Implementing a virtual mind-body prehabilitation program for patients undergoing thoracic surgery: A quality improvement project

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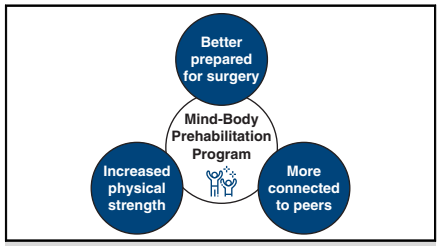
ABSTRACT

Background: Prehabilitation before thoracic surgery has been found to improve outcomes in patients with cancer; however, COVID-19 presented challenges to access on-site programs. We describe the development, implementation, and evaluation of a synchronous, virtual mind-body prehabilitation program developed in response to COVID-19.

Methods: Eligible participants were patients seen at a thoracic oncology surgical department of an academic cancer center, aged 18 years or older with a diagnosis of thoracic cancer and referred at least 1 week before surgery. The program offered 2 45-minute preoperative mind-body fitness classes each week delivered via Zoom (Zoom Video Communications, Inc). We collected data for referrals, enrollment, participation, and evaluated patient-reported satisfaction and experience. We conducted brief semistructured interviews about participants' experience.

Results: Among 278 patients referred, 260 were approached, and of those 197 (76%) patients agreed to participate. Among participants, 140 (71%) attended at least 1 class, with an average of 11 attendees per class. The majority of participants reported being extremely satisfied (97.8%), extremely likely to recommend the classes to others (91.2%), and indicated that classes were very much helpful in preparing for surgery (90.8%). Patients also reported that the classes helped reduce anxiety/stress (94.2%), fatigue (88.5%), pain (80.7%), and shortness of breath (86.5%). Qualitative data further suggest that the program made participants feel stronger, more connected to their peers, and better prepared for surgery.

Conclusions: This virtual mind-body prehabilitation program was well received with high satisfaction and benefits and is highly feasible to implement. This approach may help overcome some of the challenges to in-person participation. (JTCVS Open 2023;14:615-22)



Virtual mind-body prehabilitation program for patients undergoing thoracic surgery.

CENTRAL MESSAGE

A virtual synchronous prehabilitation program is highly feasible to implement for patients undergoing thoracic surgery and may help overcome certain challenges to in-person participation.

PERSPECTIVE

Prehabilitation before thoracic surgery has been found to improve outcomes in patients with cancer; however, COVID-19 presented challenges to access onsite programs. This virtual synchronous mind-body prehabilitation program, developed in response to COVID-19, was well received with high satisfaction and benefits among patients with thoracic cancer and is highly feasible to implement.

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Abbreviations and Acronyms
MSK = Memorial Sloan Kettering Cancer Center
Prehab = prehabilitation

Thoracic surgery is a critical component of cure for people diagnosed with resectable lung and esophageal cancers; however, surgery can result in numerous complications with high morbidity and mortality risk, especially among patients with impaired cardiopulmonary functions.[1,2] The incidence of postoperative pulmonary complications following thoracic surgery is up to 25%.[3] Studies have found a clear association between low physical activity levels and poor cardiopulmonary fitness before surgery with postoperative complications that can further exacerbate stress, anxiety, and depression, and prolong postsurgery recovery in people with thoracic cancer.[1,3-7]

Prehabilitation (prehab) programs have been found to improve functional capacity and prevent postsurgical complications in this population. Fitness and prehab programs conducted among people undergoing thoracic surgery have been shown to increase physical activity levels, improve cardiorespiratory fitness and muscle strength, and enhance postoperative recovery.[4,8-10] Furthermore, a recent systematic review and meta-analysis conducted by Sebio Garcia and colleagues[10] among people with thoracic cancer found that prehab programs led to improvements in pulmonary function prior to surgery, reduced postoperative complications, and lessened the length of hospital stay after surgery. Most recently, the American Society of Clinical Oncology clinical guidelines also recommended preoperative exercise for patients with lung cancer undergoing surgery to reduce postoperative complications and lessen the length of hospital stays.[11]

Despite potential prehab benefits, the COVID-19 pandemic has presented numerous challenges to meet the needs of people with cancer who are undergoing thoracic surgery. Hence there is an urgent need to develop prehab programs that are easy to access, safe, and ensure necessary physical distancing for this population. In response to the ongoing COVID-19 pandemic, we piloted a synchronous (live), virtual Mind-Body Prehab for Thoracic Cancer Surgery program to help prepare people with lung or esophageal cancer for their upcoming surgery and postsurgical recovery. Here, we describe the feasibility and acceptability of a virtual, synchronous mind-body prehab fitness program for people with cancer undergoing thoracic surgery.

METHODS

Implementation

During December 2020, the Memorial Sloan Kettering Cancer Center (MSK) Integrative Medicine Service and Thoracic Service jointly launched the Mind-Body Prehab for Thoracic Cancer Surgery program. The program offered free, virtual fitness and mind-body classes via the Zoom videoconferencing platform (Zoom Video Communications, Inc) to help patients with thoracic cancer prepare for their upcoming surgery and postsurgical recovery (Figure 1). This study was part of the quality improvement and program evaluation of the Mind-Body Prehab program. The Institutional Review Board of MSK approved study protocol 18-445 and publication of data on October 18, 2018. Patient written consent for the publication of the study data was waived because this type of protocol indicates that waived consent and waiver of Health Insurance Portability and Accountability Act of 1996 authorization are appropriate. Our study is reported in accordance with the Standards for Quality Improvement Reporting Excellence Checklist.[12]

Program Participants

Program participants were referred by the surgeons and nurses in the Thoracic Surgery Service from December 2020 to December 2021. To participate in the program, participants had to be aged 18 years or older, with a diagnosis of thoracic cancer, proficient in English, and referred at least 1 week before surgery.

Program Description

Each week, nurses from the Thoracic Surgery Service sent patient referrals to our team using an internal distribution list. Program coordinators would then call the patients and invite them to join the program. Program coordinators also tracked class participation and called patients who did not attend classes to understand their barriers to participation, such as language and technological challenges, and worked closely with the participants to overcome these issues. The class instructor was also available to speak with patients to motivate them to exercise.

The virtual synchronous prehab program was developed specifically for Zoom in response to COVID-19. The exercises were modeled after our existing in-person fitness classes.[13] The classes were not designed to be standalone, and participants were encouraged to attend more than 1 class depending on the window of time between enrollment and their surgery date. The program included 2 45-minute group classes each week via Zoom. No specific exercise equipment was needed to participate in the classes. The exercises were tailored based on individual participants' strength and limitations. Classes were led and supervised by a clinical fitness specialist who is also an oncology nurse and respiratory therapist. A brief outline of a typical class is included below. See Table 1 for the full list of exercises.

- 5 minutes: Connecting mind and body with mindful deep breathing exercises and mobilization stretching to improve thoracic spine mobility
- 5 minutes: Warmup with continued mindful breathing with dynamic and static stretching
- 10 minutes: Cardiorespiratory muscle movement
- 10 minutes: Upper and lower body weight movements
- 10 minutes: Moving meditation with deep breathing exercises
- 5 minutes: Questions and answers with instructor and social connections with peers

Throughout the prehab program the focus was on mindful breathing exercises to calm the mind and decrease anxiety and stress before thoracic surgery. Participants learned how to strengthen the diaphragm and accessory muscles used for breathing. Each exercise was coordinated with his or her breathing pattern. Muscle-strengthening breathing exercises included diaphragmatic aerobic breathing (eg, fast breathing) to strengthen the diaphragm as well as body weight exercises and resistance training to enhance strength and flexibility. Body weight movements incorporated isometric muscle contraction (eg, wall sits) and isotonic muscle contractions (eg, squats, lunges, shoulder press, reverse fly, and latissimus dorsi pull down). Both isometric and isotonic exercises are essential for building strength. Patients also learned how to coordinate their breathing when

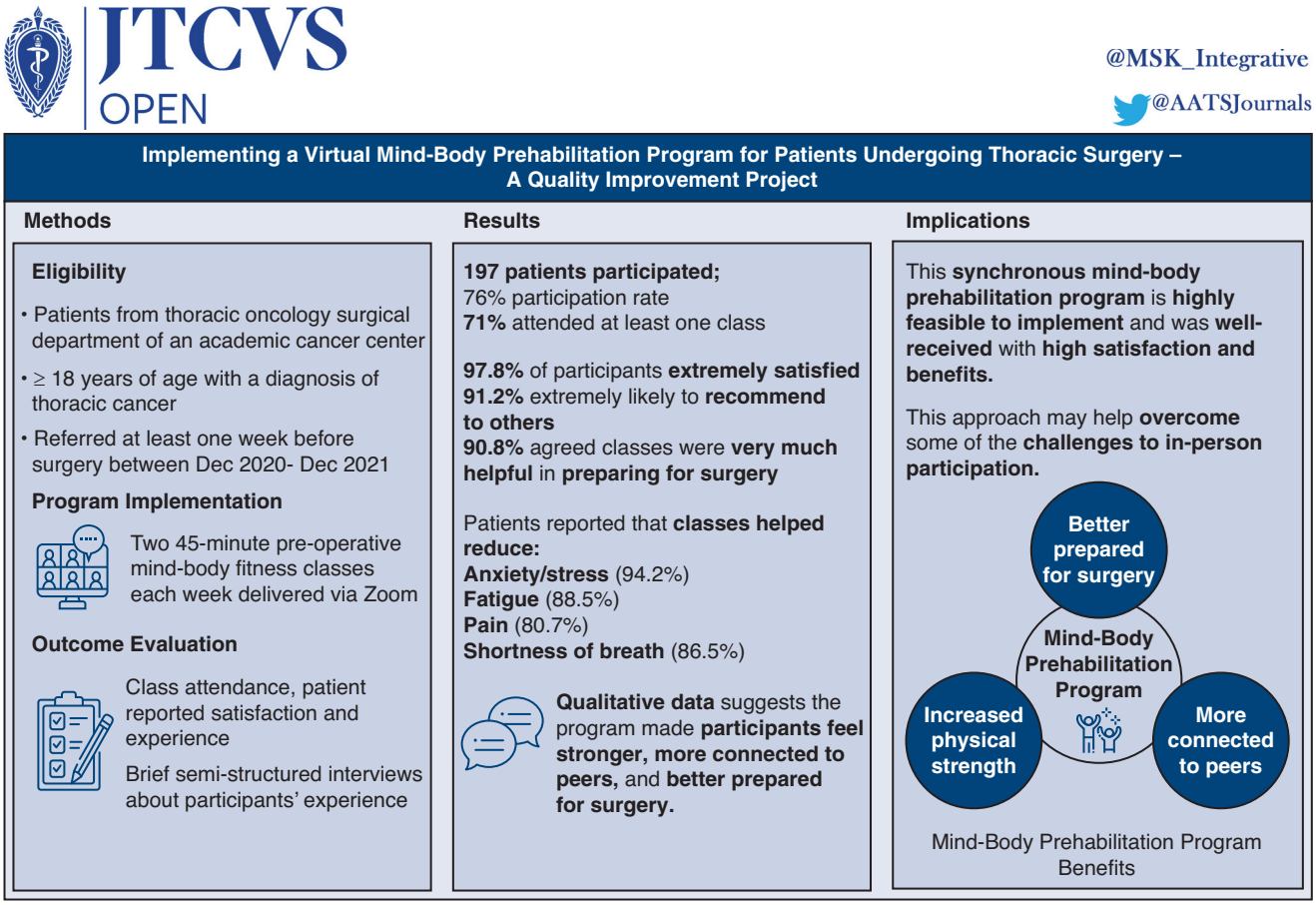

FIGURE 1. The implementation and evaluation of a virtual synchronous mind-body prehabilitation program among patients undergoing thoracic surgery.

walking on different surfaces (eg, flat vs inclined) and climbing stairs. Moreover, participants were taught relaxation breathing techniques and other mind-body activities to create a feeling of calm composure and down-regulate the sympathetic nervous system during stressful times before surgery.

Evaluation

We collected the following data to evaluate the feasibility and acceptability of the program. Program coordinators tracked participant attendance in a spreadsheet. Following each session, participants were asked to complete a 3-item questionnaire on Zoom using a 5-point Likert scale to evaluate: satisfaction with the session (1 = not at all to 5 = extremely); likelihood of recommending the class to others (1 = extremely unlikely to 5 = extremely likely); and how helpful the session was in preparing for surgery (1 = not at all helpful to 5 = very much helpful). Toward the end of the program, we asked all patients actively participating at that point to complete information about patient-reported outcomes via a 4-item questionnaire on Zoom using a 5-point Likert scale (1 = not at all to 5 = extremely) to evaluate how helpful the session was in reducing anxiety and stress, fatigue, pain, and shortness of breath.

In addition, we conducted brief qualitative interviews (n = 45) among participants who attended at least 1 class and volunteered to provide feedback about their experiences with the program. Patients were interviewed within a month of attending the prehab classes. Integrative Medicine Service staff members with qualitative research training (R.H. and K.D.) contacted participants and arranged for a telephone interview. Interviews lasted 5 to 10 minutes and were transcribed. Participants were asked a series of open-ended questions about their overall impressions and perception of the classes and any recommendations they might have for the program (see Table E1).

Statistical Analysis

Descriptive statistics were used to summarize class attendance and satisfaction. For the purpose of analysis, patient-reported outcome variables, such as anxiety/stress, pain, fatigue, and shortness of breath were dichotomized as reduced (merged moderately and extremely reduced) and not reduced (merged not at all, slightly, and somewhat).

Qualitative data were analyzed using thematic analysis.[14] One author (K.S.) coded all interviews. Interviews were coded line by line to create codes arising from the data. The transcripts were coded in several rounds. Codes were then compared across all transcripts to create preliminary themes. K.S. used an inductive and iterative process, involving constant comparison, to further develop a list of themes. The themes and codes were then presented to the program team (K.D.) to ensure the codes and themes accurately represented the data. The analysis was considered complete after all authors agreed on the themes and supportive quotes.

RESULTS

Overall Program Participation

Among 278 patients referred to the program, 260 patients were approached and 197 (76%) patients agreed to

TABLE 1. Full list of exercises from the Mind-Body Prehab for Thoracic Cancer Surgery Program

Goal	Exercise
Connecting mind-body	Mindful deep breathing exercises to calm and relax the mind Deep diaphragmatic breathing with gradual introduction of posture alignment* and mobilization stretches of the upper body, range of motion movements (allows for more efficient and effective movements-improving flexibility)
Warmup with continued mindful breathing	Shoulder shrug Shoulder rolls Elbow circles Neck stretch Figure-8 arm exercises External shoulder rotation Arm circles
Cardiorespiratory muscle movement	Jogging in place Knee lifts Modified jumping jacks
Upper and lower body weight movements	Shoulder press Front raise Lateral raise Scapulae retraction Reverse fly Lat pull down Biceps curl Triceps extension Chair squats Wall push-ups Wall sits Sumo squats Heel raises Hip mobility exercises
Cool down	Moving mediation with deep breathing exercises
Connecting with instructor and peers	Question and answer session with instructor and social connections with peers

*Throughout the class, participants are taught about the respiratory system and breathing techniques. The breathing techniques covered topics ranging from why and how you breathe, the importance of posture alignment, and diaphragmatic-pursed lip breathing. Posture alignment was discussed due to its importance in helping patients use their lungs at full capacity during rest and exercise. Diaphragmatic-pursed lip breathing is also essential for increasing lung volume, reducing unnecessary accessory respiratory muscles use at rest, and lengthening expiratory time. This also helps patients establish a more rhythmic breathing pattern that is not only physiologically, but also psychologically, satisfying for patients to develop a sense of inspiratory-to-expiratory timing.

participate. Among the 63 patients who declined to participate, the top 5 reasons for refusal were work conflict/too busy (n = 16 [25.4%]), very active/prefer to exercise on their own (n = 13 [20%]), need more information/time to think (n = 10 [15.9%]), not interested (n = 9 [14.3%]), and overwhelmed (n = 6 [9.5%]). See Table 2 for patient characteristics.

TABLE 2. Characteristics of patients who participated in the program (N = 197)

Demographic variable	Result
Age (years)	68 (61-75)
Sex	
Female	94 (47)
Male	103 (53)
Race	
White	172 (87)
Black/African American	5 (3)
Asian	12 (6)
Other	5 (3)
Unknown	3 (1)
Ethnicity	
Not Hispanic/Latino	177 (89)
Hispanic/Latino	11 (6)
Unknown	9 (5)
Clinical variables	
Cancer type	
Lung	92 (47)
Esophageal	76 (39)
Other	29 (14)

Values are presented as median (range) or n (%).

Class Attendance

We offered 104 Zoom classes with a total of 1173 nonunique class attendees. Among 197 patients who enrolled in the program, 140 (71%) attended at least 1 class, with an average of 11 attendees per class. No adverse events were reported by participants in the classes.

Among 498 nonunique responses from our satisfaction survey, 487 (97.8%) were "extremely satisfied" with the class, 454 (91.2%) were "extremely likely" to recommend the class to friends or family members, and 452 (90.8%) believed the class was "very much helpful" in helping them prepare for surgery.

In the final weeks of the program (November 2021-December 2021) we collected patient-reported outcomes on several measures. Among 52 nonunique responses from our patient-reported outcomes survey, 94.2% reported that the class reduced anxiety and stress, 88.5% reported that it reduced fatigue, 80.7% reported that it reduced pain, and 86.5% reported that it helped coping with shortness of breath.

We approached 54 participants and 45 agreed to participate in the interviews. We identified several themes through our analysis of the interviews: Prehab classes helped participants get stronger, learn more about the importance of exercise, and feel more confident in their ability to maintain their strength after the program; participants felt connected to their peers and found comfort being in similar circumstances; and the program provided personalized, tailored instruction that made participants feel seen and supported. See Table 3 for supportive quotes.

TABLE 3. Themes and supportive quotes from participants

No.	Theme	Quote
1	Prehabiliation classes helped participants get stronger, learn more about the importance of exercise, and feel more confident in their ability to maintain their strength after the program	"I'm feeling stronger and more confident in my physical strength and ability to stay strong and manage additional treatment." "I enjoyed [the sessions]. Got more aware of the importance of exercise, prepared my body to get ready for the surgery, and motivated me to walk before and after surgery." "I like the intense physical workout and I am in a better physical shape now. I am still receiving chemo and exercise makes me feel better, has positive impact on my physical and mental well-being."
2	Participants felt connected to their peers and found comfort being in similar circumstances	"It makes me feel good to see other people who have gone through the same surgery coming back to the classes, doing well, and doing exercises and feeling great. It gives me incentive to continue exercising." "Classes give me a group feeling where I can know other cancer patients who have gone through surgery and are recovering." "There are other esophageal cancer patients like me in the class going to the same surgeons. That gives me a sense that I am not alone and gives me mental strength that other people are in there. I see many postoperative patients join the class after surgery and they are doing good. This helps me mentally prepare for my surgery and think that we can get back to physical shape after surgery."
3	The program provided personalized, tailored instruction that made participants feel seen and supported	"…even though there are many cancer patients attending the classes, [the instructor] makes us feel that they are personal classes just for you." "…after high-intensity workout [the class] will have moments of light exercises, attuned to how the body works. [The instructor] is very mindful about cancer patients and their needs." "[The instructor] was careful to give guidance and offer alternatives for postsurgery patients."

DISCUSSION

In this study, we implemented a real-time synchronous virtual prehab program to meet the needs of people with cancer undergoing thoracic surgery during the COVID-19 pandemic. We found that the Mind-Body Prehab for Thoracic Cancer Surgery program was highly utilized and well accepted by participants. The majority of participants reported that they were extremely satisfied with the program and that it was helpful in preparing them for the surgery. In addition, participants reported that the classes helped reduce their anxiety, stress, fatigue, pain, and shortness of breath. Qualitative data further suggest that the program made participants feel stronger, more connected to their peers, and better prepared before and after surgery. Our findings demonstrate that prehab programs offered synchronously in a virtual format is highly feasible and acceptable.

To our knowledge, our study is the first virtual synchronous prehab program for patients with cancer undergoing thoracic surgery. Previous prehab studies on cancer center- and home-based exercise interventions among patients with thoracic cancer, have been found to be effective at improving exercise capacity, muscle strength, and quality of life.[5,8,15] A recent systematic review by Batalik and colleagues[16] found that home-based exercise rehabilitation interventions among cancer survivors are feasible to implement yet vary in the amount of supervision offered and rely on various forms of remote monitoring and counseling. The current study provides a novel approach that allows for real-time, personalized instruction of the group exercise session with tailored recommendations based on patients' abilities.

Furthermore, cancer center-based exercise interventions present numerous barriers to in-person participation, such as limited institutional resources (eg, space), travel burden, symptom burden, demanding treatment schedules, and susceptibility to infection in immunocompromised patients.[10] Regional in-person programs between hospitals and community partners demonstrate feasibility at scale and high uptake, yet still require in-person delivery and participation, which might not be conducive to a patient's wants and needs during the ongoing COVID-19 pandemic.[17] Virtual delivery models may remove these barriers and provide easy access to much-needed interventions for this population before surgery. In the present study, patients living in various parts of the United States who come to MSK for surgery were able to participate in the virtual prehab program from their homes, highlighting the vast reach of virtual programs. Future programs could explore multisite collaboration to expand participation in virtual programs.

Consistent with our study, a prior virtual synchronous mind-body intervention among people with cancer was

found to be feasible with high utilization and satisfaction.[18] Prior prehabilitation research among cancer patients with a virtual component have shown promising results; however, the interventions relied on home-based exercise programs with no live supervision.[19,20] In contrast, our program offered the opportunity to connect directly with the instructor and peers in real-time at the conclusion of every class. The educational component of our program taught participants about what to expect for their upcoming surgery, which may have helped reduce their presurgery anxiety. Participants also commented that it brought a sense of comfort seeing their peers rejoin the program postsurgery and that this motivated them to adhere to their classes. Future virtual prehabilitation programs should consider a synchronous format to promote social connection in addition to physical exercises to further support patients' mental well-being.

Although our program was well received and feasible to implement it might not meet the needs of all patients with cancer undergoing thoracic surgery. We found that some individuals preferred to exercise on their own, which means our group class structure would not be suitable for them. Another barrier to participating in our program included work conflict/too busy. Technology issues, such as lack of digital literacy and limited familiarity with Zoom, were also found to be an important barrier that prevented some individuals, especially older patients, from participating in the program. There might be potential to leverage asynchronous programming using prerecorded fitness classes to accommodate those with scheduling conflicts or offer in-person classes for those with technology barriers.

Our study has several limitations. This is a program evaluation, therefore it does not have rigorous follow-up with participants or a comparison group. We also do not have information about perioperative or long-term outcomes for those who participated in our program. Moreover, because this was a program evaluation project and not a specific research project, to protect patient privacy in accordance with Health Insurance Portability and Accountability Act of 1996, we were unable to collect patient information from our Zoom classes. Hence, there was no way to identify unique responses. Our data collection was convenience based and we do not have the overall response rate, which might have influenced our findings. Furthermore, the short length of the interviews in the context of program evaluation might have precluded us from exploring in-depth patient experiences that are often part of formal qualitative research. In addition, to participate in the program participants needed to be comfortable with using technology or have access to a reliable Internet connection, which might have limited participation from patients with limited digital literacy or no internet access. Although <5% of the patients in our study refused to participate due to a technology barrier, this might be attributable to the study setting being a tertiary cancer center. Furthermore, this program was completed through affiliation with an urban academic cancer center. Our results may not be generalizable outside of this setting. Additionally, the majority of our participants identified as White non-Hispanic, which means our program might not be generalizable to other race and ethnicities.

CONCLUSIONS

A mind-body prehab program offered synchronously and virtually was highly feasible to implement and well received among patients with thoracic cancer. This program design can help overcome some of the challenges to in-person participation as well as minimally supervised at-home programs. Our study contributes to the limited research implementing prehab programs synchronously with a mind-body component. Future implementation science research should utilize specific frameworks such as Reach, Effectiveness, Adoption, Implementation, and Maintenance[21] or Consolidated Framework Implementation Research[22] to help guide and implement virtual programming in more diverse settings. Moreover, randomized clinical trials are needed to determine whether or not this prehab program design is effective at improving reported and clinical outcomes among patients undergoing thoracic surgery.

Conflict of Interest Statement

Dr Jones serves as a consultant for AstraZeneca and on a clinical trial steering committee for Merck. Dr Molena serves on a steering committee for AstraZeneca and as a consultant for Johnson & Johnson, Bristol Myers Squibb, Merck, and Genentech. Dr Rocco has financial relationships with Scanlan, AstraZeneca, and Medtronic. Dr Mao reports grants from Tibet CheeZheng Tibetan Medicine Co Ltd outside the submitted work. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they have a conflict of interest. The editors and reviewers have no conflicts of interest.

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Key Words: prehabilitation, virtual mind-body, thoracic cancer, integrative medicine

TABLE E1. Qualitative interview guide

1) What has it been like attending the prehab classes?
a) What are your overall impressions of the sessions?
b) What did you like about them? What didn't you like about them?
2) Were there any challenges in attending the classes? If so, please explain.
3) (Ask this question to postsurgery patients only) How comfortable are you rejoining the sessions after surgery?
4) How can we improve future sessions to make our program better?
5) Is there anything else that I did not ask you about the sessions that you'd like to talk about today?