program was rapidly modified to be delivered via Zoom in patients' homes. Accordingly, the purposes of our study were to (1) examine outcomes with virtual PR in comparison with traditional in-person PR, and (2) determine which baseline characteristics are associated with program completion in virtual PR.

Methods

This was an observational cohort study approved by the University of Alberta Health Research Ethics Board (Pro00096654), and a waiver of consent was granted. Participants enrolled in PR at the G. F. MacDonald Centre for Lung Health in Edmonton, Canada, and a partner site in Camrose, Canada, between 2018 and 2021 were included in the analysis and stratified by in-person or virtual. In-person data were collected before and virtual data were collected during the pandemic.

Both virtual and in-person PR programs were 16 sessions. Table 1 provides a description of the programs. Every session included group education and supervised exercise and followed the Canadian Standardized PR program.[2] All participants attended an in-person assessment that included a pulmonologist assessment and one or both of: a 6-min walk (6MW) test[3] or cardiopulmonary exercise stress test.[4] Group and individual education topics followed a standard curriculum.[2] Group exercise training included cardiovascular, strength, flexibility, and breathing exercise components as per PR guidelines.[5,6] Aerobic training intensity was prescribed and progressed based on patients' symptoms and baseline exercise tolerance.

Table 1 contrasts virtual vs in-person PR. Participants in virtual PR were able to complete the program with a sturdy chair, three large step-lengths of empty space surrounding their chair, and a TheraBand that was given to them at their assessment. All virtual PR participants received a training video session before the start of the PR program to ensure competent use of Zoom, adequate internet connection, and safety of their exercise space. The in-person program had an additional 15 min of scheduled exercise time. To compensate, participants in virtual PR were prescribed additional aerobic exercise to do unsupervised.

Lower body functional strength was assessed with the 30-s sit-to-stand test.[7] Health-related quality of life was evaluated with the COPD Assessment Test (CAT), a survey for assessing health status in patients living with lung conditions, and demonstrated responsiveness to PR.[8,9] With in-person PR, participants completed three 6MWT before and after PR, and the average of the two best tests was used for analysis. However, because of pandemic restrictions, only one 6MWT was completed before and after virtual PR. Outcomes were collected within 2 weeks of the start and end dates of a PR program, except for the pre-program 6MWT in the virtual group, which could not consistently be collected within this timeframe because of pandemic restrictions. Program adherence was assessed via participant attendance and dropout. Participants were considered a dropout if they completed fewer than nine PR sessions with no post-program data obtained.

Independent Student *t*-tests and linear regression models evaluated the difference between patient characteristics and program responses in in-person and virtual PR. Logistic regression models were used to determine baseline characteristics (age, BMI, smoking pack-years, FEV_1 %predicted, oxygen supplementation, Medical Reasearch Council scale for dyspnea, 6MW distance, CAT score, and respiratory condition) associated with dropout in virtual PR.

Results

A total of 171 participants were enrolled in virtual PR, and 383 were enrolled in the in-person PR (see Table 2 for patient characteristics). Attendance and dropout rates did not differ between groups. There were no adverse events during virtual PR. The CAT scores significantly improved after PR in both programs, with greater improvement observed in in-person compared with virtual PR.

At baseline, 6MW distance was significantly higher in the in-person group ($P < .001$). The change in 6MW distance was significantly greater after virtual PR than after in-person. No single or combination of baseline clinical data was associated with program dropout in the virtual program.

TABLE 1] Similarities and Differences Between In-Person and Virtual Program

Program Elements	In-Person	Virtual
Program length	16 sessions	
Session length	2 h exercise, 1 h education	1 h 45 min exercise, 1 h education
Group size	12-16	4-8
Group education topics	Goal setting and healthy behaviors, exercise, chronic lung conditions, breathing management, conserving energy, medications, inhalers, integrating exercise, managing infections, aggravating factors, stress and anxiety, nutrition, sleep, travel, maintaining healthy behaviors	
Group education delivery	Group in large room, discussions encouraged, educational handouts given after each topic, reviewed at next session	Group in Zoom meeting, discussions encouraged, poll questions launched via Zoom, educational handouts for entire program given before start of program, reviewed at next session
Individual education topics	SMART goal-setting, exercise action plan, stair-climbing and breathing techniques, inhaler technique, exacerbation action plan. If indicated: smoking cessation, supplemental oxygen management	
Individual education delivery	1-on-1 in private room or sectioned area, handouts given on individualized plans	1-on-1 in Zoom breakout room, handouts on individualized plans emailed or mailed
Group exercise—flexibility	Warmup and pain-free range of motion at start of exercise session, stretching of major muscle groups after over-ground walking	Warmup and pain-free range of motion at start of exercise session, stretching of major muscle groups at end of exercise session
Group exercise—aerobic	Combination of: 6-min or 12-min over-ground walking, treadmill, stationary bike. Target of accumulating 30-45 min at intensity of 4-6/10 on Borg scale for dyspnea	Aerobic-style exercise videos either staff-made or vetted from YouTube. Combination of seated and standing positions. Target of accumulating 20-30 min at intensity of 4-6/10 on Borg scale for dyspnea. Prescribed home aerobic exercise at least 10 min in duration between sessions. Patient's choice of mode: walking, home aerobic equipment, or aerobic-style videos
Group aerobic exercise progression	Symptom-limited increases in duration of exercise bout, treadmill and hallway walking speed, treadmill incline, cycle revolutions per minute and pre-set resistance levels in a stationary bike.	Symptom-limited increases in intensity of exercise videos vetted for: proportion of movements completed in sitting vs standing, proportion of upper body movements above shoulder height, proportion of lower body movements in squat position or lifting to hip height; pace of movements, video duration
Group exercise—strengthening	Combination of: body weight exercises, dumbbell, TheraBand exercises, resistance machines. 8-12 reps to fatigue, 1-3 sets, at least 2 upper, 2 lower, and 2 core exercises	Combination of: body weight exercise and TheraBand exercises. 8-12 reps to fatigue, 1-3 sets, at least 2 upper, 2 lower, and 2 core exercises
Group exercise—breathing	Completed as a group after warmup, focusing on pursed-lip breathing, diaphragmatic engagement, thoracic expansion	

TABLE 2] Comparison of Baseline Characteristics and Outcomes Between In-Person and Virtual Pulmonary Rehabilitation

Demographics	In-Person (n = 383)	Virtual—All (n = 171)	Virtual—Complete (n = 135)	Virtual—Drop-Out (n = 36)
Characteristics				
Sex, % female	41	50	50	52
Age, y	67 ± 9	68 ± 11	67 ± 9	68 ± 10
BMI, kg/m^2	30 ± 7	30 ± 8	30 ± 7	30 ± 8
Smoking, pk y	35 ± 18	38 ± 21	34 ± 17	38 ± 18
MRC, 1-5	2.9 ± 1	2.9 ± 1	3 ± 1	2.9 ± 1
FEV_1 % Pred	57 ± 31	60 ± 25	59 ± 22	60 ± 25
Suppl O_2, No. (%)	62 (16.2)	35 (20.5)	24 (18)	35 (20.5)
Disease classification				
Asthma, No. (%)	23 (6)	13 (8)	11 (8)	13 (8)
COPD, No. (%)	280 (73)	113 (66)	84 (62)	113 (66)
ILD, No. (%)	42 (11)	19 (11)	17 (13)	19 (11)
Other, No. (%)	38 (10)	26 (15)	23 (17)	26 (15)

					B coefficients (95% CI)		
Outcomes	Pre	Post	Pre	Post	Group	Time	Group × Time
CAT score, 0-40	19.2 ± 7.3	16.8 ± 7.1	18.7 ± 7.5	17.2 ± 7.6	−0.76 (−1.96 to 0.45)	−2.6 (-3.2 to −2.0)[a]	1.4 (0.44 to 2.4)[b]
6MWD, m	377 ± 115	412 ± 116	332 ± 122	400 ± 124	−51.0 (−72.0 to −30.4)[a]	34.3 (28.1 to 40.6)[a]	21.5 (7.3 to 35.7)[a]
30s STS, #	10.5 ± 3.8	13.0 ± 4.6	10.9 ± 3.3	13.1 ± 4.4	0.37 (−0.3 to 1.0)	2.5 (2.0 to 2.9)[a]	−0.34 (−0.99 to 0.32)
Attendance, No.		13 ± 4		12 ± 4			
Attendance, %		(79 ± 25)		(78 ± 27)			
Drop out, %		15		21			

Data are presented at mean ± SD. All models adjusted for age, BMI, FEV_1 %pred, smoking history, Medical Research Council dyspnea score. 6MWD = 6-min walk distance; 30s STS= 30 s sit to stand test; attendance = number of sessions attended out of 16; CAT= COPD assessment test; ILD= interstitial lung disease; MRC = Medical Research Council.

[a] $P < .001$.

[b] $P < .005$.

Discussion

This work builds on previous tele-rehab/home-PR trials in which exercise equipment (eg, cycle ergometers) were supplied to patients,[10,11] and it demonstrates that a PR program with whole-body aerobics-style group exercise could be effectively delivered virtually in a real-world setting. Both in-person and virtual PR had similar improvements in health outcomes, attendance, and dropout rate. Improvements in functional exercise tolerance was significantly higher in virtual PR; however, only one 6MW distance was collected before and after virtual PR; thus, likely the greater increase in 6MW distance may be attributable to a learning effect.[3] Baseline exercise tolerance was also lower in virtual PR participants, which may have impacted the magnitude of change in this group. Both programs demonstrated improvement in CAT score; however, the change was lower in virtual PR despite standardized education and exercise components. Although exercise tolerance and health-related quality of life improved, virtual PR was delivered during a pandemic in which participants' health outcomes were undoubtedly impacted by isolation requirements.

This pragmatic study demonstrated that a structured PR program can be delivered virtually as an effective alternative to in-person PR. Virtual programs are likely to remain in practice post-pandemic, giving patients an alternative option to PR delivery, because similar outcomes were derived from both platforms. A limitation of this study is that the virtual program was delivered during a pandemic, whereas the in-person program was delivered pre-pandemic. Future research should examine the programs concurrently, because the results of this study may have been affected by psychosocial factors associated with the pandemic and limitations in the collection of outcome measures because of pandemic restrictions. In addition, further research on commonly cited barriers such as transportation and accessibility to attendance and dropout rate should be explored, because these were not mitigated with virtual PR in this preliminary study.

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DOI: https://doi.org/10.1016/j.chest.2022.10.036

Funding/Support

University Hospital Foundation and the Alberta Boehringer Ingelheim Collaboration, 2019, Covenant Hospital Foundation: 180.CFDN.1819.057.

Financial/Nonfinancial Disclosures

None declared.

Acknowledgments

Author contributions: All authors contributed to the design, analysis and interpretation of the work and the final version of the submitted letter.

Role of sponsors: The sponsor had no role in the design of the study, the collection and analysis of the data, or the preparation of the manuscript.

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