Exercise Professionals in the Cancer Center: Experiences, Recommendations, and Future Research

Article · July 2019

CITATIONS
5

READS
235

3 authors, including:

Bobby Cheema
Western Sydney University
78 PUBLICATIONS **2,391** CITATIONS
SEE PROFILE

Ciaran Fairman
University of South Carolina
63 PUBLICATIONS **341** CITATIONS
SEE PROFILE

Exercise Professionals in the Cancer Center: Experiences, Recommendations, and Future Research

Birinder S. Cheema,[1,2] Ciaran M. Fairman,[3] and Michael Marthick[4]

ABSTRACT

In 2018, the Clinical Oncology Society of Australia published a landmark position statement calling for exercise to be integrated as standard practice in cancer care. Efforts to implement this directive in the years ahead will come with many practical challenges. We suggest that for the successful integration of exercise therapy to occur, exercise professionals and their services will have to become a respected, visible, and promoted part of the cancer treatment center itself (i.e., "part of the woodwork"). However, we are aware of no report in the literature documenting the role or experiences of an exercise professional working within a cancer center, or practical recommendations for the implementation and evaluation of exercise services in this setting. Therefore, we detail the experiences of an accredited exercise physiologist, to our knowledge, one of the first to be employed on a full-time basis within a cancer center in Australia (M.M.). On the basis of this case study, we provide practical recommendations for exercise professionals seeking to integrate exercise services within the cancer treatment setting. In addition, we present a model of care involving a key role for the exercise professional, which could be implemented to improve patient care and health outcomes throughout cancer treatment and beyond. Although our article is written from an Australian perspective, our recommendations may be relevant to and/or adapted for health care systems in other countries.

INTRODUCTION

Epidemiological studies have consistently shown that higher levels of physical activity significantly lower the risk of many cancers, cancer recurrence, and disease-specific and all-cause mortality (1,2). In addition, clinical trials published since 1983 (3) have demonstrated that supervised exercise training (i.e., moderate-to-vigorous aerobic and/or resistance training for >8 wk), prescribed during and/or after the completion of cancer treatments, is safe and can counteract treatment-related side effects (e.g., chronic fatigue), enhance health-related quality of life (HRQoL), and elicit many other physiological, functional, and psychological benefits. The data have been summarized in robust systematic reviews across many cancers, including those with advanced disease (4), and exercise guidelines have been published by Exercise and Sports Science Australia (5) and the American College of Sports Medicine (ACSM) (6).

In 2018, the Clinical Oncology Society of Australia (COSA) published a landmark position statement calling for exercise to be "embedded as part of standard practice in cancer care and to be viewed as an adjunct therapy that helps counteract the adverse effects of cancer and its treatment" (7). The statement calls for all members of the multidisciplinary team (e.g., oncologists, nurses, etc.) to promote exercise and that "best practice cancer care include referral to an accredited exercise physiologist (AEP) or physiotherapist with experience in cancer care (7)." The COSA statement (7) represents a major milestone as the first endorsement of exercise as an adjunct cancer therapy. However, efforts to implement this directive across Australia in the years ahead will come with many practical challenges.

Clearly defined, integrated and patient-centered models of care will be required to deliver exercise services to a growing number of cancer patients; otherwise, such services will remain peripheral to standard care and underutilized. We suggest that for the successful integration of exercise therapy to occur, exercise professionals and their services will have to become a respected, visible, and promoted part of the cancer treatment center itself (i.e., "part of the woodwork"). To this end, one of the foremost challenges is to conceptualize the potential role of an exercise professional employed within this setting, including how their services could be implemented to enhance patient outcomes across the cancer continuum in a broad

[1]School of Science and Health, Western Sydney University, Locked Bag 1797, Penrith, NSW 2751, AUSTRALIA; [2]National Institute of Complementary Medicine, Western Sydney University, Campbelltown Campus, Locked Bag 1797, Penrith, NSW 2751, AUSTRALIA; [3]Exercise Medicine Research Institute, Edith Cowan University, Joondalup, WA, AUSTRALIA; and [4]Chris O'Brien Lifehouse, Sydney, NSW, AUSTRALIA

Address for correspondence: Birinder Cheema, Ph.D., A.E.P., School of Science and Health, Western Sydney University, Locked Bag 1797, Penrith, NSW 2751, Australia (E-mail: B.Cheema@westernsydney.edu.au).

2379-2868/0413/0096–0105
Translational Journal of the ACSM

range of cancers. However, we are aware of no report in the literature documenting the role or experiences of an exercise professional working within a cancer center, or practical recommendations for the implementation and evaluation of exercise services in this setting.

This article has been written for all clinicians seeking to embed exercise services as standard practice in cancer care. We detail the experiences of an AEP, to our knowledge, one of the first to be employed on a full-time basis within a cancer center in Australia (M.M.). On the basis of this case study, we provide practical recommendations for exercise professionals seeking to integrate exercise services within the cancer treatment setting. In addition, we present a model of care involving a key role for the exercise professional, which could be implemented to improve patient care and health outcomes throughout cancer treatment and beyond. Although our article is written from an Australian perspective, our recommendations may be relevant to and/or adapted for health care systems in other countries.

MICHAEL MARTHICK, ACCREDITED EXERCISE PHYSIOLOGIST, CHRIS O'BRIEN LIFEHOUSE

An AEP is a university-qualified exercise professional equipped with the knowledge, skills, and competencies to design, deliver, and assess exercise programs for people with acute or chronic medical conditions, including cancer (8). The scope of practice for an AEP also includes the provision of health education and lifestyle modification with a strong emphasis on achieving behavior change (9). Since December 2013, M.M. has served as the only AEP employed at the Chris O'Brien Lifehouse (Lifehouse), a nonprofit, integrated cancer center located in Sydney, Australia (www.mylifehouse.org.au). The position is based within the Supportive Care and Integrative Oncology Department, which provides evidence-based services from the Lifehouse Living Room (10). These services include exercise physiology, physiotherapy, yoga, nutrition, touch therapies (massage, reflexology), acupuncture, art therapy, counseling, and lymphedema therapy. Exercise physiology services are currently paid for fully by patients (fee for service) or subsidized via Medicare, private health insurance, donations, and research funding (10).

Integration of Exercise Services

Upon taking up the AEP position in late 2013, patient referrals to exercise physiology services were very slow, with the majority of patients self-referring. Realizing more internal promotion was needed to facilitate referrals, M.M. developed and executed an integration plan that targeted clinicians and patients. The plan included the following:

- Scheduling and attending private meetings with clinicians, including medical and radiation oncologists, surgeons, clinical nurses, and allied health care professionals to improve exercise oncology literacy
- Attending weekly multidisciplinary team meetings to discuss patient care and the evidence-based utility of exercise services in specific cases and/or cancer types
- Providing regular exercise in-services for clinicians. These in-services were also included within the orientation program for new Lifehouse staff, including nurses, physicians, and administrative personnel.
- Creating one-page topic sheets for clinical staff highlighting the benefits of exercise for specific treatment-related side effects/symptoms and referral pathways. Topic sheets were placed on walls in clinical consultation rooms for convenience.
- Providing free fitness testing, supervised exercise sessions, and exercise recommendations for Lifehouse staff, including oncologists and other clinicians
- Providing free 15- to 20-min consultations for patients referred immediately after a clinical review with their oncologist. These meetings took place adjacent to oncologists' offices for easy transition. The scope of the meeting included discussion about current cancer treatments, exercise habits, barriers to uptake, and basic action plan.
- Inviting medical oncologists to visit their patients during participation in group exercise sessions
- Writing educational material on exercise oncology research and practice for the monthly staff newsletter circulated to all staff via the staff intranet and e-mail

Current Role

The AEP's current role at Lifehouse, including the percentage allocation for each duty, is presented in Table 1. The role primarily involves the delivery of primary exercise services, including individual exercise consultations, group exercise sessions, and remote exercise services (60%). Additional duties include delivering exercise support programs for specific groups (20%), conducting exercise-related research (10%), providing input on exercise-related services and events (5%), and liaising with external exercise professionals (5%) (Table 1).

Growth of Primary Exercise Services and Reflections

Primary exercise services have grown by 487% between 2014 and 2017, with the most significant period of growth occurring from 2015 to 2016 (+140%; Fig. 1). Currently, over 100 occasions of service (i.e., number of patient visits) are being provided in-center weekly. In addition, one to two remote exercise services are being provided weekly, i.e., delivered via video consultations and/or web portal (Table 1). Approximately two-thirds of the patients receiving primary exercise services via the Lifehouse Living Room are women (10). The majority of patients have a history of breast cancer (30%) followed by hematological cancer (20%), colorectal cancer (15%), prostate cancer (15%), head and neck cancer (10%), upper gastrointestinal cancer (5%), and brain cancer (5%). The average age of these patients is 57.5 yr (10).

At present, the AEP is working at full capacity with many patients on a waiting list to receive exercise services (10). There is now a need to expand AEP staffing and galvanize more in-house referrals via Lifehouse clinicians in alignment with the COSA position statement and growing recognition of the importance of exercise for cancer patients (7). Notably, only 5%–10% of patients attending Lifehouse receive exercise service(s) as part of their care. Barriers to patient uptake and clinician referral have been outlined previously (10). Efforts to address these barriers are ongoing and are primarily focused on improving patient and clinician exercise literacy, undertaking formal evaluation of existing services, using philanthropic donations to supplement or eliminate patient fees

TABLE 1.
Current Role and Capacity of the AEP at the Chris O'Brien Lifehouse.

Primary exercise services (60%)	a. Individual consultations: these consultations may include any or all of the following: medical history review, fitness assessments (e.g., 6-min walk, submaximal cycle test, grip strength, 1RM row/leg press (if appropriate), balance testing, range of motion), exercise and lifestyle education, development/implementation of a home-based and/or community-based and/or Lifehouse-based exercise program. Initial consultations are provided to patients (and their carers) at any point along the cancer care continuum, from diagnosis (prehabilitation), through cancer therapy, and into survivorship or palliative care. b. Group exercise sessions: Group classes involving 4 to 12 patients are often cofacilitated by clinical exercise physiology students from local universities. Approximately 10 sessions per week are provided in a 70 m^2 floor area containing equipment: free weights (dumbbells, barbells, and kettlebells), machine weights (i.e., leg press, seated row, and pulley system), accessories (TRX and resistance bands), and aerobic training equipment (five exercise cycles, one treadmill, one arm ergometer, and one rower). Adjustments to the exercises are made to accommodate individual needs (individualization), as required. All training is prescribed at an appropriate relative intensity, as per standard guidelines. The majority of patients attending these sessions also receive an individualized exercise program to undertake on their own at home or using a fitness facility of their choice. Sessions are 60 min in duration. c. Remote exercise services: Remote services include remote health coaching using a web portal and telehealth programs delivered via video consultations (LivingRoom@home).
Establishing/coordinating cancer-specific exercise support programs (20%)	This includes an 8-wk bone marrow transplantation prehabilitation and rehabilitation program (BMT LivingWell), which has enrolled 120 patients over the last 3 yr. This was developed because of the specific needs and shared experiences of this patient cohort. Lifehouse also runs a generalized collaborative 8-wk exercise and nutrition program (ENRICH) with Cancer Council NSW. There are two programs in development, a small group adolescent and young adult focused program and a breast postsurgical support program. Both cohorts have been identified through clinician and patient consultation and feedback as having specific needs that these programs could support.
Conducting primary research on exercise and/or supportive care interventions (10%)	This involves Lifehouse-based research and/or serving as a site for multisite clinical trials.
Providing input to other exercise-related services and events (5%)	The Lifehouse LivingRoom provides a wide variety of opportunities to move, incorporate a sense of play, and maintain a positive relationship with exercise, including yoga and qi gong group classes. Lifehouse has previously hosted workshops for patients and carers on burlesque and dance.
Referral and linkage with external exercise professionals (5%)	After an initial or follow-up consultation with a patient, a component of the "action plan" may be to link the patient with an external exercise professional. This may be due to several factors, including access, convenience, and prior exercise history. There is also a proportion of patients who seek to limit their time spent in a hospital environment, preferring to exercise elsewhere. A brief phone call is often made to the external practitioner, providing opportunity for appropriate clinical handover.

RM, repetition maximum.

for exercise services, and seeking opportunities to integrate exercise directly into routine clinical care (e.g., exercise cycling during chemotherapy) (11).

RECOMMENDATIONS FOR EXERCISE PROFESSIONALS

On the basis of the experiences of M.M. at Lifehouse, we provide some practical recommendations for clinicians seeking to integrate exercise services in cancer care. We acknowledge that many of the elements of this section could be greatly expanded in stand-alone articles (i.e., the exercise prescription, behavior change strategies/support, and assessment selection). Our aim is to provide a brief and broad overview of the key elements.

Educational Qualifications

In Australia, an AEP is qualified to work with cancer patients. An AEP has completed 4–5 yr of university education, including

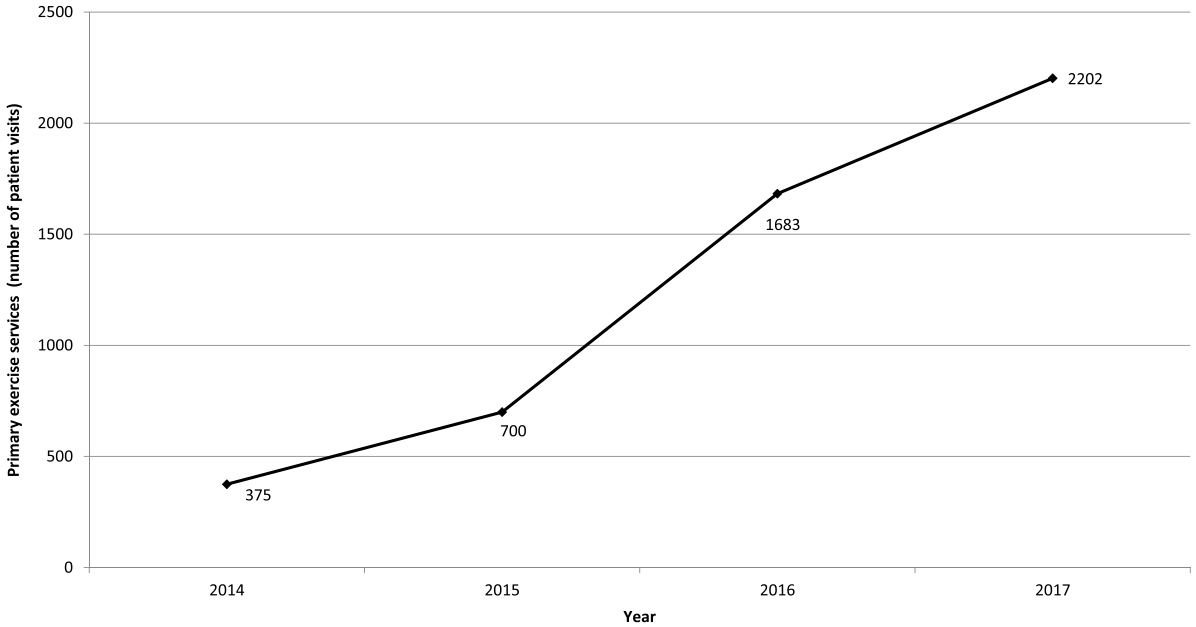

Figure 1: Number of primary exercise services provided at the Chris O'Brien Lifehouse (2014–2017).

360 h of clinical placement within a university program accredited by Exercise and Sports Science Australia. To our knowledge, university programs in exercise science (or equivalent) in other countries do not typically culminate in a professional degree. Therefore, individuals seeking to work in cancer care settings could ideally possess a university degree in exercise studies plus an appropriate specialist certification. The ACSM and the American Cancer Society have developed a comprehensive certification for delivering exercise services in cancer patients (i.e., the Certified Cancer Exercise Trainer). Prerequisites for this certification include a Bachelor's degree in any field plus 500 h of experience training older adults or individuals with chronic conditions.

Referral Pathways

Streamlined referral pathways may facilitate continuity of care and can be developed by exercise professionals in consultation with oncology clinicians. One example of a streamlined referral system is Ex-Med Cancer (www.exmedcancer.org.au). This referral system is web-based and enables any health care professional to refer a cancer patient for exercise services. It also enables patient to self-refer. Once the referral has been received, the service provider makes contact with the patient. This approach is patient centered and involves minimum investment of time by clinicians or patients.

Reporting, Safety, and Team Care Approach

In Australia, an AEP is required to provide a written report to a physician who has referred a patient under the Medicare Benefits Schedule (9). The report typically outlines the brief medical history, assessment results, exercise-related considerations (e.g., modifications), prescription (i.e., the exercise management plan), and planned follow-up schedule. The general practitioner (GP) and other members of the care team can be kept informed on safety and progress. Effective communication between health care professionals is essential for the delivery of high-quality multidisciplinary team care (12). If exercise-related contraindications have been identified, or if adverse responses have occurred, the patient can be referred to the appropriate clinician for review. A safety reference guide that considers blood counts, cardiorespiratory signs and symptoms, bone metastases, and changes in physical and cognitive functioning has recently been published to support the safe delivery of exercise in cancer patients using a team care approach (13).

Improving Exercise Literacy in Clinicians

All clinicians, including the GP, specialist physicians, nurses, and allied health care professionals, can have a major impact on the adoption of physical activity in their patients (14). For example, it has been demonstrated that oncologists can significantly increase exercise adherence in their cancer patients through supportive statements (15) and behavior change tools (e.g., pedometers) (16). However, oncologists can often be inactive and lack basic knowledge about the application and benefits of exercise training (16,17).

Exercise professionals can help to improve the exercise literacy of oncology clinicians. Formal speaking engagements, including in-services and/or private meetings with clinicians, may be beneficial, along with using web-based approaches to disseminate pertinent clinical information (e.g., via social media pages, videos, blogs, Web sites, newsletters). In addition, providing clinicians the opportunity to directly experience professionally directed exercise services for themselves, e.g., via training sessions and/or assessments, may result in a greater appreciation of these services. Clinicians who are more physically active are more likely to endorse exercise (16).

Collectively, the education and qualifications of the exercise professional, the quality of referral pathways and diligence in reporting, and the strategies to enhance the exercise literacy of clinicians can likely all serve to enhance the utilization of exercise services by cancer patients.

The Initial Consultation

Exercise prescriptions should be individualized and patient centered (6), i.e., informed by the patient's health history, current health status, and life circumstances, goals, preferences, and motivation (e.g., stage of behavior change). In our experience, a private consultation in a quiet office between the exercise professional and the patient and involving a friend or family member, if the patient so desires, is the best method to gain the insight required to

create an effective, tailored exercise prescription. These consultations typically extend for 1 h or longer.

Exercise professionals can develop their own medical and health history forms and interviewing strategies (18) and build a program around specific goals, assessments, and rewards. The initial consultation may include the following.

Complete Medical and Health History

This may include a timeline (dates and durations) of all major diseases/illnesses, medical treatments received, significant changes in body weight, hospitalizations, physical trauma (accidents/injuries), and psychological trauma (including stress and anxiety). In addition, the cancer diagnosis (i.e., type, stage, and grade); the specific type, indication, and dosage of current and upcoming treatments for cancer and other comorbidities; the experience of acute and chronic side effects related to these treatments (e.g., fatigue, stress, anxiety, and depression); and the expected duration of treatment can be documented. Exercise professionals need to understand cancer therapies and that these are continually evolving (6). Factors potentially affecting exercise participation and acute and chronic responses to exercise in cancer patients have been summarized in Table 2.

Complete Exercise History

Previous experience engaging in exercise training (i.e., resistance training and aerobic training), sport, recreation, and leisure activities, along with periods of extended sedentary behavior, can be documented. Moreover, current exercise habits can be documented according to exercise prescription dosing variables (i.e., frequency, intensity, time, and type) such that these aspects could remain within, or be adapted for, the exercise prescription. It may be beneficial to note patient preferences for exercise type (modalities) and location (e.g., home or other) and modify the prescription accordingly.

Sleep and Diet

It is recommended that exercise professionals be aware of sleep deficits, which are common during cancer therapies (19), and monitor how the exercise prescription is influencing both sleep quality and duration. Exercise training can improve sleep dysfunction in cancer patients (20). If dietary and water intake are lacking, or there is a high intake of refined sugars (21) and processed foods (22,23) known to induce fat gain and chronic disease, basic dietary recommendations in alignment with accepted guidelines can be offered by the exercise professional, as per the scope of practice for an AEP in Australia (9). However, nutritional care in cancer patients can be complex, and therefore referral to a dietitian for more detailed assessment and treatment plan may be warranted. For example, malnutrition can arise from treatment of head and neck (24) and gastrointestinal cancers (25), whereas the need to lose body fat may be of major concern in certain cancers, such as breast, where obesity is associated with a poorer prognosis and treatment outcomes (26).

Barriers to Exercise

A key element to successful adoption and maintenance of exercise is the identification of barriers and the outlining of specific strategies to overcome these barriers. Barriers in cancer patients can be general (e.g., lack of time/resources, family obligations, lack of social support, weather, etc.), cancer specific (e.g., concerns over safety, fear of exacerbating symptoms, lack of physician support, etc.), and psychologically rooted (e.g., lack of confidence and self-efficacy) (27–29). Motivational interviewing involves guiding the conversation and allowing the patient to identify their own solutions to perceived barriers, and this technique may potentially improve exercise adherence (27–29).

TABLE 2.
Factors Affecting Exercise Participation and Responses in Individuals with Cancer.

Cancer	Type Stage Metastases (including bony disease)
Time point along cancer continuum	Pretreatment Undergoing active treatment Posttreatment/survivorship Palliation
Treatment-related factors	Type Dose Combination Duration Distance to treatment center
Psychological and support factors	Motivation/engagement Self-efficacy Depression Anxiety Carer/social/health professional support Financial status/support Time concerns (responsibilities/priorities)
Physical factors/side effects of cancer treatment	Cancer-related fatigue Range of motion Physical fitness Training age (i.e., exercise experience) Nausea Sleep dysfunction Peripheral neuropathy Cardiotoxicity Lymphedema Time since surgery Distance to exercise program location
Comorbidities	Diabetes Coronary artery disease Obesity Chronic pain Other

Social Support and Roles

Influential family and friends may help to facilitate behavior change (via partnering, motivational cuing, etc.). Understanding the role of the patient within the family may be important for increasing engagement in routine activities within the home and identifying opportunities for increasing physical activity outside the home (e.g., "I have time to walk around the soccer field while my kids have soccer practice on Tuesday and Thursday"). If the patient is currently employed or has other duties (i.e., as a caregiver or volunteer), the nature of the role and weekly schedule can be discussed to identify scheduling gaps, i.e., opportunities to engage in exercise or physical activity. This may be particularly important for those exposed to extended periods of inactivity.

Goals and Rewards

Discussing life aspirations is important for the identification of intrinsic and extrinsic motivators and the development of both short- and long-term goals. Goal setting involving SMART goals aligned with the assessment outcomes, program adherence, and rewards system is important for stimulating motivation, compliance, enjoyment, and improvement (30).

Preexercise and Ongoing Assessments

Preexercise, medical, and exercise-related assessments in cancer patients have been outlined by the ACSM (6). Assessments can also be undertaken to evaluate physiological, functional, and/or psychological adaptations to the exercise prescription. The selection of assessments can be patient centered, i.e., informed by the patient's goals and health impairments, including current- and potential treatment-related side effects (e.g., bone demineralization caused by use of aromatase inhibitors). Multiple clinicians can be involved in the collection of assessments. For example, an endocrinologist could schedule the collection of routine blood tests in a patient with metabolic syndrome to align with the exercise prescription timeline. It is recommended that the time course for repeat assessments is evidence supported, as to not waste resources and/or overburden the patient and exercise professional.

Several assessments, including cardiorespiratory fitness, muscle mass (e.g., body composition), and general HRQoL, have relevance and could be collected across all cancer patients (6). In clinical practice, gold standard assessments for cardiorespiratory fitness (i.e., peak oxygen consumption, $\dot{V}O_{2peak}$) and muscle mass (via dual-energy x-ray absorptiometry) would be ideal, but resources and budgets may limit collection in clinical practice, and hence surrogate measures could be collected. The Medical Outcomes Trust Short Form-36 (SF-36) survey (31) is a generic HRQoL instrument that has been validated and used in clinical research and practice globally, and specific domains (e.g., physical function and vitality) have been shown to be sensitive to change in exercise oncology research. Disease-specific instruments can also be used to assess the impact of specific cancers and their treatments on HRQoL.

Exercise and Physical Activity Prescription

Our recommendations for the exercise and physical activity prescription align with position statements (5,6) and are also informed by our experience in research and clinical settings (Table 3). The exercise prescription should include robust training modalities (e.g., resistance and aerobic training) applied using fundamental training principles (32). A list of daily activities can also be provided to engage the patient with their role in life (e.g., domestic duties, work duties, care duties) as this is a fundamental aspect of rehabilitation (33). In addition, leisure-time activities that will inspire the patient toward lifelong physical activity can be outlined and included. Such leisure-time activities may overlap with and therefore contribute to the aerobic training prescription. If desired by the patient, the prescription can emphasize social engagement (34) and time in nature (35) as these elements are known to improve adherence, extending the benefits of exercise and physical activity.

Resistance Training

Ideally, resistance training sessions should be supervised, at least for the initial 2–3 months, to develop proper movement patterns (technique) that are essential to prevent the occurrence of musculoskeletal injuries, which have been reported in some trials (36). Alternatively, if appropriate, resistance training prescriptions can be provided to patients to be undertaken unsupervised on their own at home or in a facility or their choice. However, in our experience, unsupervised resistance training can often result in insufficient loading, poor technique, low compliance, and therefore suboptimal benefits in inexperienced lifters.

Aerobic Training

All aerobic training can be informed by the patient's exercise modality preferences. Moderate to higher intensities of aerobic training may be ideally undertaken with supervision in inexperienced patients initially (e.g., ~2–3 months), particularly those with chemotherapy-induced cardiotoxicity, cardiovascular risk factors, or known cardiovascular disease. Unsupervised training (as appropriate) can be encouraged on a daily basis to foster habitual activity and behavior change as required. Walking is often the most viable and preferred mode of aerobic training for many cancer patients (37), and it can often be undertaken without supervision, even in advanced cancers (38). However, as per all aerobic training prescriptions, the unsupervised walking program should include progressions in frequency, duration (i.e., by documenting walking time or step counts), and/or intensity (i.e., by increasing walking speed or exposure to inclines, i.e., hills) over time for ongoing benefits.

Flexibility Training

Dynamic and static stretching can be included within resistance training warm-up and cooldown procedures, respectively, to supplement improvements in joint ranges of motion achieved through dynamic resistance exercises. Additional stretching can be prescribed up to 7 $d \cdot wk^{-1}$ to address range of motion deficits induced by cancer therapies, aging, disuse, and a combination thereof.

Fostering Independence

An important component of behavior change is encouraging independent participation (autonomous practice), which includes the systematic titration away from supervised exercise sessions. In particular, individuals who are new to exercise can be encouraged to explore different exercise and self-regulatory strategies on their own. Reduced dependence on the exercise supervisor may aid in the long-term maintenance of exercise and related lifestyle changes (39). An overview of theories and strategies to promote successful adoption and maintenance of activity has been outlined elsewhere (40).

Monitoring and Progression

Accurate monitoring of each training session, including comparing planned (prescribed) versus completed (actual) exercise sessions, is essential for ensuring safety and progress. For example, a planned resistance training session may have involved 10 exercises performed for two sets by 8–12 repetitions maximum each, but pain may have limited the patient's ability to train, e.g., the individual completed only one set of five exercises with light (suboptimal) loads. Documenting planned and completed exercise sessions may more effectively inform adjustments in the prescription to accommodate acute symptomatic fluctuations (41).

Autoregulation can also be applied to adjust the exercise prescription as needed (42). There are numerous ways to apply autoregulation within a training program, e.g., to adjust intratraining loads, to progress from week to week, or to select a set/repletion or duration/intensity scheme before the exercise session (42). This can be done using scales to assess energy, recovery, or sleep before a session, or using a perceived exertion scale to adjust intrasession load. These are readily used methods of adjusting training that are beginning to be investigated in exercise oncology research (43). Autoregulatory strategies within a properly periodized training model will likely reduce the risk of injury (due to fatigue,

TABLE 3.
Exercise and Physical Activity Prescription Recommendations.

Resistance training	
Frequency	Two to three sessions per week of full-body training performed on nonconsecutive days (separated by 48–72 h to enable muscle regeneration and adaptation), ideally performed under supervision for at least 12 wk to ensure optimal movement technique, loading, and progression
Intensity	Initially 60% of 1RM (15RM) progressing to 70%–85% of 1RM (6–12RM) within several weeks. Sets should be performed to neuromuscular fatigue for optimal adaptation of muscle mass (hypertrophy), metabolic health (i.e., augmenting fat loss), and musculoskeletal fitness (i.e., strength, endurance, and flexibility). Moderate cadence initially to optimize strength and hypertrophy gains (i.e., 1–3 s concentric, 1–3 s eccentric)
Exercises/volume	Initially two sets of 5–12 dynamic exercises targeting all major muscle groups. An emphasis should be placed on correcting poor movement patterns and improving ROM using functional movements. Loading can be applied and progressed using body weight, free weights, pulley systems, machines, or a combination thereof. Examples of exercises for beginner to intermediate lifters: e.g., bench press, push-up, dead lift, lat pulldown, Australian pull-ups (using TRX, bar, or rings), seated row, bent over row, assisted chin up, shoulder press, side/front/reverse shoulder raise, biceps curl, triceps extension, bench/chair dip, leg curl, squat, split squat, Bulgarian squat, forward/reverse lunge, side squat, sit-ups, back extension, seated twists, and bird dog exercise
Warm-up/cooldown	Warm-up: Dynamic, active stretching of all joints throughout their ranges of motion Cooldown: Active and passive static stretching of all joints to their maximum ranges of motion
Progression models	Volume: Progress according to tolerance, up to three sets for the large muscle group, multijoint exercises (e.g., bench press and squat) Periodization: Training variables, i.e., intensity (loading), repetition speed, and/or degree of difficulty of each exercise can be increased to more effectively enhance other parameters of physical fitness, including muscular power, agility, coordination, balance, reaction time, speed; e.g., plyometrics (jumping) can be included for bone health and lower body muscular power
Aerobic training	
Frequency	Daily, to foster habitual movement
Intensity	Moderate (50%–70% HRR) to Vigorous (70%–85% HRR)
Time	20–30 min per session (>150 min·wk^{-1} moderate intensity or >75 min·wk^{-1} vigorous intensity, or combination thereof)
Type	Any rhythmical activity preferred by the patient/client, which ideally provides sufficient overload to improve cardiorespiratory fitness and cardiovascular disease risk factors, including body composition. Walking is often the most viable aerobic activity and can often be performed unsupervised, but should still involve progressions in frequency, duration, and/or intensity (e.g., by including more hills) for ongoing benefits.
Flexibility training	
Frequency	≥ 2 sessions per week
Intensity	Stretch to the point of feeling tightness or slight discomfort
Time	Hold each static stretch for 10–30 s
Volume	Repetition of each stretch two to four times is recommended
Daily activities	A list of daily activities should be provided to promote physical activity behavior change, focusing on reengagement with role in life. Examples include shopping, vacuuming, dusting, sweeping, laundry, dishes, meal preparation, other errands, and care of children/dependents.
Leisure-time activity	Leisure-time activities that patient/client is interested in pursuing should be diarized and undertaken regularly. These activities can provide opportunities to engage socially and with nature, if desired by the patient/client. Both short- and long-term goals and rewards (internal and external) can be created around engagement in leisure-time activities. Moderate- to

	vigorous-intensity leisure-time activities can be used as a substitute for aerobic training sessions.
Exercise modifications	Exercise modifications are often necessary in individuals with cancer, particularly in those who are older. Mobility deficits: It is common for individuals to present with joint mobility impairments (e.g., at the shoulder, hip, or ankle), which can contribute to dysfunctional movement patterns and therefore increase the risk of musculoskeletal injury when lifting heavy loads. Resistance exercises should be prescribed commensurate to the patient's physical capabilities, i.e., adhering to proper lifting technique. Functional resistance training movements involving stepwise progressions to basic push, pull, squat, twist, and bend/extend exercises, along with appropriate stretching (flexibility work), may be the best approach for addressing mobility deficits, where possible. Moreover, this approach may be the safest and most effective way to achieving gains in muscular fitness, muscle mass, and activities of daily living (e.g., a patient's ability to squat down to 90° knee bend translates directly to rising from a chair or toilet). Neuromuscular deficits: The inclusion of balance elements (e.g., using single leg and various other stances, and equipment such as balance boards and bosu balls) within functional resistance training exercises may further enhance the neuromuscular and proprioceptive benefits of resistance exercises and contribute to greater reductions in the risk of falls. In individuals presenting with significant balance and/or other neuromuscular impairments (e.g., as a result of peripheral neuropathy), machine-based resistance training and weight-supported aerobic training modalities (e.g., recumbent cycle) may be preferred. Logistical considerations: As with many clinical exercise settings, the ratio of staff to patients and the number of patients attending a group class at any one time can potentially restrict/limit the order and type of exercises performed, i.e., training efficiency and effectiveness. Patients should therefore be encouraged to aim for the exercises that will give them the "most bang for their buck," i.e., large, multijoint exercises (e.g., squat) as a priority versus smaller, single-joint exercises (e.g., leg extensions or biceps curls).

ROM, range of motion; RM, repetition maximum; HRR, heart rate reserve.

overtraining, etc.), minimize mental staleness, and promote long-term adoption of exercise (42,43).

Digital Health

The adoption of innovative technology tools to improve clinician and patient contact and monitoring in exercise oncology is rapidly advancing. This includes opportunities to provide remote monitoring of exercise behaviors using wearable technologies (e.g., pedometers) and online portals (44) through to full telerehabilitation programs (45). Such innovative methods could be implemented to improve patient access and monitoring.

AN INTEGRATED MODEL OF CARE

Thirty-five years of empirical research culminating in clinical guidelines and position statements has demonstrated that exercise can be integrated as standard practice in cancer care, across all cancers, and be viewed as an adjunct therapy that helps counteract the adverse effects the disease and its treatment (7). In Figure 2, we present an integrated and patient-centered model of care to enhance health outcomes both during and beyond cancer treatment. This model of care is currently being implemented and refined at the Chris O'Brien Lifehouse. In this model, we propose that exercise professionals employed within the cancer center itself can play a major role in the long-term care of cancer patients. Exercise services, by their nature, require an individualized (patient-centered) approach that involves extended consultations, long-term planning, consistent and periodic contact, and the input of other health care professionals. In Australia, the scope of practice of an AEP positions them optimally to take on the role of the "supportive care navigator" for patients who are undergoing intensive cancer treatment (or in palliative care) and looking toward maintaining and/or improving HRQoL.

We propose that the referral for exercise services can ideally come from the consulting oncologist given that these physicians are directing the cancer treatment. Oncologists have the duty of care to inform the patient about both the positive and the negative effects of their treatments and the best-practice approaches to mitigate symptoms and maintain and improve their health status and HRQoL. Exercise is likely the most evidence-supported intervention that an oncologist can recommend in this regard (7). In Australia, the referral for Medicare-supported services must be provided by the GP. In such instances, the oncologist could provide a written recommendation for the GP to refer a patient to an AEP under the appropriate Medicare scheme.

Individuals with cancer will have psychological, musculoskeletal, and nutritional concerns that will require the expertise of other health care professionals. Ideally, as at Lifehouse (10), these professionals would also be embedded within the cancer center itself (Fig. 2). Referrals to other health care professionals could be made by the exercise professional, as identified in the first consultation with the patient. A comprehensive, but realistic, suite of therapies to complement the exercise program will likely provide patients with the best possible outcomes during their cancer treatments.

Transitioning back to the community: The in-center exercise physiologist could be in an ideal position to enhance continuity of care from the clinical setting to the community. This continuity of care could be facilitated by identifying and creating a network of community-based exercise professionals who can best address the needs of cancer patients and survivors. Referrals to community-based exercise professionals could take

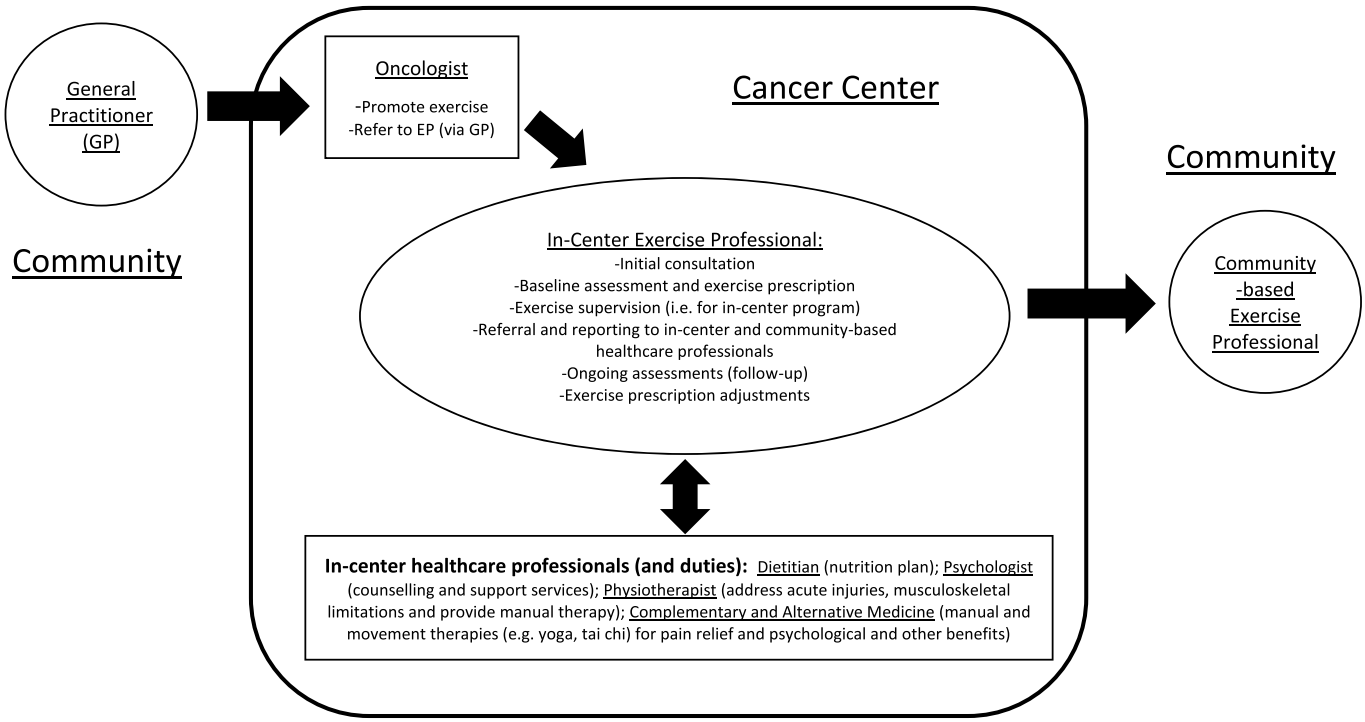

Figure 2: An integrated and patient-centered model of care to enhance patient outcomes during and beyond cancer treatment. Large arrows represent patient flow into and out of the cancer center.

place at any time point along the cancer continuum, informed by patient preference. Such an approach may lead to better health outcomes, HRQoL, and survival prospects for any given patient over the long term.

FUTURE TRANSLATIONAL RESEARCH

We have presented evidence and recommendations for the inclusion of exercise professionals within the cancer center and have outlined a model of care that is realistic and currently being implemented and refined at the Chris O'Brien Lifehouse. The implementation of this model, or an adaptation thereof, could potentially result in better continuity of care and health outcomes for patients throughout their treatment journey and beyond. Therefore, the main avenue for a formal translational research program would be to investigate the feasibility and effectiveness of such a model of care in all its aspects. We are planning to undertake such research at the Lifehouse. Such research initiatives could enhance the implementation and refinement of exercise services more broadly in cancer treatment settings. Moreover, research into the cost-effectiveness of such programs could provide valuable information to policymakers and third-party payers and provide support for reimbursement. We suggest that a comprehensive translational research program needs to be undertaken if cancer patients are to truly benefit from the research efforts put forth in previous decades.

BSC is the guarantor of the article, taking responsibility for the integrity of the work as a whole, from inception to published article. BSC, CF, and MM conceived and drafted the manuscript. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The views expressed in this article do not constitute endorsement by the ACSM.

REFERENCES

1. Moore SC, Lee I, Weiderpass E, et al. Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA Intern Med*. 2016;176(6):816–25. doi: 10.1001/jamainternmed.2016.1548.
2. Cormie P, Zopf EM, Zhang X, Schmitz KH. The impact of exercise on cancer mortality, recurrence, and treatment-related adverse effects. *Epidemiol Rev*. 2017;39(1):71–92. doi: https://dx.doi.org/10.1093/epirev/mxx007. PubMed PMID: 28453622.
3. Winningham ML. *Effects of a Bicycle Ergometer Program on Functional Capacity and Feelings of Control in Women with Breast Cancer [Dissertation]*. Columbus (OH): Ohio State University; 1983.
4. Albrecht TA, Taylor AG. Physical activity in patients with advanced-stage cancer: a systematic review of the literature. *Clin J Oncol Nurs*. 2012;16(3):293–300. Epub 2012/05/30. doi: 10.1188/12.Cjon.293-300. PubMed PMID: 22641322; PubMed Central PMCID: PMCPMC4408536.
5. Hayes S, Spence R, Galvao D, Newton R. Australian Association for Exercise and Sport Science position stand: optimising cancer outcomes through exercise. *J Sci Med Sport*. 2009;12(4):428–34.
6. Schmitz KH, Courneya KS, Matthews C, et al. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med Sci Sports Exerc*. 2010;42(7):1409–26. Epub 2010/06/19. doi: 10.1249/MSS.0b013e3181e0c112. PubMed PMID: 20559064.
7. Cormie P, Atkinson M, Bucci L, et al. Clinical Oncology Society of Australia position statement on exercise in cancer care. *Med J Aust*. 2018. Epub 2018/05/03. PubMed PMID: 29719196.
8. Cheema BS, Robergs RA, Askew CD. Exercise physiologists emerge as allied healthcare professionals in the era of non-communicable disease pandemics: a report from Australia, 2006–2012. *Sports Med*. 2014;44(7):869–77. doi: 10.1007/s40279-014-0173-y.
9. Exercise and Sport Science Australia: Accredited Exercise Physiologist Scope of Practice 2016.
10. Grant SJ, Marthick M, Lacey J. Establishing an integrative oncology service in the Australian healthcare setting—the Chris O'Brien Lifehouse Hospital experience. *Support Care Cancer*. 2018. doi: 10.1007/s00520-018-4460-2.
11. Edwards K, Thomas V, Seet-Lee C, Cheema B, Boyer M, Marthick M. Piloting the effect of aerobic exercise during chemotherapy infusion in patients with cancer. *Med Sci Sports Exerc*. 2018;50(5S):383–4.
12. Babiker A, El Husseini M, Al Nemri A, et al. Health care professional development: working as a team to improve patient care. *Sudanese Journal of Paediatrics*. 2014;14(2):9–16. PubMed PMID: PMC4949805.

13. Mina DS, Langelier D, Adams SC, et al. Exercise as part of routine cancer care. *Lancet Oncol*. 2018;19(9):e433–6. Epub 2018/09/08. doi: 10.1016/s1470-2045(18)30599-0. PubMed PMID: 30191843.

14. Exercise Is Medicine: Your Prescription for Health [October 28, 2013]. Available from: http://exerciseismedicine.org/.

15. Jones LW, Courneya KS, Fairey AS, Mackey JR. Effects of an oncologist's recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: a single-blind, randomized controlled trial. *Ann Behav Med*. 2004;28(2):105–13. Epub 2004/09/30. doi: 10.1207/s15324796abm2802_5. PubMed PMID: 15454357.

16. Park J-H, Oh M, Yoon YJ, et al. Characteristics of attitude and recommendation of oncologists toward exercise in South Korea: a cross sectional survey study. *BMC Cancer*. 2015;15(1):249. doi: 10.1186/s12885-015-1250-9.

17. Smaradottir A, Smith AL, Borgert AJ, Oettel KR. Are we on the same page? Patient and provider perceptions about exercise in cancer care: a focus group study. *J Natl Compr Canc Netw*. 2017;15(5):588–94. Epub 2017/05/10. PubMed PMID: 28476738.

18. Bennett JA, Lyons KS, Winters-Stone K, Nail LM, Scherer J. Motivational interviewing to increase physical activity in long-term cancer survivors: a randomized controlled trial. *Nurs Res*. 2007;56(1):18–27. Epub 2006/12/21. PubMed PMID: 17179870.

19. Mustian KM, Sprod LK, Janelsins M, Peppone LJ, Mohile S. Exercise recommendations for cancer-related fatigue, cognitive impairment, sleep problems, depression, pain, anxiety, and physical dysfunction: a review. *Oncol Hematol Rev*. 2012;8(2):81–8. PubMed PMID: PMC3647480.

20. Rogers LQ, Courneya KS, Oster RA, et al. Physical activity and sleep quality in breast cancer survivors: a randomized trial. *Med Sci Sports Exerc*. 2017;49(10):2009–15. doi: https://dx.doi.org/10.1249/MSS.0000000000001327. PubMed PMID: 28538261.

21. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am J Clin Nutr*. 2013;98(4):1084–102. doi: 10.3945/ajcn.113.058362.

22. Simmons AL, Schlezinger JJ, Corkey BE. What are we putting in our food that is making us fat? Food additives, contaminants, and other putative contributors to obesity. *Curr Obes Rep*. 2014;3(2):273–85. doi: 10.1007/s13679-014-0094-y. PubMed PMID: PMC4101898.

23. de Souza RJ, Mente A, Maroleanu A, et al. Intake of saturated and trans unsaturated fatty acids and risk of all cause mortality, cardiovascular disease, and type 2 diabetes: systematic review and meta-analysis of observational studies. *BMJ*. 2015;351:h3978. Epub 2015/08/14. doi: 10.1136/bmj.h3978. PubMed PMID: 26268692; PubMed Central PMCID: PMCPMC4532752.

24. Grobbelaar EJ, Owen S, Torrance AD, Wilson JA. Nutritional challenges in head and neck cancer. *Clin Otolaryngol Allied Sci*. 2004;29(4):307–13. Epub 2004/07/24. doi: 10.1111/j.1365-2273.2004.00850.x. PubMed PMID: 15270813.

25. Heneghan HM, Zaborowski A, Fanning M, et al. Prospective study of malabsorption and malnutrition after esophageal and gastric cancer surgery. *Ann Surg*. 2015;262(5):803–7; discussion 7-8. Epub 2015/11/20. doi: 10.1097/sla.0000000000001445. PubMed PMID: 26583669.

26. Demark-Wahnefried W, Campbell KL, Hayes SC. Weight management and its role in breast cancer rehabilitation. *Cancer*. 2012;118(8 Suppl):2277–87. Epub 2012/04/18. doi: 10.1002/cncr.27466. PubMed PMID: 22488702; PubMed Central PMCID: PMCPMC3812811.

27. Clifford BK, Mizrahi D, Sandler CX, et al. Barriers and facilitators of exercise experienced by cancer survivors: a mixed methods systematic review. *Support Care Cancer*. 2018;26(3):685–700. Epub 2017/12/01. doi: 10.1007/s00520-017-3964-5. PubMed PMID: 29185105.

28. Blaney JM, Lowe-Strong A, Rankin-Watt J, Campbell A, Gracey JH. Cancer survivors' exercise barriers, facilitators and preferences in the context of fatigue, quality of life and physical activity participation: a questionnaire-survey. *Psychooncology*. 2013;22(1):186–94. Epub 2013/01/09. doi: 10.1002/pon.2072. PubMed PMID: 23296635.

29. Blaney J, Lowe-Strong A, Rankin J, Campbell A, Allen J, Gracey J. The cancer rehabilitation journey: barriers to and facilitators of exercise among patients with cancer-related fatigue. *Phys Ther*. 2010;90(8):1135–47. Epub 2010/06/19. doi: 10.2522/ptj.20090278. PubMed PMID: 20558566.

30. Bovend'Eerdt TJ, Botell RE, Wade DT. Writing SMART rehabilitation goals and achieving goal attainment scaling: a practical guide. *Clin Rehabil*. 2009;23(4):352–61. doi: 10.1177/0269215508101741.

31. Stewart AL, Hays RD, Ware JE Jr. The MOS short-form general health survey. Reliability and validity in a patient population. *Med Care*. 1998;26(7):724–35.

32. Sasso JP, Eves ND, Christensen JF, Koelwyn GJ, Scott J, Jones LW. A framework for prescription in exercise-oncology research. *J Cachexia Sarcopenia Muscle*. 2015;6(2):115–24. Epub 2015/07/03. doi: 10.1002/jcsm.12042. PubMed PMID: 26136187; PubMed Central PMCID: PMCPMC4458077.

33. Pinquart M, Silbereisen RK, Frohlich C. Life goals and purpose in life in cancer patients. *Support Care Cancer*. 2009;17(3):253–9. Epub 2008/05/02. doi: 10.1007/s00520-008-0450-0. PubMed PMID: 18449572.

34. McKenzie DC. Abreast in a boat–a race against breast cancer. *CMAJ*. 1998;159(4):376–8.

35. Barton J, Pretty J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environ Sci Technol*. 2010;44(10):3947–55. Epub 2010/03/27. doi: 10.1021/es903183r. PubMed PMID: 20337470.

36. Cheema BS, Kilbreath SL, Fahey PP, Delaney GP, Atlantis E. Safety and efficacy of progressive resistance training in breast cancer: a systematic review and meta-analysis. *Breast Cancer Res Treat*. 2014;148(2):249–68.

37. Jones LW, Courneya KS. Exercise counseling and programming preferences of cancer survivors. *Cancer Pract*. 2002;10(4):208–15. Epub 2002/07/09. PubMed PMID: 12100105.

38. Cheville AL, Kollasch J, Vandenberg J, et al. A home-based exercise program to improve function, fatigue, and sleep quality in patients with stage IV lung and colorectal cancer: a randomized controlled trial. *J Pain Symptom Manage*. 2013;45(5):811–21. doi: https://doi.org/10.1016/j.jpainsymman.2012.05.006.

39. Focht BC, Lucas AR, Grainger E, et al. Effects of a group-mediated exercise and dietary intervention in the treatment of prostate cancer patients undergoing androgen deprivation therapy: results from the IDEA-P trial. *Ann Behav Med*. 2018;52(5):412–28. Epub 2018/04/24. doi: 10.1093/abm/kax002. PubMed PMID: 29684136.

40. Burgess E, Hassmen P, Welvaert M, Pumpa KL. Behavioural treatment strategies improve adherence to lifestyle intervention programmes in adults with obesity: a systematic review and meta-analysis. *Clinical obesity*. 2017;7(2):105–14. Epub 2017/02/16. doi: 10.1111/cob.12180. PubMed PMID: 28199047.

41. Nilsen TS, Scott JM, Michalski M, et al. Novel methods for reporting of exercise dose and adherence: an exploratory analysis. *Med Sci Sports Exerc*. 2018;50(6):1134–41. Epub 2018/01/10. doi: 10.1249/mss.0000000000001545. PubMed PMID: 29315168.

42. Fairman CM, Zourdos MC, Helms ER, Focht BC. A scientific rationale to improve resistance training prescription in exercise oncology. *Sports Med*. 2017;47(8):1457–65. Epub 2017/01/12. doi: 10.1007/s40279-017-0673-7. PubMed PMID: 28074412.

43. Hart NH, Galvao DA, Newton RU. Exercise medicine for advanced prostate cancer. *Curr Opin Support Palliat Care*. 2017;11(3):247–57. Epub 2017/06/01. doi: 10.1097/spc.0000000000000276. PubMed PMID: 28562375.

44. Marthick M, Dhillon HM, Alison JA, Cheema BS, Shaw T. Development of a web portal for physical activity and symptom tracking in oncology patients: protocol for a prospective cohort study. *JMIR Res Protoc*. 2018;7(5):e136. Epub 15.05.2018. doi: 10.2196/resprot.9586. PubMed PMID: 29764798.

45. Galiano-Castillo N, Cantarero-Villanueva I, Fernandez-Lao C, et al. Telehealth system: a randomized controlled trial evaluating the impact of an Internet-based exercise intervention on quality of life, pain, muscle strength, and fatigue in breast cancer survivors. *Cancer*. 2016;122(20):3166–74. Epub 2016/06/23. doi: 10.1002/cncr.30172. PubMed PMID: 27332968.