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Original research

How do practitioners prescribe exercise to patients with breast cancer? Professional perspectives on the key considerations for aerobic exercise in patients with breast cancer undergoing chemotherapy

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ABSTRACT

Objectives: This study aimed to understand the key factors experienced accredited exercise physiologists (AEPs) and medical professionals consider when prescribing/recommending aerobic exercise to patients with breast cancer undergoing chemotherapy.
Design: Modified Delphi Survey.
Methods: A four-round, two-phase survey was conducted. Following a Delphi approach, four cancer-specific AEPs, four oncologists, and one breast cancer surgeon (median 13-yr breast-cancer-specific experience) completed phase one. Eighty-four AEPs (median 5-yr experience) completed phase two. Phase one participants answered open- and close-ended questions regarding key considerations for aerobic exercise in patients with breast cancer undergoing chemotherapy, and what information should be collected to guide exercise prescription. All questions and considerations agreed upon in phase one (>70 % rating 7–9 on a 0–9 Likert Scale) were rated by AEPs in phase two.
Results: Key considerations for exercise assessment and prescription aligned closely with exercise guidelines for cancer survivors. Common strategies for exercise individualisation were identified by AEPs, including separating aerobic exercise into 5-to-–9-minute bouts when required and avoiding exercising to complete exhaustion. Exercise intensity and duration should be adjusted throughout chemotherapy to improve tolerance and adherence. Novel considerations for subjective questioning and objective assessments to tailor exercise prescription were outlined.
Conclusions: This study identifies how professionals approach exercise assessment and prescription in patients with breast cancer undergoing chemotherapy. Findings can guide AEPs in practice when prescribing tailored exercise to breast cancer patients undergoing chemotherapy and inform future guidelines.

Practical implications

- Current AEP practice with patients with breast cancer undergoing chemotherapy is closely aligned with exercise guideline recommendations for cancer survivors.
- Common ways individualisation is applied by AEPs in practice were outlined.
- Findings can guide less experienced exercise professionals when designing tailored aerobic exercise interventions for patients with breast cancer undergoing chemotherapy, and guide medical professionals when recommending aerobic exercise participation to patients.

1. Introduction

Breast cancer is the most commonly diagnosed cancer in females worldwide, with over 2.1 million new cases each year.[1] Breast cancer treatment is associated with many side effects causing reductions in physical function and quality of life, both during treatment and survivorship.[2,3] Consequently, physical inactivity is common during

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and following breast cancer treatment, increasing associated cardiovascular health risks.[4] Recent meta-analytic research has demonstrated that exercise following breast cancer diagnosis is inversely associated with cardiovascular, all cause, and cancer-related mortality.[5] Furthermore, exercise has been shown to reduce anxiety, depression, and fatigue, whilst improving health-related quality of life and physical function, in some people with cancer.[3,6]

Given the significant benefits of exercise for individuals with cancer, several exercise guidelines have been developed. Initial guidelines were developed by Exercise and Sports Science Australia (ESSA) in 2009,[7] and the American College of Sports Medicine (ACSM) in 2010.[8] Both concluded that exercise was safe and well tolerated during and following cancer treatment, and could improve physical fitness, quality of life and reduce cancer-related fatigue. With most exercise-based research at this time focussed on breast and prostate cancers, specific exercise prescription recommendations (i.e., frequency, intensity, time, type (FITT principles)) were not provided for all cancers or treatment modalities.[7,8] However, these guidelines did discuss exercise assessment, exercise prescription, and exercise contraindications for certain types of cancer (breast, prostate, colon) and certain phases of treatment (pre/post-surgery, during/after chemotherapy/radiotherapy). These initial guidelines also outlined the importance of individualised exercise prescription for cancer populations. In 2018, the Clinical Oncology Society of Australia (COSA) released a position statement on exercise in cancer care, recommending that all cancer patients should avoid inactivity and be as physically active as their abilities allow, that exercise should be individualised, and where possible, exercise should be prescribed and delivered by an accredited exercise physiologist or physiotherapist.[9] These recommendations align closely with earlier guidelines, regarding the importance of avoiding inactivity and individualised exercise prescription.[7,8] In 2019, ESSA and ACSM updated their exercise guidelines for cancer survivors.[2,6] ESSA's updated position statement provided FITT recommendations, considerations, and precautions for specific cancer-related side effects and patient comorbidities. A guide for exercise individualisation was also outlined, including details specific to patient assessment, and processes for determining suitable exercise intervention characteristics.[2] ACSM's updated guidelines provided FITT recommendations for cancer-related side effects where strong evidence supported the benefits of exercise, including anxiety, depression, fatigue, quality of life, physical function, and lymphedema. Exercise testing and medical clearance recommendations specific to patient presentation were also outlined.[6]

With improvements in the specificity of recent guidelines, exercise professionals can refer to them to inform and assist exercise prescription for cancer survivors. However, it is not known if interventions prescribed by exercise professionals for patients with breast cancer undergoing chemotherapy align with guideline recommendations, or what key factors they consider to inform exercise prescription in this specific population. Whilst the perspectives of patients with breast cancer undergoing chemotherapy pertaining to exercise have been explored thoroughly in the literature, this remains relatively unknown.[10,11]

As outlined in ESSA's updated position statement and previous literature, patient assessment plays a key role in tailoring exercise prescription.[2,12] Specifically, the collection of subjective (i.e., client history) and objective (i.e., physical testing) information directly impacts the decision-making process of exercise professionals.[13] However, the specific subjective and objective information that practicing exercise professionals collect from patients with breast cancer undergoing chemotherapy to inform exercise prescription is not known. In addition, it is unclear if medical professionals who recommend exercise to patients with breast cancer (i.e., oncologists, surgeons) do so in line with guidelines, or what subjective and objective information they believe is necessary to be collected by exercise professionals. This is an important step to understand, as communication between exercise professionals and at least one member of a patients treating team (i.e., oncologist, surgeon) is recommended for all patients with cancer.[2]

Thus, the aims of this study were 1) to explore key considerations for aerobic exercise in patients with breast cancer undergoing chemotherapy from a selected group of highly experienced interprofessional clinicians; and 2) identify how these considerations align with the practice of current exercise physiologists working with patients with breast cancer.

2. Methods

A four-round electronic survey was conducted across two phases using RedCAP Survey Platforms (v10.0.19, TN, USA) and Survey Monkey Inc. (CA, USA) between October 2020 and September 2022. The study was granted ethical approval by the University of South Australia Human Research Ethics Committee (Protocol Number 203189).

2.1. Phase 1

2.1.1. Purpose and design

Phase one sought opinions from a selected group of experienced accredited exercise physiologists (AEPs) specialising in cancer care, medical and radiation oncologists, and breast cancer surgeons across three survey rounds. Phase one was designed using an established Delphi methodology,[14,15] with the number of survey rounds, analytical approach, and threshold for agreement between participants determined a priori.

2.1.2. Participants

To be selected for phase one, AEPs required a current accreditation with ESSA and a minimum of five years academic or clinical experience researching/working with patients with cancer. Oncologists and breast cancer surgeons required accreditation with their relevant governing body (i.e., Royal Australasian College of Physicians), and a minimum of five years of experience treating or operating on patients with breast cancer. AEPs, oncologists, and breast cancer surgeons that met the inclusion criteria were identified via governing body websites, profiles on business/work pages, and word of mouth, and directly invited via email to participate in phase one of this study.

2.1.3. Process

In the first round, AEPs, oncologists, and breast cancer surgeons provided written responses to 14 open-ended questions. Questions were designed to understand key considerations for aerobic exercise prescription in patients with breast cancer undergoing chemotherapy, including what subjective and objective information AEPs, oncologists, and breast cancer surgeons believe is necessary for AEPs to collect to prescribe a tailored exercise intervention to patients with breast cancer undergoing chemotherapy, and what information should be included in a referral from an oncologist/breast cancer surgeon to an AEP. Three different exercise guidelines for cancer survivors were also presented,[6,8,9] with AEPs, oncologists, and breast cancer surgeons indicating which guidelines they believed were most appropriate and suitable for patients with breast cancer undergoing chemotherapy based on their knowledge and experience in their given fields. Additional open-ended questions regarding key considerations for specific aerobic exercise modalities, intensities, frequencies, and durations were also answered. All questions are detailed in supplementary digital content 1, Table 1. Any response that appeared two or more times within areas of subjective, objective, referral, or prescription was converted into a close-ended question for round two. Answers were cross-checked by a co-author (HB). Any additional information gathered from open-ended questions that asked participants to provide rationale to their responses (i.e., 'why'), was presented within the Results section to provide further context for the reader.

In round two, close-ended questions derived from answers gathered in round one, were sent to participants to rate on a 9-point Likert scale (1–3 = disagree; 4–6 = neither agree nor disagree; 7–9 = agree). This scale has previously been used successfully to define key domains for

subjective assessments by AEPs.[12] Questions were categorised into subjective, objective, referral, and prescription parameters relating to the FITT principles. AEPs, oncologists, and breast cancer surgeons were asked to rate each question relating to its importance and suitability when receiving/giving a referral, collecting subjective and objective information, or prescribing/recommending exercise to this population. They were also given the opportunity to provide further comments at the end of each section. Agreement was considered between participants for each question if >70 % scored 7–9 (agree).[16] Questions that reached agreement were presented to participants in round three for informative purposes as "questions that have reached agreement". The percentage of agreement achieved, median score, and interquartile range for each question were also presented.

Questions that did not reach agreement in round two were again presented to participants in round three. The median and interquartile range of each question were provided for consideration when rating each question. AEPs, oncologists, and breast cancer surgeons were also given the opportunity to consider comments (de-identified) from other participants in round two when making their decision. Questions that did not reach agreement after round three were interpreted as pieces of information AEPs, oncologists, and breast cancer surgeons could not agree upon as necessary to include in a referral to an AEP, collect subjectively or objectively, or consider when prescribing/recommending exercise to patients with breast cancer undergoing chemotherapy.

The link to access each round of the survey in phase one was sent to AEPs, oncologists, and breast cancer surgeons individually via email. Weekly email reminders were sent for three consecutive weeks for each round, or until a response had been gathered. AEPs, oncologists, and breast cancer surgeons had to complete round one to be involved in round two, and round two to be involved in round three. If no response had been received following three email reminders (across three consecutive weeks), participants were deemed to have withdrawn from the study.

2.2. Phase 2

2.2.1. Purpose and design

Phase two was designed to determine how the key considerations for aerobic exercise prescription identified by a group of highly experienced interprofessional clinicians align with current AEP practice with patients with breast cancer undergoing chemotherapy.

2.2.2. Participants

AEPs currently accredited with ESSA and with any level of experience prescribing exercise to cancer populations were eligible to participate in this phase. Potential participants were identified by searching the ESSA website using the "find an AEP" function.[17] The study was also advertised via social media to find additional participants.

2.2.3. Process

In phase two, all questions, assessments, and exercise prescription parameters/considerations that met agreement in phase one were presented, with AEPs asked to rate how well each item aligns with their practice on a 9-point Likert scale (1–3 = disagree; 4–6 = neither agree nor disagree; 7–9 = agree). Agreement was considered for each question if >70 % of AEPs scored 7–9 (agree).[16] Responses for phase two were collected over a four-week period (August to September 2022), with one follow-up email sent to those identified AEPs and/or AEP practices two weeks following the original email. At the beginning of phase two, AEPs provided information regarding their years of experience as an AEP, and the percentage of their clientele that are cancer patients.

2.3. Statistical analysis

Qualitative responses to phase one, round one were separated into key themes and presented in text format. Written responses that appeared two or more times were converted into close-ended questions for rating in rounds two, three, and four. Responses to each question for rounds two, three, and four were collated to determine the level of agreement between AEPs, oncologists, and breast cancer surgeons (rounds two and three) and AEPs (round four). Agreement for each question across each round was considered if >70 % of participants scored 7–9 (agree) on the Likert scale.[16] Results from each round were presented descriptively (percentage, median, interquartile range). To explore whether years of experience and cancer-specific clientele impacted the results, a Mann Whitney *U* test was performed on data collected in phase two to determine if there were any differences between AEPs with more or less than five years' experience, and AEPs with more or less than 50 % of their clientele as cancer patients.

3. Results

3.1. Demographics

3.1.1. Phase one

A total of 29 AEPs, oncologists, and breast cancer surgeons were identified and approached to be involved in phase one. Seven AEPs, four oncologists (medical (n = 3), radiation (n = 1)) and one breast cancer surgeon meeting the inclusion criteria agreed to participate in phase one. The median number of years of experience working with patients with breast cancer across participants was 9.5 years (IQR = 6 years). All AEPs, and three oncologists were based in Australia, with one oncologist, and the only breast cancer surgeon based in Malaysia. Eleven participants completed round one (91.7 %), nine of the eleven participants completed round two (81.2 %), and all nine participants that completed round two also completed round three (100 %). Dropout occurred due to participants not responding to the survey questionnaire nor replying to email prompts. One AEP dropped out in round one, and a further two AEPs dropped out in round two. The median number of years of experience for those that completed phase one was 13 years (IQR = 8 years).

3.1.2. Phase two

In phase two, a total of 84 AEPs (all based in Australia) met the inclusion criteria and responded to the survey, with a median of 5 years (IQR = 6.25 years) experience, and a median of 20 % (IQR = 40 %) of their clientele being patients with cancer. Five participants were excluded from phase two for not having experience prescribing exercise to cancer populations.

3.2. Progression through study

Supplementary digital content, Fig. 1 summarises the progression through each phase of the study and the final number of questions in each domain that reached agreement between AEPs at the completion of phase 2. At the completion of phase one, 51 questions reached agreement across the five domains between AEPs, oncologists, and breast cancer surgeons (subjective = 28, objective = 10, referral = 4, exercise prescription = 5, general considerations = 4). In phase two, 50 of these 51 questions reached agreement between AEPs, with only one objective assessment not agreed upon. All individual questions rated by AEPs, oncologists, and breast cancer surgeons in phase one, and AEPs in phase two, including those that did not meet agreement, are detailed in supplementary digital content, Tables 2–6.

3.3. Qualitative responses to round one

Table 1 presents the key considerations AEPs, oncologists, and breast cancer surgeons identified in phase one, round one, when tailoring aerobic exercise interventions for patients with breast cancer undergoing chemotherapy. The qualitative information presented formed the basis of the close-ended questions presented in rounds two and three (phase one), and round four (phase two).

Table 1
Qualitative responses to open-ended questions in phase one, round one.

Question	Key theme/s (example/s), [frequency of theme – n/11]
When prescribing exercise to a patient with breast cancer undergoing chemotherapy, what key things should an exercise physiologist ask, observe, screen for, or assess?	Ask: 1. Treatment-related side effects (e.g., fatigue, nausea, neuropathies, quality of life), [$n = 8$]. 2. Past medical history and comorbidities (e.g., cardiovascular disease risk factors, lung diseases, musculoskeletal conditions, medications), [$n = 7$]. 3. Cancer diagnosis and treatment plan (e.g., stage, type, surgeries (and outcomes), treatments), [$n = 5$]. 4. Exercise history (e.g., current exercise, previous exercise, current activity of daily living capacity), [$n = 5$]. 5. Exercise-related goals (e.g., short term, long term), [$n = 5$]. 6. Social characteristics (e.g., support networks, work commitments), [$n = 5$] 7. Metastases (e.g., skeletal, cerebral, lung), [$n = 3$]. Screen: 8. Cardiovascular health (e.g., blood pressure, resting heart rate), [$n = 4$]. 9. Mental health (e.g., stress), [$n = 2$]. Assess: 10. Physical capacity and fitness (e.g., aerobic fitness, upper and lower body strength, balance, upper body range of motion, posture), [$n = 8$]. 11. Pain and lymphedema (e.g., areas of pain and swelling from treatments), [$n = 4$].
What information or test results would be needed to tailor an exercise programme to patients with breast cancer undergoing chemotherapy?	1. Blood test results (e.g., white blood cells, red blood cells, platelets), [n = 6]. 2. Diagnosis and treatment schedules (e.g., stage, timing and frequency of chemotherapy, neoadjuvant or adjuvant), [$n = 5$]. 3. Outcomes of physical capacity and fitness testing (e.g., aerobic fitness, strength), [$n = 5$]. 4. Outcomes of cardiovascular health screening (e.g., blood pressure, resting heart rate), [$n = 4$]. 5. Other scans/tests (e.g., echocardiography, x-ray, computed tomography scans), [$n = 4$].
Are there any aerobic exercises, or types of aerobic exercises, that you believe breast cancer patients undergoing chemotherapy should avoid, and why?	1. No (e.g., all modalities are safe), [$n = 6$]. 2. Swimming (e.g., due to infection risk), [$n = 4$]. 3. Weight bearing/high impact activity (e.g., if metastases or neuropathies are present), [$n = 4$].
Are there any aerobic exercises, or types of aerobic exercises, that you believe would be best suited to breast cancer patients undergoing chemotherapy, and why?	1. Enjoyment (e.g., whatever the patient enjoys), [$n = 4$]. 2. Access (e.g., whatever the patient can access), [$n = 3$]. 3. Safety (e.g., whatever is safe for the patient), [$n = 2$]. 4. Walking (e.g., treadmill, land), [$n = 2$]. 5. Stationary cycling (e.g., ergometer, exercise bike), [$n = 2$].
Are there any specific frequencies (number of sessions per week), durations (total minutes per session), or intensities of aerobic exercise that you believe breast cancer patients undergoing chemotherapy should avoid, and why?	Frequencies: 1. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 5$]. Durations: 2. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 5$]. Intensities 1. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 5$]. 2. High intensity exercise (e.g., don't exercise to exhaustion), [$n = 2$].
Are there any specific frequencies (number of sessions per week), durations (total minutes per session), or intensities of aerobic exercise that you believe breast cancer patients undergoing chemotherapy would be best suited to, and why?	Frequencies: 1. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 4$]. Durations: 2. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 4$]. 3. 10 min of intermittent exercise (e.g., breaking exercise bouts into smaller durations), [$n = 2$]. Intensities 3. No (e.g., should be individualised to the patient based on exercise tolerance, capacity, treatments), [$n = 4$].
Which of the proposed guideline/s do you believe would be best suited to breast cancer patients undergoing chemotherapy? (Can select more than one).	1. Clinical Oncology Society of Australia Position Statement on Exercise in Cancer Care 2018, [$n = 8$]. 2. American College of Sports Medicine Exercise Guidelines for Cancer Survivors 2019: Consensus Statement from International Multidisciplinary Roundtable, [$n = 4$]. 3. American College of Sports Medicine 2010 Roundtable on Exercise Guidelines for Cancer Survivors, [$n = 2$].
Additional comments:	1. Exercise must be individually tailored (e.g., guidelines are not appropriate for everyone, must be adjusted to suit individual needs), [$n = 5$]. 2. Avoid inactivity (e.g., try and do any physical activity and exercise relevant to capacity), [n = 3]. 3. Exercise should be overseen or prescribed by relevant professional (e.g., exercise physiologist or physiotherapist), [n = 3].

e.g., for example; n, number of participants identifying each key theme.
Only themes that were identified two or more times by participants are presented.

3.4. Results at the completion of phase two

A total of 67 questions, assessments, and exercise prescription parameters/considerations (derived from open-ended responses in phase one, round one) were presented to AEPs, oncologists, and breast cancer surgeons in phase one, round two (supplementary digital content, Tables 2–6). Of those, 51 (76 %) reached agreement upon the completion of phase one. 50 of these 51 questions, assessments, and exercise prescription parameters/considerations reached agreement between AEPs at the completion of phase two (Table 2). The level of agreement achieved (%), and median and interquartile range for each question are presented. The level of agreement ranged from 70.0 % to 97.6 % across the five domains.

Table 3 outlines the FITT principles from the three guidelines presented to cancer specialist AEPs, oncologists, and breast cancer surgeons in phase one, alongside the final recommendations agreed upon at completion of phase two. Similarities are observed for all elements of the FITT principle between exercise guidelines presented in phase one and participants interpretations.

Fig. 1 presents an infographic summary of the findings from each domain upon the completion of phase two.

There were no differences in individual questions across any domain between AEPs with more or less than five years' experience, or between AEPs with more or less than 50 % of their clientele as cancer patients in phase two ($p \geq 0.05$ for all questions).

4. Discussion

To the authors' knowledge, this is the first study to understand the key factors experienced AEPs, oncologists, and breast cancer surgeons consider when prescribing/recommending aerobic exercise interventions for patients with breast cancer undergoing chemotherapy, and

Table. 2
Questions that reached agreement between AEPs in phase two across all domains.

Questions that reached agreement (>70 %)	Agreement (%)	Median (IQR)
When conducting a subjective interview with a patient with breast cancer undergoing chemotherapy, and exercise physiologist should discuss, question, and understand… (n = 84)		
The forms of treatment a patient has been/will be exposed to (i.e., surgery, radiation, chemotherapy).	97.6	9 (0)
A patient's fatigue levels (i.e., changes in fatigue in response to treatment, daily fluctuations).	97.6	9 (0)
A patient's past medical history, including any co-morbidities and/or chronic health conditions.	96.4	9 (0)
A patient's cardiometabolic risk profile, including any history of heart disease, high blood pressure or type 2 diabetes.	96.4	9 (0)
The medications a patient is taking to manage any comorbidities/chronic health conditions.	96.4	9 (1)
A patient's current physical activity levels since breast cancer diagnosis.	96.4	9 (1)
A patient's sites and severity of lymphedema.	95.9	9 (0)
A patient's current mental health status.	95.2	9 (1)
A patient's current pain experiences, including specific sites of pain.	95.2	9 (1)
Any physical weaknesses or limitations a patient may have (i.e., weakness of specific muscles, limitations in functional ability or aerobic fitness).	95.2	9 (1)
A patient's dyspnoea experiences/symptoms.	95.2	9 (1)
A patient's physical activity/exercise preferences (i.e., likes and dislikes).	95.2	9 (1)
A patient's peripheral neuropathy symptoms.	95.2	9 (1)
A patient's short-term goals during their treatment.	95.2	9 (1)
A patient's nausea levels (i.e., changes in nausea in response to treatment, daily fluctuations).	95.2	9 (2)
A patient's surgery type and outcomes (i.e., mastectomy vs breast conserving, axillary dissection etc.)	94.0	9 (0)
A patient's motivators to exercise during and following their treatment (i.e., for health benefit, or due to oncologist recommendation etc.)	94.0	9 (1)
Any metastases a patient may have, including their location.	92.9	9 (0)
The stage, type, and specific location of a patient's cancer.	91.7	9 (0)
A patient's long-term goals after their treatment (once in remission).	91.7	9 (1)
A patient's expectations after completing an exercise intervention.	90.5	9 (1)
A patient's changes in cognition.	90.5	9 (2)
If a patient has a port or peripherally inserted central catheter (PICC).	89.3	9 (0)
A patient's physical activity levels prior to breast cancer diagnosis.	88.1	9 (2)
A patient's sleep quality since beginning treatment.	86.9	9 (2)
A patient's social and support networks (i.e., family, friends, access to facilities, travel arrangements).	85.7	8 (1)
A patient's weight changes since beginning treatment.	85.7	9 (2)
A patient's work/family commitments during their treatment.	83.3	8 (2)
Prior to prescribing an exercise intervention to a patient with breast cancer undergoing chemotherapy, an exercise physiologist should test, measure and/or assess… (n = 80)		
Aerobic capacity either directly (gas-analysis etc.) or in-directly (6-minute walk test, step test etc.)	90.0	8.5 (1)
Lower limb strength (i.e. sit to stand etc.)	87.5	8 (2)
Upper limb strength (i.e. grip strength, bicep curl etc.)	86.3	9 (2)
Resting blood pressure.	85.0	9 (2)
Upper limb range of motion.	85.0	9 (2)
Balance.	81.3	8 (2)
Resting heart rate.	78.8	8.5 (2)
Heart rate recovery from cardiovascular testing.	76.3	8 (2)
Circumference measures of upper arm to measure risk of/changes in lymphedema.	72.5	8 (2.25)
The following should be included in a referral to an exercise physiologist by an oncologist/GP for a patient with breast cancer undergoing chemotherapy… (n = 79)		
A patient's comorbidities/chronic health conditions	98.7	9 (0)
The sites of patient metastases.	96.2	9 (0)
A patient's medications related to any comorbidities/chronic health conditions.	96.2	9 (0.5)
Results from any scans performed (Echo, PET, CT, X-Ray, DEXA).	84.8	9 (2)
General exercise prescription considerations (n = 72)		
Exercise guidelines should always be adapted to a patient's individual circumstance and/or capabilities.	97.2	9 (0)
If possible, resistance training should be included alongside aerobic exercise in breast cancer patients undergoing chemotherapy.	95.8	9 (0)
If a patient is unable to meet the FITT (frequency, intensity, time, type) principles proposed (i.e., the options you have selected above), the advice should be to reduce sedentary behaviour and avoid inactivity.	86.1	9 (1)
Exhaustive exercise (i.e., exercising to a state of exhaustion) should be avoided with breast cancer patients undergoing chemotherapy.	72.2	9 (3)
Exercise Prescription Parameters (n = 72)		
The most appropriate aerobic exercise modality(s) for patients with breast cancer undergoing chemotherapy is/are…		
Any modality preferred by the patient, with cycling or walking most preferred cancer specialist AEPs, oncologists, and breast cancer surgeons.	87.5	8 (2)
Most of the time, the best option(s) for prescribing exercise intensity to patients with breast cancer undergoing chemotherapy is/are…		
Heart rate (HR) and ratings of perceived exertion (RPE) are appropriate to prescribe exercise intensity.	91.7	9 (1)
The most appropriate aerobic exercise intensity(s) for patients with breast cancer undergoing chemotherapy is/are…		
Agreement not met for most appropriate exercise intensity band.	nr	nr
Individual circumstances may warrant low or vigorous aerobic exercise intensities.	91.7	9 (1)
Most of the time, a suitable/appropriate aerobic exercise frequency range (sessions per week) for breast cancer patients undergoing chemotherapy is…		
3–5 sessions per week.	70.8	7 (3)
The most appropriate aerobic exercise duration(s) (minutes achieved each day) for patients with breast cancer undergoing chemotherapy is/are….		
Agreement not met for most appropriate exercise duration range.	nr	nr
Individual circumstances may warrant aerobic exercise sessions of 60 min or greater in duration.	70.8	8 (3)
If a patient cannot achieve recommended aerobic exercise durations in one bout (20–30 min), what would be the minimum increment range (in minutes) that aerobic exercise could be broken up into:		
Breaking aerobic exercise into 5-to-–9-minute bouts to reach a total of 20-to-–30 min per day is appropriate if required.	84.7	9 (1)
Monitoring during aerobic exercise.		
Heart rate (HR), ratings of perceived exertion (RPE), and oxygen saturation (SpO2) are appropriate to monitor exercise intensity.	91.7	9 (1)
Altering aerobic exercise intensity and/or duration based on chemotherapy schedule (n = 67)		
The week prior to chemotherapy treatment: Either increase or maintain intensity and/or duration.	80.6	8 (2)
The week of chemotherapy treatment: Either maintain or decrease intensity and/or duration.	71.6	8 (2.5)
The week after chemotherapy treatment: Either decrease or maintain intensity and/or duration.	70.0	7.0 (2)

n, number of AEPs responding to each domain in phase two; nr, not reported. Median (IQR) represents the Likert ratings for each question from all experts.

Table. 3
Comparison between exercise guidelines for cancer survivors presented in phase 1 round 1, and the final recommendations for women with breast cancer undergoing chemotherapy at the completion of phase two.

FITT Principle	Guideline 1 (ACSM 2010)	Guideline 2 (ACSM Consensus Roundtable 2019)	Guideline 3 (COSA 2018)	Findings upon completion of phase 2
Frequency	3–5× per week.	2–3× per week.	3–5× per week.	3–5× per week
Intensity	Moderate to vigorous.	60–85 % HRmax, 45–85 % VO2max or 11–15 RPE.	Moderate to vigorous.	Agreement not met.
Time	75 min of vigorous or 150 min of moderate exercise per week.	20–60 min per exercise session.	75 min of vigorous or 150 min of moderate exercise per week.	Agreement not met.
Type	Walking or cycling.	Walking or cycling.	Walking, cycling, or swimming	Any modality preferred by patient. Walking or cycling most preferred.
Notes/other recommendations	Evidence provided regarding benefits for specific exercise (i.e., strength, aerobic fitness) and treatment--related (i.e., fatigue) outcomes for breast, prostate, and colon cancer at different stages of treatment.	Specific FITT recommendations provided for management of anxiety, depression, fatigue, quality of life, physical function, and lymphedema. Exercise testing, medical clearance, and general consideration recommendations provided.	Avoid inactivity. Progress towards achieving physical activity guidelines for general population (above). Exercise delivered by AEP or physiotherapist. Exercise should be individualised.	Breaking aerobic exercise into 5-to-–9-minute bouts to reach a total of 20-to-–30 min per day is appropriate if required. Avoid exercising to a state of exhaustion. Exercise intensity or duration should be altered based on a patient's chemotherapy schedule in the following manner: 1) Week *prior* to chemotherapy infusion: Increase or maintain intensity or duration. 2) Week *of* chemotherapy infusion: Maintain or decrease intensity or duration. 3) Week *after* chemotherapy infusion: Decrease or maintain intensity or duration.

FITT, frequency, intensity, time, type; ACSM, American College of Sports Medicine; COSA, Clinical Oncology Society of Australia; HR, heart rate; AEP, accredited exercise physiologist.

explore how these considerations align with current AEP practice. Results from this study identify how AEPs individualise exercise prescription for patients with breast cancer undergoing chemotherapy, and highlight the key patient assessment information required to tailor exercise prescription in this population.

At the completion of phase two, 50 items met agreement across five domains (Table 2). It is recommended that AEPs consider these questions, assessments, prescription principles, and general considerations when tailoring an exercise intervention to a patient with breast cancer undergoing chemotherapy. Items in each domain provide examples for AEPs and other professionals working with this cohort regarding common ways individualisation can be applied in practice, which is important as not all individuals will present for exercise services with the same needs or physical capacities. Therefore, the findings of this paper, derived from experienced interprofessional clinicians, can guide AEPs when selecting individualised exercise assessments and prescriptions for this population. Although specific questions, assessments, and prescription recommendations were identified, the importance of individualisation was emphasised by all participants throughout each phase of the study, which aligns with exercise guidelines for cancer survivors.[2,6–9] Whilst oncologists and breast cancer surgeons are not trained in the specifics of exercise prescription, they play an important role in recommending exercise services.[10,11] Their inclusion ensured a wholistic, multidisciplinary approach to outcomes of this study, with notable similarities observed between considerations identified in phase one, current AEP practice (phase two), and current guidelines.

When prescribing aerobic exercise, AEPs sampled in phase two agreed 3-to-5 exercise sessions per week of any aerobic exercise modality (i.e., walking, cycling, dancing, cross-trainer) preferred by a patient with breast cancer undergoing chemotherapy is suitable. This frequency of weekly exercise aligns with commonly planned training frequencies in randomised controlled trials for patients with breast cancer, whereby adherence has been shown to be high (>70 %).[18–20] Further research has demonstrated that adherence to weekly exercise sessions decreases with cumulative chemotherapy dose (three cycles or greater) in patients with breast cancer.[21] As such, the lower end of the agreed frequency range by AEPs may be an appropriate target for patients with breast cancer from their third cycle of chemotherapy onwards. AEPs did not agree on the *most* suitable aerobic exercise intensities or durations, but instead agreed that aerobic exercise intensity and duration should be dictated by individual capabilities. This mirrors responses from experienced AEPs, oncologists, and breast cancer surgeons in phase one and the exercise guideline recommendations for cancer survivors, and demonstrates that creating a generalisable FITT principle is not always appropriate for this population.[2,6,9] This finding also highlights the importance of questioning previous exercise history and assessing tolerance to exercise during an initial consultation, as it will have a notable impact on what exercise is suitable for a patient during chemotherapy. Although an exact range for aerobic exercise intensity or duration was not agreed upon, AEPs did outline common ways individualisation is applied for these parameters. AEPs agreed exercising to a complete state of exhaustion should be avoided during chemotherapy to prevent significant post-exercise fatigue and/or a 'crash' when symptoms of fatigue are heightened. In saying that, AEPs did agree vigorous intensity exercise (70–90 % HRmax) and exercise durations of 60 min or greater may be appropriate for this population, especially in individuals with extensive exercise experience pre-diagnosis.[22] AEPs' suggestions regarding adjustments to intensity and duration of

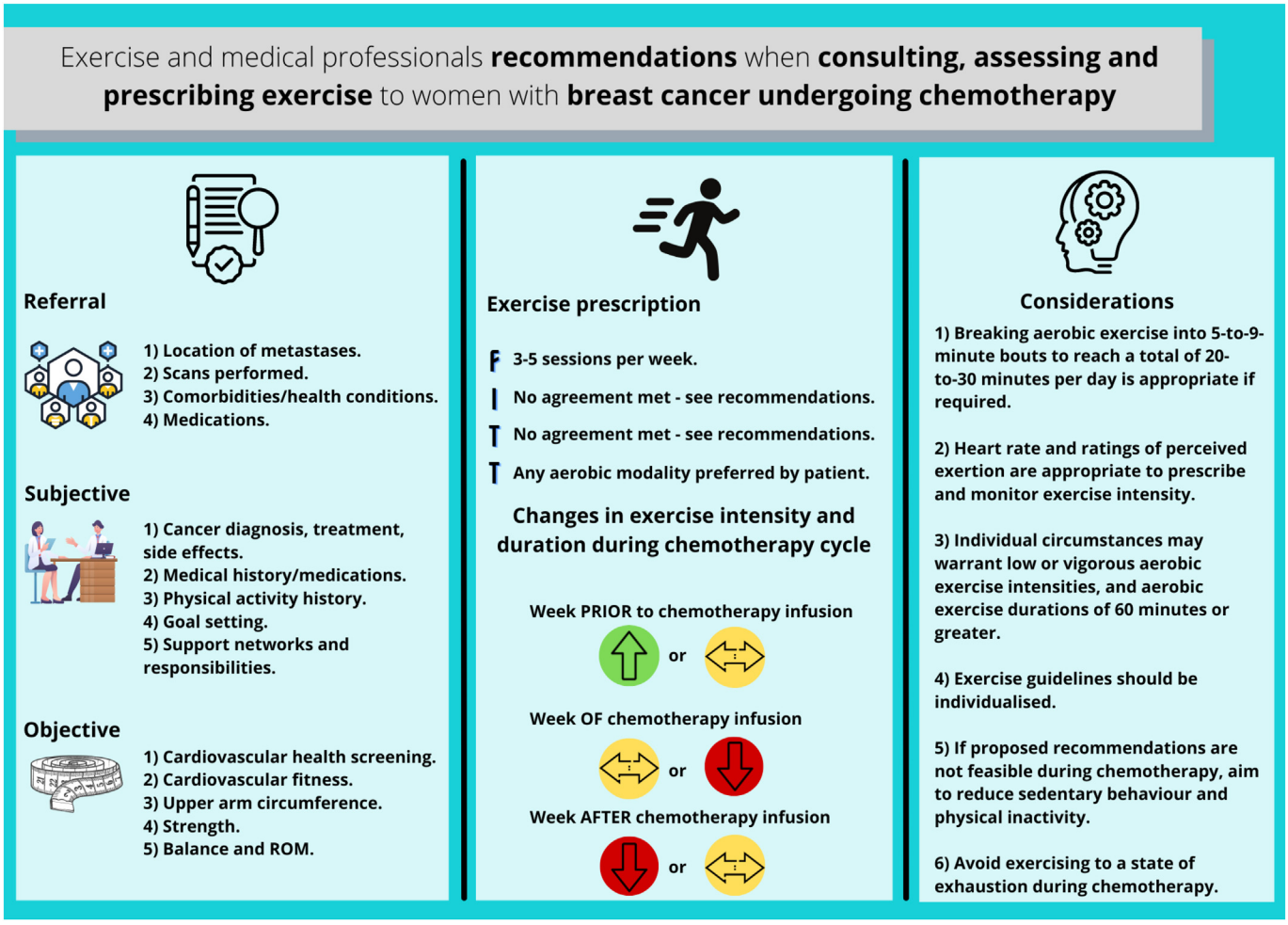

Fig. 1. Summary of participant opinions, interpretations, and recommendations when consulting, assessing and prescribing exercise to patients with breast cancer undergoing chemotherapy, upon completion of phases one (n = 9) and two (n = 84). F = frequency, I = intensity, T = time, T = type. Up arrow symbol = increase, down arrow symbol = decrease, double arrow symbol = keep the same. ROM – range of motion. >70 % agreement was met by participants across phases one and two for all information presented.

exercise based on a patient's chemotherapy schedule (Table 3) would suggest that if prescribed, vigorous intensity exercise and durations of 60 min or greater may be most suitable in the week prior to each chemotherapy dose. Conversely, AEPs suggested that exercise intensity and duration should be decreased and/or maintained in the 7 days following chemotherapy infusion. A maintenance in intensity and duration is likely appropriate in the first 1–3 days post chemotherapy, as nausea and fatigue are often blunted due to the effect of steroid medication prescribed prior to infusion,[23] with a decrease in intensity and duration appropriate 4–5 days post infusion, when fatigue typically peaks.[24] This may also be the timepoint in treatment when 5-to-–9-minute bouts of exercise are implemented, which was agreed by AEPs as appropriate for patients who cannot achieve 20-to-–30 min of exercise in one bout. It has been hypothesised that the negative impact chemotherapy can have on exercise tolerance may necessitate variations in the volume and intensity of exercise interventions to improve tolerability and adherence,[25] which these recommendations support. Indeed, recent research has indicated that non-linear periodisation strategies, where exercise intensity is altered in response to an individual's chemotherapy schedule cause significant improvements in health and function in breast cancer patients, and may promote slightly better adherence than linear (i.e., unchanging) periodisation approaches.[26,27] Furthermore, ESSA's early guidelines had noted that exercise programmes need to be flexible during cancer treatment due to the presence of side effects.[7] As such, these findings add depth to earlier recommendations, and outline specific ways AEPs can adjust exercise prescription with patients with breast cancer undergoing chemotherapy to enhance adherence. When monitoring patients during exercise, AEPs agreed that ratings of perceived exertion (RPE) and heart rate (HR) are appropriate. This seems logical, as the measurement of RPE and HR will allow AEPs to understand how a patient feels during exercise, which will likely fluctuate throughout the chemotherapy cycle, whilst still monitoring physiological responses to exercise. These considerations provide useful insight into AEPs' approaches to exercise prescription for patients with breast cancer undergoing chemotherapy.

A non-cancer-specific subjective assessment framework for individuals presenting for clinical exercise services has been previously developed through a Delphi consensus survey.[12] This survey identified 22 domains that AEPs believe should be covered to ensure all relevant subjective information is collected to base their clinical decisions on.[12] ESSA's updated exercise guidelines for cancer survivors also outlined information that should be collected during patient assessment.[2] Many subjective questions noted by interprofessional clinicians in phase one, and agreed upon by AEPs in phase two, align with the domains identified in each of these papers, again indicating that current AEP practice with patients with breast cancer undergoing chemotherapy aligns closely with exercise guideline recommendations for cancer survivors. Bahl, Dollman, Davison[12] identified a patient's 'condition profile' as one domain that should be discussed. Results from this work outline the key condition specific questions AEPs discuss with a patient with

breast cancer undergoing chemotherapy. These include the stage, type, and location of a patient's breast cancer diagnosis, the type of treatments performed to date (i.e., surgery, radio/chemotherapy) and those currently being undertaken/planned, outcomes of surgery, side effects experienced by the patient (i.e., fatigue, nausea, peripheral neuropathy, sleep quality, weight changes, lymphedema) and how these side effects fluctuate at different periods of their treatment cycles. These findings add depth to the literature specific to patients with breast cancer undergoing chemotherapy. AEPs also agreed that understanding a patient's expectations of partaking in an exercise intervention during chemotherapy is important to obtain, as it can aid clinical decision-making with respect to exercise prescription. The importance of identifying patient-specific goals to tailor exercise prescription has been noted in guidelines.[2] As such, identifying a patient's expectations of partaking in an exercise intervention during chemotherapy will assist in the goal setting process and tailoring of exercise prescription. Support networks, responsibilities and access to services were not a part of the subjective framework developed in the study by Bahl, Dollman, Davison,[12] with only accessibility noted in ESSA's updated guidelines. AEPs in the present study agreed that these factors should be discussed in a subjective assessment with a patient with breast cancer undergoing chemotherapy. Given the side effects associated with breast cancer treatment, and the regular need to attend external facilities to receive treatment and undertake exercise, understanding a patient's support networks and ability to access these services is particularly relevant.

In addition to subjective assessment, AEPs agreed upon relevant objective tests they would conduct to inform exercise prescription for patients with breast cancer undergoing chemotherapy. As certain types of chemotherapy can negatively affect heart function, and breast cancer treatment can increase the risk of developing cardiovascular comorbidities,[28–30] assessments that can identify such risk including resting blood pressure and resting heart rate were considered relevant and practical by AEPs. Abnormalities in such measures should be highlighted to the referring oncologist, who can facilitate referral to cardiology for further cardiac testing (i.e., echocardiography and exercise cardiovascular magnetic resonance imaging) if deemed necessary.[26] Further assessments that could identify the risk of developing cardiovascular comorbidities, such as weight, body mass index, and waist circumference were not considered relevant to collect by AEPs in phase two, despite participants in phase one agreeing on the relevance of these measures. This may reflect the time pressure of AEP practice, with AEPs needing to prioritise objective assessments that provide the most relevant information. However, as chemotherapy can cause unfavourable changes in body composition (increased body fat percentage, decrease fat-free mass),[31] such measures may still be relevant to monitor in patients at an increased risk of developing cardiovascular disease. AEPs agreed the measurement of upper arm circumference, to identify signs of swelling related to lymphedema should be performed. Although there is a discord in the literature regarding the risk of lymphedema following certain chemotherapies, such a measurement is useful given the other treatments typically performed in conjunction with chemotherapy for breast cancer (i.e., surgery), especially in patients undergoing axillary emptying or with a high body mass index.[32,33] Such a measurement is practical and inexpensive, making it a feasible addition, and any change in upper arm circumference relating to lymphedema is information that can be relayed to the treating oncologist, supporting communication between exercise professionals and treating specialists.[2] Additionally, AEPs recommended the assessment of upper arm range of motion and strength given the functional limitations that can occur following breast surgery. The assessment of full body strength and cardiorespiratory fitness are further measures AEPs would perform to monitor the effectiveness of their exercise intervention and any potential declines in function due to chemotherapy. However, these assessments would be tailored based on patient goals and the identified priorities of the intervention. These findings highlight the array of individualised objective assessments that AEPs may perform to ensure exercise prescription is tailored for patients with breast cancer undergoing chemotherapy.

4.1. Strengths, limitations, and future research

The active identification of experienced cancer specialist AEPs, oncologists, and breast cancer surgeons in phase one was a strength of this study. A further strength of this research is practical applicability. These findings can be immediately implemented by AEPs and medical professionals working with breast cancer patients. Moreover, as they were derived from, and supported by, experienced professionals working with this population, there is a high degree of confidence in the findings. The small number of experts identified meeting the inclusion criteria for phase one is a potential limitation. A larger cohort may have identified further considerations that are important when prescribing exercise to patients with breast cancer undergoing chemotherapy. It is important to note that 83 % of respondents in phase one, and 100 % of respondents in phase 2 were located in Australia at the time of data collection. As such, the findings presented may not be generalisable outside of an Australian health care context. Lastly, this study was limited to AEPs, oncologists, and breast cancer surgeons. Consequently, other allied health practitioners involved in breast cancer care (i.e., physiotherapists and nurses) may have additional insights that were not reported in this study.

5. Conclusion

This study provides insight into approaches to exercise assessment and prescription in patients with breast cancer undergoing chemotherapy. Findings identified that exercise assessments and interventions prescribed by AEPs for patients with breast cancer undergoing chemotherapy closely mirror exercise guideline recommendations for cancer survivors. Common ways individualisation can be applied in practice were highlighted throughout, for example, breaking daily exercise goals into 5-to-9-minute bouts and adjusting exercise intensity and duration upon chemotherapy schedules to improve tolerance and adherence. These findings contribute to our understanding of the factors that experienced interprofessional clinicians and AEPs consider important when working with this population, which may be useful for novice AEPs and help inform future guidelines.

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Confirmation of Ethical Compliance

The study was granted ethical approval by the University of South Australia Human Research Ethics Committee (Protocol Number 203189).

CRediT authorship contribution statement

James Murray: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft. **Hunter Bennett:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Rebecca Perry:** Conceptualization, Methodology, Writing – review & editing. **Eva Bezak:** Conceptualization, Methodology, Writing – review & editing. **Kade Davison:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Interest Statement

All authors declare no conflict of interest.

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Appendix A. Supplementary data

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