The Oncologist, 2026, 31, oyag153
https://doi.org/10.1093/oncolo/oyag153
Published: April 21, 2026
Original Article

OXFORD

Real-world feasibility and effectiveness of a personalized exercise program during cancer treatment: results from the CHOiCE prospective study

Alice Avancini, PhD[*,1,2], Anita Borsati, MSc[2,3], Gloria Adamoli, MSc[2], Linda Toniolo, MSc[2], Christian Ciurnelli, MSc[2], Andrea Trevisan, BSc[2], Lorenzo Belluomini, MD, PhD[1], Ilaria Trestini, RD[4], Daniela Tregnago, MSc[1], Marco Sposito, MD[1], Jessica Insolda, MSc[1], Stefano Manduca, MD[5], Alessandra Auriemma, MD[5], Elena Fiorio, MD[5], Michele Milella, MD[1], Massimo Lanza, MSc[2], Federico Schena, MD, PhD[2], Sara Pilotto, MD, PhD[*,1]

[1]Section of Innovation Biomedicine - Oncology Area, Department of Engineering for Innovation Medicine (DIMI), University of Verona, and University and Hospital Trust (AOUI) of Verona, Verona, 37134, Italy
[2]Department of Neurosciences, Biomedicine and Movement, University of Verona, Verona, 37134, Italy
[3]Biomedical, Clinical and Experimental Sciences, Department of Medicine, University of Verona, Verona, 37134, Italy
[4]Dietetic Service, Medical Direction, Azienda Ospedaliera Universitaria Integrata di Verona, Verona, 37134, Italy
[5]Section of Oncology, University of Verona Hospital Trust (AOUI), Verona, 37134, Italy
[*]Corresponding authors: Sara Pilotto, MD, PhD, Section of Innovation Biomedicine - Oncology Area, Department of Engineering for Innovation Medicine (DIMI), University of Verona, P.le L.A. Scuro 10, 37134, Verona, Italy. E-mail: sara.pilotto@univr.it; Alice Avancini, PhD, Section of Innovation Biomedicine - Oncology Area, Department of Engineering for Innovation Medicine (DIMI), University of Verona and University and Hospital Trust (AOUI) of Verona, P.le L.A. Scuro 10, 37134, Verona, Italy. E-mail: alice.avancini@univr.it.

Abstract

Background: **Despite strong evidence supporting exercise in oncology, real-world data on its feasibility and effectiveness across cancer types remain limited. The CHOiCE (Choose Health: Oncological patients Centered Exercise) study aimed to evaluate a flexible, patient-centered exercise program in routine clinical practice.**

Materials and Methods: **This prospective cohort study enrolled 180 adult patients undergoing treatments. Participants completed a 12-week program combining aerobic and resistance training, delivered in person, at home, or hybrid. Primary outcomes were recruitment rate, adherence, dropout, and safety. Secondary outcomes included physical fitness, quality of life, and physical activity. Subgroup analyses explored responses by cancer type, stage, treatment, and delivery mode.**

Results: **Recruitment rate was 82%, with a median attendance of 88%. The dropout rate was 32%, mainly due to personal reasons or disease progression. No serious adverse events were reported. Significant improvements were observed in the six-minute walk test (+39 m, $P < .001$), leg press strength (+7.1 kg, $P < .001$), handgrip strength (+1.0 kg, $P = .003$), and flexibility tests ($P < .05$). Quality of life improved in physical, role, emotional, and social functioning. Fatigue, nausea, dyspnea, insomnia, and appetite loss were significantly reduced. Patients with gastrointestinal cancer, stage III-IV disease, or undergoing chemotherapy showed the largest gains.**

Conclusion: **A patient-centered exercise program for patients with cancer is feasible and effective in a real-world setting. These findings support integrating tailored exercise into routine oncology care.**

Trial Registration: **NCT04226508**

Key words: physical exercise; real-world setting; quality of life; tailored intervention; physical fitness

Received: June 17, 2025. **Accepted:** April 15, 2026

Implications for practice

This study demonstrates that a flexible, patient-centered exercise program, tailored to individual preferences and needs, is feasible and safe for patients undergoing cancer treatment, including those with advanced disease. The program achieved high adherence and preliminary improvements in cardiorespiratory fitness and quality of life, even in a real-world setting. These findings support the integration of patient-preferred exercise strategies into routine oncology care to enhance compliance and therapeutic outcomes, particularly in the advanced setting.

Introduction

Despite advances in cancer treatment and growing survivorship, patients with cancer often experience multiple physical and psychological side effects overall impairing their quality of life (QoL).[1] Therefore, interventions supporting patients during the treatment phase may be fundamental.

Accumulating evidence indicates that exercise may improve patients' physical fitness, especially cardiorespiratory fitness,[2] muscle strength,[3] and mass,[3] which are prognostic factors in the oncological context.[4] Regarding treatment-related side effects, exercise has demonstrated to ameliorate fatigue,[5] nausea,[6] peripheral neuropathy,[7] lymphedema,[8] anemia,[9] and cancer-related pain,[10] overall enhancing patients' QoL. Moreover, observational data highlight an inverse association between physical activity and mortality risk, even in patients receiving novel therapeutic options, such as immunotherapy.[11] Recently, a randomized controlled trial has demonstrated a beneficial impact of exercise on disease-free survival and overall survival among patients with colon cancer.[12] This has led to the development of several guidelines advocating for the integration of exercise into cancer care across various professional fields, including exercise professionals[1] and medical oncology.[13]

However, clinical trials, and even the community-based programs, in exercise oncology are usually focused on limited cancer types (predominantly breast, lung and colorectal) or early-stage disease, and, additionally, they often apply stringent eligibility criteria, in which the most frail patients, eg, those with metastatic disease, comorbidities, or with a compromised functional status, are usually excluded. In real-world settings, about 10%-30% of patients had a metastatic disease at diagnosis, 30%-72% of those initially diagnosed with early-stage disease develop metastases during the disease trajectory,[14] and 65% had at least one comorbid condition.[15] Real translation from clinical research into everyday practice has yet to be established and remains a key research priority. To date, there is limited evidence on the efficacy of an outpatient exercise program for patients with cancer in a real-world context, where the just-mentioned, research-related issues are absent. In this sense, *Kirkham and colleagues* conducted a first real-world study on 299 patients, investigating the effectiveness of a group-based exercise program in patients with cancer. This first study demonstrated that the benefits of exercise for physical function and QoL observed in clinical trials can be translated to real-world settings. However, fewer than half of the participants completed the program. Moreover, the sample was predominantly female (83%), with a high proportion of individuals diagnosed with breast cancer (61%) and at an early-stage disease (57%), thus not properly mirroring the overall cancer population.[16] A more recent implementation study, exploring a 12-week group-based exercise program, found similar findings on physical and patient-reported outcomes; nevertheless, only 37% of 274 enrolled patients completed the program, suggesting that the program was not sustainable for most patients.[17] Maintenance of exercise over time is essential to achieve benefits. In cancer, several features may interfere with exercise; treatment-related side effects, and distance from facilities, are frequently reported by patients undergoing therapies.[18,19] This indirectly implies that theprograms directed to this population should be flexible (eg, about appointments and delivery methods), and adapted to patients' symptoms and experienced adverse events; a one-size-fits-all group-based approach rarely accommodates these diverse needs,. However, to our knowledge, detailed data on feasibility and the exploration of a flexible exercise program are currently lacking in real-world settings.

Based on these premises, the current study proposes to investigate the effectiveness of the Choose Health: Oncological patients Centered Exercise (CHOiCE) program, an evidence-based physical exercise intervention, targeted on patients' symptoms and needs, in a real-world setting, for patients receiving anticancer treatments. The primary aim of the study was to examine the feasibility and benefits of the CHOiCE program. A series of sub-analyses by cancer type, cancer stage, anticancer treatments, and exercise delivery modality were conducted to explore the subgroups potentially more responsive to exercise.

Materials and methods

Study design

The CHOiCE program employed a single-arm hybrid effectiveness-implementation design, which enabled the investigation of the intervention's efficacy and feasibility in a real-world setting. The program began in December 2018, continued until April 2024, and was temporarily suspended from March 2020 to September 2021 due to the COVID-19 pandemic. The project was conducted by the Oncology and Sports Science Sections of the University of Verona. It was approved by the Ethics Committee for Clinical Trials for the University of Verona (Prot. No. 33320) and registered on ClinicalTrials.gov (ID: NCT04226508). The study was conducted according to the principles of Good Clinical Practice and the Declaration of Helsinki.

Participants and procedures

The CHOiCE program was directed to patients having the following characteristics: (i) age ≥18 years, (ii) a confirmed diagnosis of cancer, any stage, (iii) undergoing anticancer treatments, (iv) medical clearance to participate in the study, and (v) signing the written informed consent. Exclusion criteria were: (i) pregnancy status, (ii) contraindications to exercising as determined by the clinicians, and (iii) less than 8 weeks from the latest surgery. Potential eligible participants were referred by healthcare

providers working in the Oncology Section (eg, oncologists, nurses, dietitians). Contacts of the interested patients were sent to the research staff, who then contacted them to explain the project in detail and schedule a first appointment at the Sports Science Section facilities. During the first meeting, the staff obtained written informed consent and performed the baseline assessments.

The CHOiCE training program

Framework of the CHOiCE project

The CHOiCE program is a patient-centered, evidence-based exercise intervention designed for patients with cancer undergoing treatment, aiming to alleviate cancer- and treatment-related side effects and to improve physical and psychological outcomes (Figure 1). The program was informed by two prior implementation studies exploring patients' exercise preferences and perceived barriers and facilitators to physical activity adoption.[18,19] These studies highlighted the importance of supervision by exercise specialists, flexible delivery options, and adaptation to symptoms and treatment-related side effects to support exercise adherence and maintenance. To ensure an evidence-based approach, the CHOiCE program was developed in accordance with current exercise oncology guidelines from the American College of Sports Medicine (ACSM) and Exercise and Sports Science Australia (ESSA).[1,20,21] In line with these recommendations, baseline functional assessments were used to inform individualized exercise prescription and symptom-guided adaptations throughout the program.[20,21]

The exercise intervention

The 12-week exercise program consisted of bi-weekly training sessions, including a warm-up, aerobic and resistance training, and a cool-down. The warm-up, lasting 5-10 minutes, consisted of dynamic stretching exercises. The aerobic component included cardiovascular exercises, starting with 10-15 minutes and progressing in duration every two weeks to 30-35 minutes, according to the patient's condition. Resistance training consisted of five bodyweight or elastic-band exercises targeting the major upper- and lower-body muscle groups. The selection of exercises was individually prescribed, and each was performed in 2-3 sets of 8-12 repetitions, with progression over the week based on the patient's response. The intensity for both components was moderate to somewhat vigorous, ie, 3-5 of the 10-point Borg Scale. The cool-down phase was composed of five static stretching exercises.

The intervention was delivered at the Sports Science Section by specialized exercise professionals (Supplementary Information 1), where patients were offered a choice among different exercise delivery modalities based on their preferences and needs. The exercise intervention was consistent across the modalities, as described above:

- *Home-based program*: a written exercise program for patients to perform independently. The program detailed the activities' types, frequencies, intensities, and duration, and a log diary was proposed to monitor adherence. At 2, 4, and 6 weeks, meetings with the exercise professional were scheduled to deliver updated programs, provide exercise instructions, and guide patients on self-monitoring intensity. The research staff also made weekly phone calls to monitor the adherence. An example of the program is provided in the Supplementary Information 2 and 3.
- *Personal training program:* sessions were conducted one-on-one with a dedicated exercise professional at the Department's facilities, ensuring personalized supervision throughout the program.
- *Hybrid (home-based/in-person) program*: composed of one session in the dedicated facilities, as personal training program, and one to follow at home, as the home-based program (Supplementary Information 2 and 3).

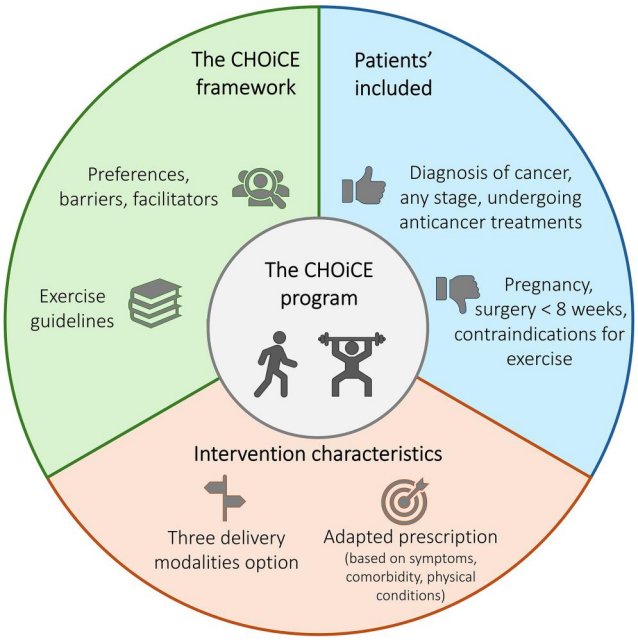

Figure 1. Characteristics of the CHOiCE program.

Outcome measurements

The primary outcome was the feasibility of the intervention, defined according to the following criteria: (i) recruitment rate > 50%, (ii) attendance to the exercise program > 80% (iii) dropout rate < 20%, and (iv) the absence of severe adverse events.[22]

The secondary outcomes included: (i) cardiorespiratory fitness, estimated using the "Six-minute walking test" (6MWT),[23] (ii) strength, with the handgrip and isometric leg press strength tests,[24,25] (iii) flexibility using the sit and reach and back scratch tests,[26] (iv) anthropometric measures, ie, weight, height, hip and waist circumferences,[27] (v) QoL using the European Organization for Research and Treatment of Cancer Quality of Life and Core Questionnaire (EORTC QLQ-C30),[28] and (vi) amount of physical activity with the Godin-Shephard Leisure-Time Exercise Questionnaire.[29] Socio-demographic information was collected using a dedicated questionnaire, while clinical data were extracted from medical charts. Detailed descriptions of the outcomes are available in the Supplementary Information 4.

Statistical considerations

Data were analyzed with *SigmaStat v. 4.0* (Systat Software Inc.). The Shapiro-Wilk test was used to assess the normality assumption of the data. Demographic, clinical, and feasibility data were analyzed using descriptive statistics. Across the entire cohort, Student's t-test or Wilcoxon signed-rank test, when appropriate, was used to explore changes from baseline to post-intervention in the secondary outcomes. Exploratory subgroup analyses were conducted to investigate the effect of exercise according to cancer type (breast, gastrointestinal, thoracic, others), cancer stage (I-II, III-IV), anticancer treatments (chemotherapy, immunotherapy/target therapy/radiotherapy, hormone therapy, combined therapy), and exercise delivery (home-based, personal training, hybrid program). These factors were selected because they may influence both feasibility and response to exercise in this population. Group differences were evaluated using the Student's t-test, one-way analysis of variance, or the non-parametric equivalent tests, as appropriate. The chi-squared test was used to assess group differences for categorical variables. No adjustments for multiple comparisons were applied, as the subgroup analyses were exploratory and hypothesis-generating; these exploratory analyses were not powered for confirmatory inference and should be interpreted accordingly. All tests were two-tailed, and *P*-values of <.05 were considered statistically significant.

Results

The flow of the study participants is shown in Figure 2. Overall, 214 patients were referred to the CHOiCE program; 34 were

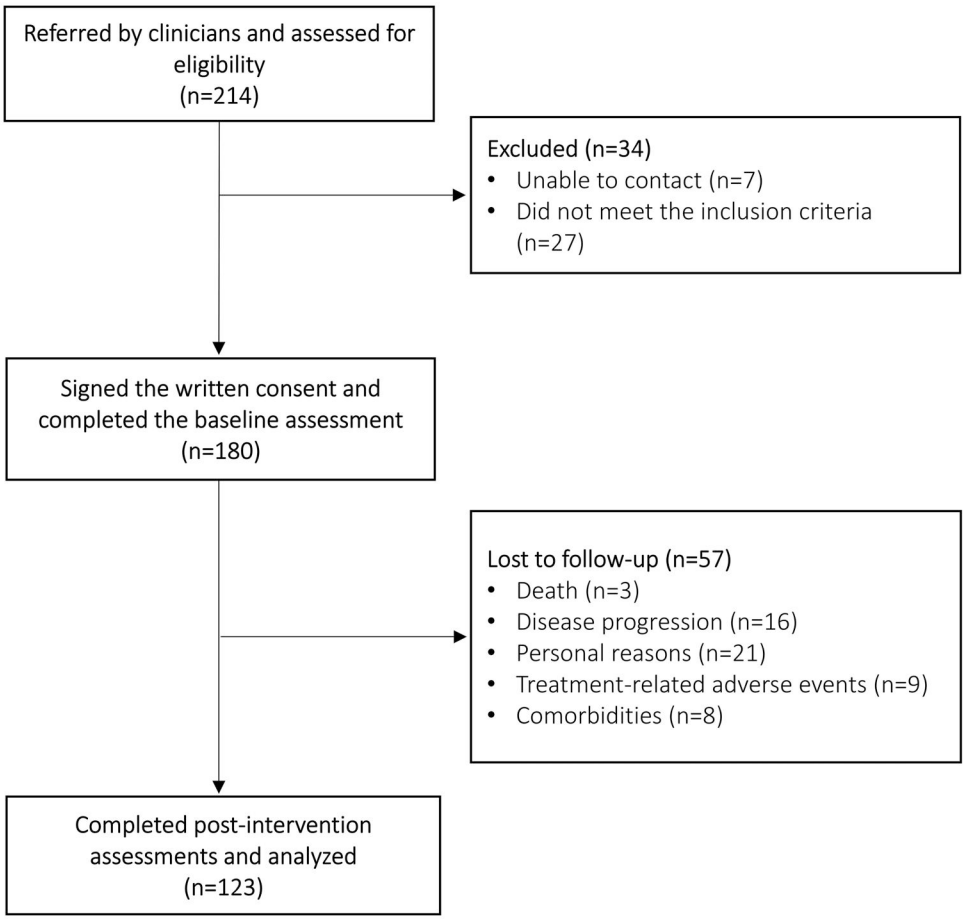

Figure 2. Study flow-diagram.

excluded due to inability to contact them ($n = 7$) or failure to meet the eligibility criteria ($n = 27$). 180 patients provided informed consent. Patients had a mean age of 55.0 ± 10.7 years, 63.3% were female, 73.9% were married, and 73.9% held at least a high school degree (Table 1). The most frequent cancer types were gastrointestinal (37.8%) and breast (34.4%), with a median time since diagnosis of 10.5 months. Nearly half (49.4%) of participants had a stage IV disease. All patients were undergoing anticancer treatments at the time of enrollment, including chemotherapy (53.9%), hormone therapy (19.4%), and combined therapies (15.0%).

Feasibility outcomes

Figure 3 shows the feasibility outcomes. The study recruitment rate was 82%, whereas the dropout rate was 32%, principally due to personal reasons (37%) and disease progression (28%). Except for employment, time since diagnosis, handgrip strength, dyspnea, and insomnia levels, completers and patients who dropped out did not differ at baseline (Tables S1 and S2, Supplementary Information). The median overall attendance at the training session was 88% (IQR: 73%-100%; 4855 of 5904 planned sessions), with no differences between the aerobic (88% [IQR: 75%; 100%]) and resistance (88% [IQR: 75%; 100%]) components. Overall, 1049 sessions were missed, mainly due to personal reasons (57%) and treatment-related side effects or hospital appointments (34%). During the study, 15 non-serious adverse events emerged, including musculoskeletal pain ($n = 10$), dizziness ($n = 3$), tachycardia ($n = 1$), and nausea ($n = 1$).

Physical fitness and patients' reported outcomes

Changes from baseline to postintervention for secondary outcomes are reported in Table 2. A significant gain in body weight (72.3 ± 14.5 kilograms [kg] vs. 73.3 ± 14.7 kg, $P = .002$) was observed, whereas BMI did not change. Patients reported improvements in the 6MWT (516.0 meters [m], [IQR: 460.0; 574.0] vs. 554.9 m [IQR: 471.0; 597.0]; $P < .001$), handgrip strength (54.0 kg [IQR: 44.0; 66.6] vs. 55.0 kg [IQR: 46.0; 65.5]; $P = .003$), leg press strength (80.5 kg [IQR: 54.8; 106.3] vs. 87.6 kg [IQR: 62.6; 119.0]; $P < .001$), sit and reach test (−3.6 ± 11.5 centimeters [cm] vs. −0.9 ± 12.1 cm; $P < .001$), back scratch (0.0 cm [IQR: −10.0; 4.0] vs. 1.0 cm [IQR: −9.7; 4.5]; $P = .040$; right-arm; and −8.0 cm [IQR: −15.3; −0.8] vs. −6.5 cm, [IQR: −14.9; 0.9]; $P = .040$; left-arm).

For QoL, all functioning domains, ie, physical (82.7 ± 14.4 points [pts] vs. 86.4 ± 14.7 pts; $P = .002$), role (83.3 pts [IQR: 66.7; 100.0] vs. 100.0 pts [IQR: 83.3; 100.0]; $P < .001$), emotional (75.0 pts [IQR: 66.7; 91.7] vs. 83.3 pts [IQR: 75.0; 91.7]; $P < .001$), and social (66.7 pts [IQR: 66.7; 83.3] vs. 83.3 pts [IQR: 66.7; 100.0]; $P < .001$), were enhanced, except of cognitive functioning. Similarly, all symptom domains improved; fatigue (33.8 ± 20.4 pts vs. 26.9 ± 19.3 pts; $P < .001$), nausea/vomiting (9.0 ± 15.9 pts vs. 4.9 ± 10.7 pts; $P = .003$), pain (16.7 pts [IQR: 0.0; 33.3] vs. 8.3 pts [IQR: 0.0; 33.3]; $P = .031$), dyspnea (33.3 pts [IQR: 0.0]; 33.3 vs.

Table 1. Baseline demographics and clinical characteristics.

Characteristics	Participants ($n = 180$)
Age, mean (SD)	55.0 (10.7)
Male, *n* (%)	66 (36.7)
Female, *n* (%)	114 (63.3)
Education, *n* (%)	
Elementary School	3 (1.7)
Secondary School	44 (24.4)
High school degree	76 (42.2)
Undergraduate degree	44 (24.4)
Postgraduate degree	11 (6.1)
Missing	2 (1.1)
Marital status, *n* (%)	
Single	27 (15.0)
Married	133 (73.9)
Divorced	17(9.4)
Widow	1 (0.6)
Missing	2 (1.1)
Employment, *n* (%)	
Part-time employed	19 (10.6)
Full-time employed	60 (33.3)
Retired	61 (33.9)
On sick leave	26 (14.4)
Unemployed	12 (6.7)
Missing	2 (1.1)
Family income, *n* (%)	
Inadequate	2 (1.1)
Barely adequate	25 (13.9)
Adequate	104 (57.8)
More than adequate	45 (25.0)
Missing	3 (1.7)
Cancer site, *n* (%)	
Breast	62 (34.4)
Thoracic	25 (13.9)
Gastrointestinal	68 (37.8)
Others[a]	25 (13.9)
Cancer stage, *n* (%)	
I	31 (17.2)
II	21 (11.7)
III	39 (21.7)
IV	89 (49.4)
Months since diagnosis, median (IQR)	10.5 (4.75-22.0)
Prior treatments, *n* (%)	
Yes[b]	139 (77.2)
No	41 (22.8)
Type of current treatment, *n* (%)	
Chemotherapy	97 (53.9)
Radiotherapy	3 (1.7)
Immunotherapy	5 (2.8)
Target therapy	13 (7.2)
Hormone therapy	35 (19.4)
Combined therapy	27 (15.0)

(continued)

Table 1. (continued)

Characteristics	Participants ($n = 180$)
Concomitant comorbidities, *n* (%)	
Yes[c]	83 (46.1)
No	97 (53.9)

[a]Others cancer types: cervix (1.1 %); melanoma (3.1%), kidney (2.1%), prostate (3.7%), ovary (1.6%), testicular (1.1%), brain (0.5%), uterus (0.5%).
[b]Prior treatment type: surgical intervention (45.3%), chemotherapy (36.4%), target therapy (3.6%), immunotherapy (1.3%), hormonotherapy (2.2%), radiotherapy (11.1%).
[c]Type of comorbidities: musculoskeletal disease (22.4%), cardiovascular disease (26.5%), metabolic disease (17.0%), gastrointestinal disease (5.4%), neurological disease (12.2%), urogenital disease (4.1%), dermatological disease (2.7%), endocrine disease (9.5%).

0.0 pts [IQR: 0.0; 33.3]; $P = .003$), insomnia (33.3 pts [IQR: 0.0; 33.3] vs. 0.0 pts [IQR: 0.0; 33.3]; $P = .029$), appetite loss (13.1 ± 24.0 pts vs. 3.7 ± 11.6 pts; <0.001) and diarrhea (11.7 ± 22.6 pts vs. 7.8 ± 17.1 pts; $P = .010$). Financial problems (11.2 ± 21.7 pts vs. 7.9 ± 18.7 pts; $P = .020$) and global health status (64.5 ± 19.3 pts vs. 68.6 ± 19.0 pts; $P = .008$) also improved. Significant increases in vigorous- (0.0 min/week [IQR: 0.0; 0.0] vs. 0.0 min/week [IQR: 0.0; 60.0]; $P < .001$), moderate-intensity (0.0 min/week [IQR: 0.0; 180.0] vs. 120.0 min/week [IQR: 45.0; 240.0]; $P < .001$), and total (205.0 min/week [IQR: 0.0; 420.0] vs. 300.0 min/week [IQR: 120.0; 550.0]; $P < .001$) physical activity were observed.

Exploratory analysis according to cancer type

At baseline, patients with breast, thoracic, gastrointestinal, and other cancer types showed significant differences for gender, education, employment, cancer stage, treatments, prior anticancer therapies, body weight, waist-hip ratio, handgrip strength, and fatigue. Regarding feasibility, the gastrointestinal cancer group displayed the highest dropout rate (16%), and overall, the lowest attendance rate, which resulted in significantly different rates compared to the other cancer types (79% [IQR: 65%; 94%] vs. 98% [IQR: 90%; 100%]; $P < .05$).

All groups significantly improved the 6MWT. The gastrointestinal group showed significant gains for body weight, waist-hip ratio, back scratch (right arm), handgrip, and leg press strength. The breast cancer group improved significantly in sit and reach, patients with thoracic cancer in leg press strength, and the other cancer group in waist-hip ratio, sit and reach, and leg press strength. For patient-reported outcomes, patients with gastrointestinal cancers reported significant improvements in physical, role, emotional, and social functioning, global health status, fatigue, pain, dyspnea, appetite loss, financial problems, total, moderate-, and vigorous-intensity physical activity. The breast cancer group improved physical and social functioning, fatigue, nausea/vomiting, dyspnea, and vigorous-intensity physical activity. The thoracic cancer group improved physical functioning and fatigue, whereas the other cancer group enhanced dyspnea. Detailed analyses are reported in Tables S3 and S8, Supplementary Information.

Exploratory analysis according to cancer stage

At baseline, the groups differed significantly in education, cancer type, prior treatments, type of anticancer treatment, handgrip strength, and physical, role, and emotional functioning. Regarding feasibility, patients with stage III-IV had a higher dropout rate (25% vs. 7%) and experienced more mild adverse events (87% vs 13%); no differences were found for attendance to the exercise sessions.

Patients with stage III-IV cancer reported significant gains in body weight, waist-hip ratio, sit and reach test, back scratch test (left arm), handgrip and leg press test, and 6MWT. The group with early-stage cancer significantly improved in the sit and reach test. For patient-reported outcomes, the group with a stage III-IV cancer significantly enhanced physical, role, emotional, and social functioning, global health status, fatigue, dyspnea, appetite loss, and total, light-, moderate-, and vigorous-intensity physical activity. The early-stage group improved social functioning, fatigue, nausea/vomiting, appetite loss, and diarrhea. Detailed analyses are reported in Tables S9 and S14, Supplementary Information.

Exploratory analysis according to anticancer treatments

The four groups were balanced for baseline characteristics, except for gender, cancer type, prior treatments, and handgrip strength. Regarding feasibility, the chemotherapy group reported the highest dropout rate (22%), whereas adverse events occurred more frequently in the hormone therapy and the immunotherapy/target therapy/radiotherapy groups. No differences in attendance rate were observed across the groups.

The 6MWT significantly improved across all groups. The chemotherapy group significantly gained body weight and enhanced waist-hip ratio, handgrip, and leg press strength. The hormone therapy group improved the sit and reach test, back scratch (left arm), whereas patients undergoing combined therapies increased the sit and reach test, and back scratch (right arm). The group receiving immunotherapy/targeted therapy/radiotherapy experienced enhancements for back scratch (left arm) and handgrip strength. For patient-reported outcomes, the chemotherapy group improved physical, role, and social functioning, global health status, fatigue, pain, appetite loss, financial problems, vigorous- and moderate-intensity physical activity. The hormone therapy group enhanced the physical and role functioning, fatigue, and light-intensity physical activity, whereas the combined therapy group, showed improvements for physical functioning, fatigue, nausea/vomiting, dyspnea, appetite loss, vigorous- and moderate-intensity physical activity. The group receiving immunotherapy/targeted therapy/radiotherapy displayed enhancements in emotional functioning. Detailed analyses are reported in Tables S15 and S20, Supplementary Information.

Exploratory analysis according to exercise delivery methodology

Baseline characteristics are balanced between the personal training, home-based, and hybrid training groups. Home-based

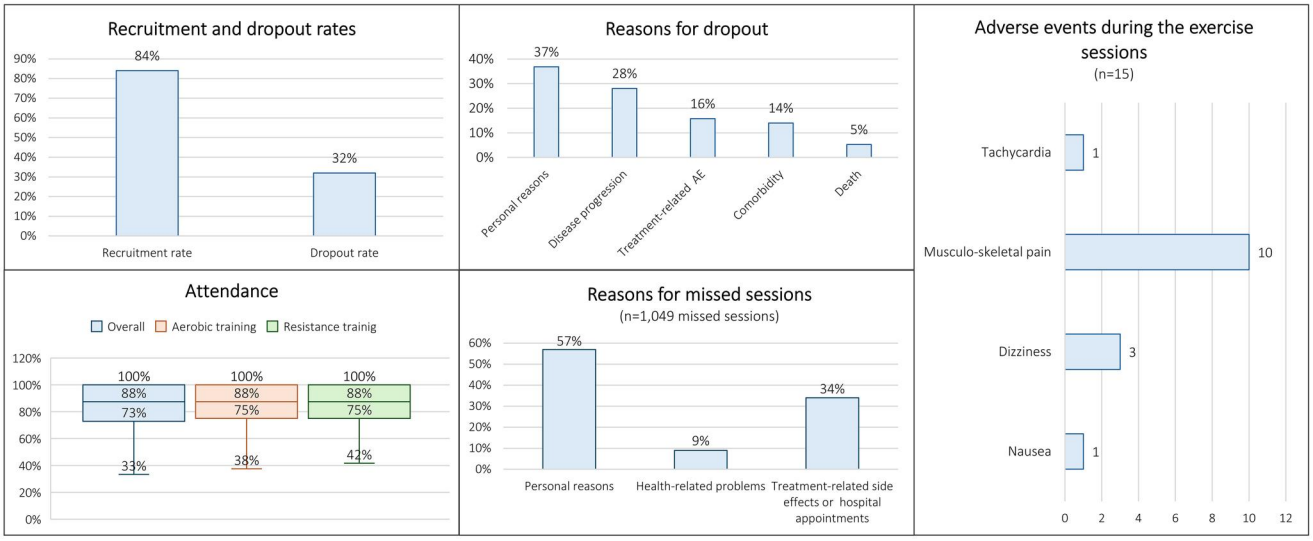

Figure 3. Feasibility outcomes of the CHOiCE program.

(13%) and personal training (14%) groups reported the highest dropout rates; the home-based group registered more adverse events (67%), whereas the attendance rates revealed a significantly lower attendance of the hybrid training group than the home-based group (63% [IQR: 47%; 75%] vs. 96% [IQR: 75%; 100%]; $P < .05$).

The hybrid training group did not report significant improvements in functional and patient-reported outcomes. Patients choosing the personal training program significantly enhanced the waist-hip ratio, sit and reach test, handgrip and leg press strength, and 6MWT. Concerning QoL and physical activity, enhancements in physical, role, emotional, cognitive, and social functioning, as well as in fatigue, dyspnea, and appetite loss, vigorous-, moderate-intensity, and total physical activity were observed. The home-based group significantly gained body weight and BMI, improved in the sit and reach test, back scratch (right and left arms), leg press strength, and the 6MWT. Enhancements for physical, role, emotional, and social functioning, fatigue, nausea/vomiting, dyspnea, insomnia, appetite loss, diarrhea, financial problems, vigorous- and moderate-intensity physical activity were also observed. Detailed analyses are reported in Tables S21 and S26, Supplementary Information.

Discussion

The CHOiCE findings demonstrate that a structured, evidence-based exercise program tailored to patients undergoing anticancer treatment can be implemented in a real-world setting and lead to meaningful improvements in physical fitness and QoL. In terms of feasibility, the program achieved high recruitment (82%) and attendance rates (median 88%), and no serious adverse events were reported. However, the observed dropout rate (32%) exceeded the predefined threshold (<20%)[22] and therefore did not fully meet the original criterion of feasibility. This finding warrants careful consideration. Notably, the CHOiCE program was implemented in a clinically complex and heterogeneous population, with a substantial proportion of patients (71.1%) presenting with advanced-stage disease and all undergoing active treatment. In this context, dropout was largely attributable to clinical reasons rather than to intervention-related factors. Although the dropout rate limits the extent to which feasibility can be claimed under the a priori definition, it remains comparable or favorable relative to other real-world exercise oncology programs, in which completion rates are frequently below 50%. Moreover, adherence among participants who remained in the program was high, supporting the acceptability and safety of the intervention. Taken together, these findings suggest that the CHOiCE program demonstrates partial feasibility in a real-world oncology setting, while highlighting the challenges of maintaining participation during active treatment and the need for adaptive strategies to further reduce attrition, particularly among patients with advanced disease. In this light, the real-world design of the CHOiCE study aligns with established implementation science frameworks, such as RE-AIM and PRECIS-2, which emphasize external validity, feasibility, and applicability of interventions in routine clinical practice.[30,31]

Regarding effectiveness, the CHOiCE program produced significant increases in cardiorespiratory fitness, upper and lower limb muscle strength, and flexibility, as well as in the management of anthropometric parameters. Additionally, patients reported meaningful enhancements in almost all domains of QoL, including symptom burden, eg, fatigue, nausea/vomiting, dyspnea, appetite loss, and pain. These findings underscore the beneficial role of exercise as a supportive strategy capable of mitigating both physical and psychosocial side effects of anticancer treatments. Several clinical trials and meta-analyses have investigated the impact of exercise on these outcomes and described comparable benefits.[2,3,32,33] Similarly, community-based programs and other real-world studies reinforced the positive effect of exercise on physical function.[34] Our study aligns with these investigations, but it makes a significant and novel contribution to the current body of knowledge by focusing on participants undergoing treatment and enrolling a cancer

Table 2. Functional assessments, patient-reported outcomes, and change over 3 months.

Variables	Baseline, median (IQR)	Postintervention, median (IQR)	*P*-Value
Anthropometric measures			
Body weight (kg)[a]	72.3 (14.5)	73.3 (14.7)	.002
Body mass index (kg/m^2)	25.9 (22.5; 28.6)	25.5 (21.3; 28.3)	.549
Waist-hip ratio (cm)	0.87 (0.8; 0.9)	0.84 (0.8; 0.9)	.017
Sit and reach (cm)[a]	−3.6 (11.5)	−0.9 (12.1)	<.001
Back scratch (cm)			
Right arm	0.0 (−10.0; 4.0)	1.0 (−9.7; 4.5)	.040
Left arm	−8.0 (−15.3; −0.8)	−6.5 (−14.9; 0.9)	.009
Handgrip (kg)	54.0 (44.0; 66.0)	55.0 (46.0; 65.5)	.003
Leg press (kg)	80.5 (54.8; 106.3)	87.6 (62.6; 119.0)	<.001
Six-minute walking test (m)	516.0 (460.0; 574.0)	554.9 (471.0; 597.0)	<.001
Quality of life (EORTC QLQ-C30 - points)			
Physical functioning[a]	82.7 (14.4)	86.4 (14.7)	.002
Role functioning	83.3 (66.7; 100.0)	100.0 (83.3; 100.0)	<.001
Emotional functioning	75.0 (66.7; 91.7)	83.3 (75.0; 91.7)	<.001
Cognitive functioning	83.3 (83.3; 100.0)	100.0 (83.3; 100.0)	.082
Social functioning	66.7 (66.7; 83.3)	83.3 (66.7; 100.0)	<.001
Global health status[a]	64.5 (19.3)	68.6 (19.0)	.008
Fatigue[a]	33.8 (20.4)	26.9 (19.3)	<.001
Nausea/vomiting[a]	9.0 (15.9)	4.9 (10.7)	.003
Pain	16.7 (0.0; 33.3)	8.3 (0.0; 33.3)	.031
Dyspnea	33.3 (0.0; 33.3)	0.0 (0.0; 33.3)	.003
Insomnia	33.3 (0.0; 33.3)	0.0 (0.0; 33.3)	.029
Appetite loss[a]	13.1 (24.0)	3.7 (11.6)	<.001
Constipation[a]	12.8 (20.8)	11.9 (19.2)	.558
Diarrhea[a]	11.7 (22.6)	7.8 (17.1)	.010
Financial problems[a]	11.2 (21.7)	7.9 (18.7)	.020
Physical activity level (min/week)			
Vigorous	0.0 (0.0; 0.0)	0.0 (0.0; 60.0)	<.001
Moderate	0.0 (0.0; 180.0)	120.0 (45.0; 240.0)	<.001
Light	52.5 (0.0; 240.0)	95.0 (0.0; 240.0)	.225
Total	205.0 (0.0; 420.0)	300.0 (120.0; 550.0)	<.001

[a]Data presented as mean and standard deviation.

population that closely mirrors the real-world clinical practice, and further confirms the benefits of exercise even outside non-controlled, everyday settings.

The exploratory analyses revealed those subgroups that are likely to be more responsive to the program. To the best of our knowledge, no prior investigations have reported similar results, making the analyses particularly interesting, especially in the future perspective of precision exercise oncology. Patients with gastrointestinal cancers, those with an advanced-stage disease, or those undergoing chemotherapy appeared to obtain enhanced benefit in both physical fitness and QoL. These findings deserve attention considering that these patients are generally considered the most vulnerable and commonly underrepresented in clinical research. Other patients' subgroups, eg, breast cancer, early-stage disease, reported an inferior benefit from the program, partially in disagreement with available evidence.[35–37] In this sense, it may be speculated that the stimulus produced by the CHOiCE program was insufficient to produce adequate adaptation from exercise in these subgroups, suggesting that the prescription should be further refined for this population, particularly, in terms of duration and intensity. In our study the group receiving innovative therapies, such as immunotherapy or target therapy, was relatively small; nevertheless, given the strong rationale supporting the synergy between exercise and such treatments in terms of efficacy, but also for management of specific side effects, eg, weight gain induced by some tyrosine kinase inhibitors, it may represent a fascinating area for future research.[12,38–40]

The current study has some limitations that should be acknowledged. First, a self-selection bias may have occurred, with more motivated patients being more likely to participate and to maintain attendance at the exercise sessions. Second, the observational design and the absence of a control group limit causal inference regarding the effects of the intervention. Third, physical activity levels were assessed using self-reported questionnaires, which may be subject to recall and reporting bias.

In addition, the generalizability of our findings may be limited for some specific cancer populations or clinical settings with

fewer resources or limited access to trained exercise professionals, as the program was fully funded and delivered within an academic hospital setting.

Nevertheless, the study has several strengths. The CHOiCE merged patient needs and the current evidence-based guidelines. This has enabled the development of a patient-centered program, in which the different delivery modalities facilitated adaptation to patients' evolving needs during the intervention, likely contributing to the program's feasibility. All these aspects make CHOiCE the first of its kind; to our knowledge, this is the first study on patients undergoing treatment in a real-world setting that integrates a series of sub-analyses based on relevant clinical characteristics.

Conclusion

In conclusion, the CHOiCE study confirms that a flexible, patient-centered exercise program is feasible and beneficial in real-world cancer care, including among patients with advanced disease and those undergoing intensive treatment. Overall, these findings support the effective translation of exercise-oncology research to clinical practice.

Acknowledgments

S.P. is supported by the Associazione Italiana per la Ricerca sul Cancro (AIRC, Next Gen Clinician Scientist 2023 no. 30204).

Author contributions

Alice Avancini (Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing), Anita Borsati (Conceptualization, Data curation, Investigation, Methodology, Resources, Visualization, Writing—original draft, Writing—review & editing), Gloria Adamoli (Data curation, Investigation, Methodology, Resources, Visualization, Writing—original draft, Writing—review & editing), Linda Toniolo (Resources, Visualization, Writing—review & editing), Christian Ciurnelli (Resources, Visualization, Writing—review & editing), Andrea Trevisan (Resources, Visualization, Writing—review & editing), Lorenzo Belluomini (Data curation, Investigation, Visualization, Writing—review & editing), Ilaria Trestini (Resources, Visualization, Writing—review & editing), Daniela Tregnago (Resources, Visualization, Writing—review & editing), Marco Sposito (Visualization, Writing—review & editing), Jessica Insolda (Data curation, Visualization, Writing—review & editing), Stefano Manduca (Resources, Visualization, Writing—review & editing), Alessandra Auriemma (Data curation, Visualization, Writing—review & editing), Elena Fiorio (Data curation, Visualization, Writing—review & editing), Michele Milella (Conceptualization, Data curation, Project administration, Supervision, Visualization, Writing—review & editing), Massimo Lanza (Data curation, Visualization, Writing—review & editing), Federico Schena (Project administration, Supervision, Visualization, Writing—review & editing), and Sara Pilotto (Conceptualization, Data curation, Project administration, Supervision, Visualization, Writing—original draft, Writing—review & editing)

Supplementary material

Supplementary material is available at *The Oncologist* online.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

The authors have declared no conflicts of interest.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

References

1. Campbell KL, Winters-Stone KM, Wiskemann J, et al. Exercise guidelines for cancer survivors: consensus statement from international multidisciplinary roundtable. *Med Sci Sports Exerc*. 2019;51:2375-2390. https://doi.org/10.1249/MSS.0000000000002116
2. Scott JM, Zabor EC, Schwitzer E, et al. Efficacy of exercise therapy on cardiorespiratory fitness in patients with cancer: a systematic review and meta-analysis. *J Clin Oncol*. 2018;36:2297-2305. https://doi.org/10.1200/JCO.2017.77.5809
3. Padilha CS, Marinello PC, Galvão DA, et al. Evaluation of resistance training to improve muscular strength and body composition in cancer patients undergoing neoadjuvant and adjuvant therapy: a meta-analysis. *J Cancer Surviv*. 2017;11:339-349. https://doi.org/10.1007/s11764-016-0592-x
4. Bettariga F, Galvao DA, Taaffe DR, et al. Association of muscle strength and cardiorespiratory fitness with all-cause and cancer-specific mortality in patients diagnosed with cancer: a systematic review with meta-analysis. *Br J Sports Med*. 2025;59:722-732. https://doi.org/10.1136/bjsports-2024-108671
5. Mustian KM, Alfano CM, Heckler C, et al. Comparison of pharmaceutical, psychological, and exercise treatments for cancer-related fatigue: a meta-analysis. *JAMA Oncol*. 2017;3:961-968. https://doi.org/10.1001/jamaoncol.2016.6914
6. Belluomini L, Avancini A, Sposito M, et al. Integrating nutrition, physical exercise, psychosocial support and antiemetic drugs into CINV management: the road to success. *Crit Rev Oncol Hematol*. 2024;201:104444. https://doi.org/10.1016/j.critrevonc.2024.104444
7. Guo S, Han W, Wang P, et al. Effects of exercise on chemotherapy-induced peripheral neuropathy in cancer patients: a systematic review and meta-analysis. *J Cancer*

Surviv. 2023;17:318-331. https://doi.org/10.1007/s11764-022-01182-3
8. Schmitz KH, Ahmed RL, Troxel A, et al. Weight lifting in women with breast-cancer–related lymphedema. *N Engl J Med*. 2009;361:664-673. https://doi.org/10.1056/NEJMoa0810118
9. Avancini A, Belluomini L, Tregnago D, et al. Exercise and anemia in cancer patients: could it make the difference? *Expert Rev Hematol*. 2021;14:979-985. https://doi.org/10.1080/17474086.2021.2007764
10. Plinsinga ML, Singh B, Rose GL, et al. The effect of exercise on pain in people with cancer: a systematic review with meta-analysis. *Sports Med*. 2023;53:1737-1752. https://doi.org/10.1007/s40279-023-01862-9
11. Verheijden RJ, et al. Physical activity and checkpoint inhibition: association with toxicity and survival. *J Natl Cancer Inst*. 2023;116:573-579. https://doi.org/10.1093/jnci/djad245.
12. Courneya KS, Vardy JL, O'Callaghan CJ, et al. Structured exercise after adjuvant chemotherapy for colon cancer. *N Engl J Med*. 2025;393:13-25. https://doi.org/10.1056/NEJMoa2502760
13. Ligibel JA, Bohlke K, May AM, et al. Exercise, diet, and weight management during cancer treatment: ASCO guideline. *J Clin Oncol*. 2022;40:2491-2507. https://doi.org/10.1200/JCO.22.00687
14. Gallicchio L, Devasia TP, Tonorezos E, et al. Estimation of the number of individuals living with metastatic cancer in the United States. *J Natl Cancer Inst*. 2022;114:1476-1483. https://doi.org/10.1093/jnci/djac158
15. Unger JM, Hershman DL, Fleury ME, et al. Association of patient comorbid conditions with cancer clinical trial participation. *JAMA Oncol*. 2019;5:326-333. https://doi.org/10.1001/jamaoncol.2018.5953
16. Kirkham AA, Klika RJ, Ballard T, et al. Effective translation of research to practice: hospital-based rehabilitation program improves health-related physical fitness and quality of life of cancer survivors. *J Natl Compr Canc Netw*. 2016;14:1555-1562. https://doi.org/10.6004/jnccn.2016.0167
17. Heinze SS, Chiekwe CJ, Christensen T, et al. Activating cancer communities through an exercise strategy for survivors: an effectiveness-implementation trial. *Front Cancer Control Soc*. 2024;2. https://doi.org/10.3389/fcacs.2024.1389084
18. Avancini A, Pala V, Trestini I, et al. Exercise levels and preferences in cancer patients: a cross-sectional study. *Int J Environ Res Public Health*. 2020;17. https://doi.org/10.3390/ijerph17155351
19. Avancini A, Tregnago D, Rigatti L, et al. Factors influencing physical activity in cancer patients during oncological treatments: a qualitative study. *Integr Cancer Ther*. 2020;19:1534735420971365. https://doi.org/10.1177/1534735420971365
20. Avancini A, Borsati A, Toniolo L, et al. Physical activity guidelines in oncology: a systematic review of the current recommendations. *Crit Rev Oncol Hematol*. 2025;210:104718. https://doi.org/10.1016/j.critrevonc.2025.104718
21. Hayes SC, Newton RU, Spence RR, et al. The Exercise and Sports Science Australia position statement: exercise medicine in cancer management. *J Sci Med Sport*. 2019;22:1175-1199. https://doi.org/10.1016/j.jsams.2019.05.003
22. Heywood R, McCarthy AL, Skinner TL. Safety and feasibility of exercise interventions in patients with advanced cancer: a systematic review. *Support Care Cancer*. 2017;25:3031-3050. https://doi.org/10.1007/s00520-017-3827-0
23. Society AT,. ATS statement: guidelines for the six minute walk test. *Am J Respir Crit Care Med*. 2012;166.
24. Ev, I., Handgrip strength testing: a review of the literature. *Aust Occup Ther J*. 1999.
25. Impellizzeri FM, Rampinini E, Maffiuletti N, et al. A vertical jump force test for assessing bilateral strength asymmetry in athletes. *Med Sci Sports Exerc*. 2007;39:2044-2050. https://doi.org/10.1249/mss.0b013e31814fb55c
26. Rikli RE, Jones CJ. Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years. *Gerontologist*. 2013;53:255-267. https://doi.org/10.1093/geront/gns071
27. de Onis O, den Broeck, C, Martorell, for the WHO Multicentre Growth Reference Study Group. Measurement and standardization protocols for anthropometry used in the construction of a new international growth reference. *Food Nutr Bull*. 2004;25:S27-36.
28. Aaronson NK. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst*. 1993;85:365-76.
29. Amireault S, Godin G, Lacombe J, et al. The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. *BMC Med Res Methodol*. 2015;15:60. https://doi.org/10.1186/s12874-015-0045-7
30. Antikainen I, Ellis R. A RE-AIM evaluation of theory-based physical activity interventions. *J Sport Exerc Psychol*. 2011;33:198-214. https://doi.org/10.1123/jsep.33.2.198
31. Loudon K, Treweek S, Sullivan F, et al. The PRECIS-2 tool: designing trials that are fit for purpose. *BMJ*. 2015;350:h2147. https://doi.org/10.1136/bmj.h2147
32. Buffart LM, Kalter J, Sweegers MG, et al. Effects and moderators of exercise on quality of life and physical function in patients with cancer: an individual patient data meta-analysis of 34 RCTs. *Cancer Treat Rev*. 2017;52:91-104. https://doi.org/10.1016/j.ctrv.2016.11.010
33. Avancini A, Sperduti I, Borsati A, et al. Effect of exercise on functional capacity in patients with advanced cancer: a meta-analysis of randomized controlled trials. *Crit Rev Oncol Hematol*. 2022;175:103726. https://doi.org/10.1016/j.critrevonc.2022.103726
34. Rajotte EJ, Yi JC, Baker KS, et al. Community-based exercise program effectiveness and safety for cancer survivors. *J Cancer Surviv*. 2012;6:219-228. https://doi.org/10.1007/s11764-011-0213-7
35. Ajmera P, Miraj M, Kalra S, et al. Impact of telehealth interventions on physiological and psychological outcomes in breast cancer survivors: a meta-analysis of randomised controlled trials. *Front Oncol*. 2022;12:1017343. https://doi.org/10.3389/fonc.2022.1017343
36. Bekhet AH, Abdallah AR, Ismail HM, et al. Benefits of aerobic exercise for breast cancer survivors: a systematic review of randomized controlled trials. *Asian Pac J Cancer Prev*. 2019;20:3197-3209. https://doi.org/10.31557/APJCP.2019.20.11.3197
37. Kang H, Moon M. Effects of digital physical activity interventions for breast cancer patients and survivors: a

systematic review and meta-analysis. *Healthc Inform Res*. 2023;29:352-366. https://doi.org/10.4258/hir.2023.29.4.352

38. Ashcraft KA, Peace RM, Betof AS, et al. Efficacy and mechanisms of aerobic exercise on cancer initiation, progression, and metastasis: a critical systematic review of In vivo preclinical data. *Cancer Res*. 2016;76:4032-4050. https://doi.org/10.1158/0008-5472.CAN-16-0887
39. Koelwyn GJ, Quail DF, Zhang X, et al. Exercise-dependent regulation of the tumour microenvironment. *Nat Rev Cancer*. 2017;17:620-632. https://doi.org/10.1038/nrc.2017.78
40. Trestini I, Belluomini L, Dodi A, et al. Body composition derangements in lung cancer patients treated with first-line pembrolizumab: a multicentre observational study. *J Cachexia Sarcopenia Muscle*. 2024;15:2349-2360. https://doi.org/10.1002/jcsm.13568

The Oncologist, 2026, 31, 1–11
https://doi.org/10.1093/oncolo/oyag153
Original Article