The Journal of Nutrition, Health and Aging 29 (2025) 100424

Contents lists available at ScienceDirect

The Journal of Nutrition, Health and Aging

journal homepage: www.elsevier.com/locate/jnha

Brief Report

Effects of an individualised exercise program in hospitalised older adults with cancer: A randomised clinical trial

M.C. Ferrara [a], F. Zambom-Ferraresi [b,c], A. Castillo [d], M. Delgado [d], A. Galbete [e], V. Arrazubi [d], I. Morilla [b,d], F. Zambom-Ferraresi [b], M.L. Fernández González de la Riva [b], R. Vera Garcìa [d,1], N. Martínez-Velilla [b,c,f,*,1]

[a] School of Medicine and Surgery, University of Milano-Bicocca, Milan, Italy
[b] Navarrabiomed, Hospital Universitario de Navarra (HUN), Universidad Pública de Navarra (UPNA), IdiSNA, Pamplona, Spain
[c] CIBER of Frailty and Healthy Aging (CIBERFES), Spain
[d] Department of Medical Oncology, Hospital Universitario de Navarra (HUN), IdiSNA, Pamplona, Spain
[e] Department of Statistics, Computer Science and Mathematics, Institute of Smart Cities (ISC), Public University of Navarre (UPNA), IdiSNA, Pamplona, Spain
[f] School of Medicine, University of Navarra, Pamplona, Spain

ARTICLE INFO

Keywords:
Oncology
Rehabilitation
Older adults
Mobility
Quality of life
Fatigue

ABSTRACT

We aimed to examine the effects of an individualised multicomponent exercise program on functional outcomes in hospitalised older patients with cancer. Patients aged ≥ 65 were recruited upon admission to a Medical Oncology Department and randomly allocated to receive a multicomponent exercise training program twice daily for five days or standard hospital care. The primary outcome measure was the change in functional status using the Short Physical Performance Battery. This study allocated 30 patients in the Control group and 28 in the intervention group. The mean age was 74.4 years. The intervention group (n = 14) showed significant improvements vs the Control group (n = 20) in the Short Physical Performance Battery (SPPB) (between-group difference, 1.92; 95% CI = 0.80,3.07), knee extension strength (between-group difference 7.72; 95% CI = 1.83,13.8), as well as a significant reduction in fatigue (between-group difference −26.5; 95% CI = −38.6,−13.9). This individualised exercise program appears to have contributed to improving functional abilities and reducing fatigue in hospitalised older cancer patients.

1. Introduction

Cancer is a significant global health issue in which advanced age plays a notable role as a risk factor. Despite the exponential increase in the number of older adults with cancer, evidence-based literature on the management of older adults with cancer remains scarce. As a matter of fact, older patients have long been underrepresented in cancer clinical trials [1,2], being their level of complexity regarded as a barrier rather than a challenge to be faced. Conversely, randomised clinical trials (RCT) should be specifically designed for this population to delve deeper into the topic, by including tailored assessments and patient-reported outcomes.

Functional autonomy, cognition, depression, nutrition, symptoms, fatigue, and quality of life are relevant domains that guide the management and treatment of older adults. Functionality is one of the most important outcomes, as functional decline is a distressing event that leads to greater dependency and higher mortality. Longitudinal decline in physical function can be both cancer and treatment-related. In addition, acute hospitalisation can trigger the sudden development of disability, which irreversibly marks the life course of cancer patients. There is evidence that almost 60% of patients remain bedridden during their hospital stay for an average of 20 h per day, and these data can be plausibly inferred in cancer patients [3].

Numerous studies have recently evaluated the physical activity benefits in frail older adults [4–6]. The VIVIFRAIL model is one of the most successful multicomponent physical exercise prescription programs and has been shown to reduce functional and cognitive impairment in various geriatric settings [7,8]. Evidence of the beneficial role of exercise has been unanimously demonstrated in cancer patients, mostly in outpatients, and through the application of long-lasting intervention training programs [9]. A feasible and effective strategy for preventing functional impairment in hospitalised oncogeriatric patients remains lacking.

* Corresponding author at: Hospital Universitario de Navarra, Irunlarrea 3, 31008 Pamplona, Spain.
E-mail addresses: nicolas.martinez.velilla@navarra.es, @martinezvelilla (N. Martínez-Velilla).
[1] These authors share last authorship.

http://doi.org/10.1016/j.jnha.2024.100424
Received 25 September 2024; Received in revised form 24 October 2024; Accepted 17 November 2024
Available online 29 November 2024

This RCT aimed to address the existing knowledge gap, by analysing the effects of a brief individualised multicomponent exercise training on functional capacity outcomes in acutely hospitalised older patients with cancer. Our hypothesis was that the multicomponent exercise program may outperform usual hospital care in enhancing functional outcomes. This study provides insights into the beneficial mechanisms underlying physical exercise in cancer and provides evidence for the use of exercise as a valuable tool to improve the overall well-being of hospitalised older adults with cancer.

2. Methods

2.1. Study design and participants

This study was conducted in the acute medical oncology department of a tertiary hospital in Spain, Hospital Universitario de Navarra (HUN). The study protocol was approved by the HUN Clinical Research Ethics Committee (PI_2020/7) and has been previously reported [10]. The study followed the principles of the Declaration of Helsinki, and the protocol employed relevant standard items for clinical trials according to the SPIRIT 2013 statement and CONSORT statement for transparent reporting. The trial is registered at ClinicalTrials.gov (NCT05424055).

Patients were recruited during the oncologist assessment process at admission to the Medical Oncology Department, where they were acutely hospitalised due to complications linked to their underlying disease or oncological treatments, regardless of their type of cancer. Oncologists conducted screening interviews to determine whether potentially eligible patients met the inclusion criteria. Patients were included if they were 65 years or older, were able to ambulate (with/without assistance) and to collaborate with the research team after signing the informed consent form. Patients were excluded if the expected length of stay was less than six days, if they had terminal illness, or any of the following: very severe cognitive decline (Global Deterioration Scale score, 7), uncontrolled arrhythmias, acute pulmonary embolism, acute myocardial infarction, or extremity bone fracture in the past 3 months.

Participants who met the inclusion criteria were randomly assigned to the intervention or control group using the tool http://www.randomizer.org. The assignment keys were kept in a confidential file in the HUN and opened at the end of the study's analyses. To ensure masking, alpha numerical code was assigned to each group. This code was delivered to the associated researcher and was not revealed to the investigators in charge of processing the data until the analysis of the coded interventions was completed. Assessors of outcomes were blinded to patient data, including allocation at baseline and follow-up. Owing to the nature of the study, patients could not be blinded to the exercise training modality.

2.2. Intervention

After randomisation, a multidisciplinary research team (physiotherapist, sports science specialist, oncologist, and geriatrician) experienced in functional geriatric assessment and prescription of exercise in frail older patients [11,12], performed the baseline measurement of medical, cognitive, and functional assessments, including mobility and strength evaluations. Sociodemographic data were also collected at baseline. Standard medical care was provided to all participants, and all interventions were performed at the Oncology Department of HUN. The control group received normal hospital care, including physical rehabilitation if needed.

The multicomponent exercise group (intervention) received a multicomponent exercise training program, including supervised progressive resistance exercise training, balance training, and walking for four consecutive days [10] (Figure S1, Supplementary material). During the training period, the patients were trained twice a day for 20-min sessions (morning and afternoon). The supervised multicomponent exercise training program included upper and lower body strengthening exercises tailored to the individual's muscle function, using weight machines, and aiming for 2–3 sets of 8–10 repetitions at an intensity of 40–70% of 1 repetition maximum (1RM) combined with balance, gait exercises progressively more difficult, and functional exercises, such as rising from a chair. The second part of the session consisted of functional exercises such as knee extension and flexion, hip abduction, balance movements, and daily walking in the hospital. The resistance training session included two exercises for the leg extensor muscles (bilateral leg extension and bilateral knee extension muscles) and one exercise for the upper limbs (seated bench press). In each session, the subjects performed a specific warm-up with one set of extremely light loads on the upper and lower body. The participants and their family members were familiarised with the training procedure in advance. Patients were reassessed after the training or control period on the 6th day after inclusion to evaluate the outcomes. All adverse events were recorded in a diary by self-report or by training and testing staff.

2.3. Primary endpoint

The primary outcome was the change in functional status during the study period (at admission and after 5 days), evaluated using the Short Physical Performance Battery (SPPB) [13], with the total score ranging from 0 (worst) to 12 points (best). The test evaluates the ability to maintain the standing position for 10 s with three different feet-positions, the gait speed to progress for four linear meters, and the ability to stand from a chair five consecutive times without using the arms. The SPPB test is a valid instrument to screen frailty and predict disability, institutionalisation and mortality [5,13,14].

2.4. Secondary endpoints

- Handgrip strength (measured while seated, with the dominant hand with the elbow straight and the shoulder abducted at 15°, Takei 5401 Digital Dynamometer) [15–17].
- Maximal dynamic strength was assessed using the 1RM test with bilateral leg press, chest press, and knee extension using exercise machines (Matrix, Johnson Health Tech, Ibérica, S.L., Madrid, Spain). Each subject's maximal load was determined in no more than five attempts, with a 3-min recovery period between attempts. Qualified fitness specialists individually monitored and carefully supervised all the training sessions and provided instructions.
- Changes in mood status were measured by the 15-item Yesavage Geriatric Depression Scale Spanish Version, with a score greater than 5 suggesting depression [18].
- Changes in the Trail Making Test (TMT) part A, which requires individuals to draw lines sequentially connecting 25 encircled numbers distributed on a sheet of paper [19].
- The European Organization for Research and Treatment (EORTC) Quality of Life Questionnaire–Core 30 (QLQ-C30) is a widely used cancer-specific quality-of-life (QOL) questionnaire that incorporates nine multi-item scales: five functional scales (physical, role, cognitive, emotional, and social), three symptom scales (fatigue, pain, and nausea and vomiting), and a global health and quality of life scale. Several single-item symptom measures were also included [20].
- Gait ability was assessed using the 6-meter gait velocity test (GVT). The starting and ending limits were marked on the floor with tapelines, for a total distance of 8 m. The participants were instructed to walk at their usual pace for two attempts. The results of both the trials were averaged to obtain a single value. The first and last meters, considered as the warm-up and deceleration phases, respectively, were not included in the gait assessment calculations.
- Dual-task GVT and cognitive scores during dual-task (arithmetic-GVT). During the arithmetic dual-task test (arithmetic-GVT), gait velocity was assessed while the participants were counting backward aloud from 100 one at a time. Cognitive scores were measured by determining how

many numbers were counted backward (dual task with arithmetic performance).

2.5. Statistical analysis

The description of the sample by group was conducted using statistics, such as means and standard deviations or medians and interquartile ranges for the quantitative variables and frequencies and percentages for the qualitative variables. For comparisons between groups at baseline, the *t*-test was used for continuous variables, whereas the chi-square test or Fisher's test was used for categorical variables. Linear mixed-effects models were used to determine the efficacy of the intervention in the quantitative variables, using outcome values as dependent variables, time, group, and time by group interaction as fixed effects, and patient as random effects. This method allow for the inclusion of all available data, and this approach adheres to the intention-to-treat principle, ensuring that all randomised participants are accounted for in the outcome assessments.

In the case of qualitative or categorised variables (such as whether an improvement of a given magnitude between pre-and post-intervention was achieved), comparisons between groups were conducted using the chi-square test or Fisher's test and complemented with logistic regression if additional adjustment was needed. Statistical significance was set at $P < 0.05$. Data were analysed using an intention-to-treat approach with R and SPSS statistical packages.

3. Results

Table 1 shows the baseline characteristics of participants in the control ($n = 30$) and intervention ($n = 28$) groups. The mean age of the sample was 74.4 years, and 60% of the patients were male, mostly malnourished, or at risk of malnutrition. The enrolled patients had mixed solid tumours, mostly in the metastatic stage. The control and intervention groups showed a good balance in the mean age, sex, type and stage of the tumour, health, and nutritional status. Most patients in both groups were hospitalised due to acute medical events, whereas a minor part of them were hospitalised due to neoplastic progression, acute complications, or chemotherapy toxicity. However, the control group exhibited a slightly better baseline functional capacity and strength parameters, with a significant difference in knee extension strength (56 kg in the control group vs. 44 kg in the intervention group). Among the total number of allocated patients, 10 (33%) and 14 (50%) dropped out in the control and in the intervention groups, respectively, owing to worsening of their medical conditions or early discharge (Figure S2, Supplementary material).

Several differences were observed between the baseline characteristics of the patients included in the final analysis and those excluded from both groups (Table S1, Supplementary material). The excluded patients in the control group were mostly male, with significantly higher baseline values for SPPB, handgrip strength, leg press, chest press, and knee extension, resulting in an overall better baseline functional condition. However, it is worth noting that the mean values of baseline functional variables in the patients excluded from the control group were much better than those of the patients included in the control group as well as those of the Intervention group. No baseline differences were found between the included and excluded patients within the intervention group, except for a better reported health status in the excluded patients.

When comparing the pre- and post-intervention outcomes between the two groups (Table 2), SPPB significantly improved in the intervention group (between-group difference, 1.92; 95% CI = 0.80,3.07), as well as knee extension strength (between-group difference 7.72; 95% CI = 1.83,13.8), but not in the control group. Functional scales, including physical domain and role functioning, as well as global health measures, showed trends towards improvement in the intervention group, but statistical significance was not reached for these parameters. In terms of symptoms, the intervention group exhibited a significant reduction in

Table 1
Baseline characteristics of participants in the Control and Intervention groups.

Variable	Control group ($N = 30$)	Intervention group ($N = 28$)	*P*
Age; *mean (SD)*	74.4 (5.2)	74.4 (5.3)	0.977[1]
Male sex	18 (60.0%)	17 (60.7%)	0.956[2]
Living alone	6 (20.0%)	4 (15.4%)	0.737[2]
BMI, *mean (SD)*	25.7 (4.1)	27.1 (5.8)	0.319[1]
Type of tumor			0.636[3]
Colorectal	7 (23.3%)	9 (32.1%)	
Upper digestive	12 (40.0%)	5 (17.9%)	
Lung	4 (13.3%)	5 (17.9%)	
Breast	1 (3.3%)	2 (7.1%)	
Genitourinary	4 (13.3%)	5 (17.9%)	
Head and neck cancer	2 (6.7%)	2 (7.1%)	
Tumor stage			0.082[3]
Localized	3 (10.0%)	0 (0.0%)	
Localized but advanced	6 (20.0%)	2 (7.4%)	
Metastatic	21 (70.0%)	25 (92.6%)	
GVT m/s, *mean (SD)*	0.82 (0.25)	0.77 (0.28)	0.256[1]
GVT during dual-task (arithmetic-GVT) m/s, *mean (SD)*	0.68 (0.25)	0.65 (0.23)	0.654[1]
Cognitive score during dual-task (arithmetic-GVT), mean (SD)	10.7 (4.1)	10.4 (2.7)	0.365[1]
MNA-SF, *mean (SD)*	10.8 (2.4)	9.7 (2.4)	0.203[1]
Pain, *mean (SD)*	1.2 (2.1)	1.3 (2.2)	0.826[1]
Health status, *mean (SD)*	57.0 (21.5)	57.3 (18.7)	0.955[1]
GDS, *mean (SD)*	2.4 (1.7)	2.4 (2.4)	0.948[1]
SPPB, *mean (SD)*	9.0 (2.5)	7.9 (3.0)	0.153[1]
Trail Making Test, *mean (SD)*	60.5 (24.7)	69.1 (40.0)	0.351[1]
Handgrip strength, *mean (SD)*	26.2 (8.4)	23.5 (7.1)	0.215[1]
Brief Fatigue Inventory, *mean (SD)*	2.8 (2.4)	3.5 (2.4)	0.251[1]
1 RM Leg press (kg), *mean (SD)*	80.3 (28.9)	69.1 (28.0)	0.091[1]
1 RM Chest press (kg), *mean (SD)*	20.4 (9.8)	19.1 (10.0)	0.306[1]
1 RM Knee extension (kg), *mean (SD)*	56.9 (22.1)	44.0 (15.1)	0.010[1]

Note: [1] t-test; [2] Chi square test; [3] Fisher's exact test.
Abbreviations: SD, standard deviation; BMI, Body Mass Index; GVT, Gait velocity speed; MNA-SF, Mini-Nutritional Assessment short-form; GDS, Geriatric Depression Scale; SPPB, Short Physical Performance Battery; 1 RM, 1 Repetition Maximum.

Table 2
Pre-post comparison between groups regarding motor functional and cognitive domains, quality of life, and symptoms.

Variable	Control group ($N = 20$)	Intervention group ($N = 14$)	Between-group difference (95%CI)	P^*
SPPB	0.38 (−0.34, 1.09)	2.30 (1.43, 3.18)	1.92 (0.80, 3.07)	0.002
GDS	0.49 (−0.11, 1.10)	0.95 (0.23, 1.70)	0.46 (−0.48, 1.42)	0.348
Trail Making Test-A	−11.1 (−16.7, −5.35)	−7.40 (−13.7, −1.20)	3.70 (−4.93, 12.0)	0.398
GVT	0.10 (0.02, 0.17)	0.15 (0.06, 0.24)	0.05 (−0.06, 0.17)	0.350
GVT during dual-task (arithmetic-GVT)	0.08 (0.0, 0.15)	0.09 (0.01, 0.18)	0.02 (0.09, 0.14)	0.756
Cognitive score during dual-task (arithmetic-GVT)	1.22 (−0.15, 2.65)	−0.03 (−1.72, 1.65)	−1.26 (−3.48, 0.90)	0.265
Handgrip strength	0.05 (−0.93, 1.02)	0.61 (−0.54, 1.78)	0.56 (−0.94, 2.09)	0.475
1 RM Leg press	2.39 (−3.82, 8.39)	9.54 (2.14, 16.8)	7.15 (−2.33, 16.7)	0.153
1 RM Chest press	0.59 (−0.52, 1.67)	1.26 (−0.05, 2.58)	0.68 (−1.02, 2.39)	0.445
1 RM Knee extension	2.05 (−2.10, 5.98)	9.77 (5.33, 51.5)	7.72 (1.83, 13.8)	0.018
Global health status	4.93 (−3.66, 13.3)	6.59 (−3.54, 16.5)	1.65 (−11.4, 14.7)	0.806
Physical domain	−0.90 (−3.77, 1.89)	3.30 (−0.09, 6.59)	4.19 (−0.15, 8.55)	0.068
Role functioning	−2.55 (−7.23, 2.01)	2.68 (−2.77, 8.02)	5.23 (−1.85, 12.3)	0.157
Emotional domain	7.23 (0.88, 13.6)	11.8 (4.17, 19.2)	4.54 (−5.40, 14.3)	0.374
Cognitive domain	−0.08 (−6.92, 6.42)	2.81 (−5.17, 10.8)	2.89 (−7.36, 13.5)	0.589
Social domain	−5.29 (−19.8, 9.15)	−2.87 (−19.7, 13.8)	2.42 (−19.8, 24.4)	0.832
Symptom scales				
Fatigue	−1.17 (−9.05, 6.70)	−27.7 (−36.9, −17.9)	−26.5 (−38.6, −13.9)	<0.001
Nausea, vomiting	−7.65 (−17.0, 1.80)	0.0 (−11.1, 11.1)	7.65 (−6.9, 22.1)	0.309
Pain	−13.0 (−24.5, −1.50)	−20.5 (−34.5, −7.16)	−7.49 (−25.8, 10.0)	0.413
Dyspnoea	−3.50 (−13.6, 6.58)	−15.2 (−27.5, −3.43)	−11.7 (−27.7, 3.73)	0.152
Insomnia	−4.94 (−20.2, 9.81)	−1.21 (−18.5, 16.2)	3.72 (−18.9, 27.0)	0.752
Loss of appetite	−13.7 (−31.6, 4.89)	−17.5 (−38.5, 3.52)	−3.77 (−32.0, 23.7)	0.792
Constipation	−5.13 (−18.6, 8.32)	−11.55 (−27.9, 4.97)	−6.41 (−27.5, 14.9)	0.559
Diarrhoea	1.52 (−8.06, 11.1)	−4.46 (−16.1, 6.80)	−5.98 (−21.1, 8.76)	0.437

Abbreviations: 95%CI, 95% Confidence Interval; SD, standard deviation; SPPB, Short Physical Performance Battery; GDS, Geriatric Depression Scale; GVT, Gait velocity speed; 1 RM, 1 Repetition Maximum.
* p-value of the interaction term in the linear mixed model.

fatigue, compared to the control group (between-group difference −26.5; 95% CI = −38.6, −13.9). Regarding intra-group differences, significant improvements in SPPB, GDS, leg press, and knee extension strength were observed in the intervention group. A significant reduction in TMT errors was observed in both the Intervention and control groups. No specific adverse events during or after the exercise were reported in the intervention group.

4. Discussion

The results of this RCT indicate that a brief individualised multicomponent exercise program might have a positive impact on functional capacity in hospitalised older patients with cancer, as shown by some differences in the SPPB, knee extension strength, and fatigue symptoms favoring the intervention group. To the best of our knowledge, this is the first study to demonstrate the effectiveness of a brief exercise program in older patients with solid cancer during acute hospitalisation.

Our results advance previous research supporting the potential benefits of exercise interventions in older patients with cancer. In recent years, physical activity and exercise programs have become increasingly recognised as useful and safe interventions for patients with cancer during and after treatment to such a degree that international guidelines have incorporated recommendations regarding the introduction of regular aerobic and resistance exercise into standard practice [21–23]. However, the optimum dose and intensity of exercise as well as the settings in which physical exercise should be proposed remain unknown. Only one study was conducted in hospitalised cancer patients to test an in-hospital intervention from admission to discharge, but it was conducted in a younger population of patients undergoing hematopoietic cell transplantation, considering self-directed exercise programs, and showed no effectiveness [24]. A recent systematic review showed that exercise during cancer treatment reduced hospital length of stay by 1.40 days and lowered the rate of hospital admission by 8% compared with usual care. However, most studies were conducted on younger subjects (mean age 52.2 ± 10.9 years, which was significantly lower than the mean age of patients enrolled in our study), and mostly in patients with haematological cancers, thus representing an important barrier in cancer treatment research. As for the exercise intervention length, the review reported a median duration of 5.5 weeks (range 2–52), which is notably longer than the duration proposed in our trial.

Precarious conditions of older patients with cancer are often considered a barrier to physical exercise interventions during hospitalisation. However, our study suggests that brief treatment is effective and well-tolerated. The positive effects of this program are plausible if we consider that the VIVIFRAIL physical exercise prescription model adopted in this study has already been successfully applied to the general population of frail and cognitively impaired hospitalised older adults [11]. Given the established relationship between cancer and frailty, interventions that are effective in frail patients could also be beneficial in oncogeriatric patients. In the same vein as personalised medicine, this model individualises specific recommendations on exercise doses (intensity, volume, and frequency), similar to what we do with other medications.

The pivotal consideration is that older patients with cancer often require acute hospitalisations, but this should not lead to a physical deconditioning due to the imposed in-hospital sedentary behaviour. Notably, physical deconditioning increases the risk of clinical complications and falls, reducing QoL and satisfaction with care. Consequently, reduced physical function, fatigue, and muscle wasting further worsen the QoL. Multiple mechanisms underlie the positive effects of exercise on functional improvement in older cancer patients during hospitalisation. Exercise is likely to enhance adaptations in the cardiovascular and skeletal muscle systems, supporting better performance in the SPPB score and knee extension strength. Better balance and muscle strength have outstanding clinical benefits in older patients by reducing fall and fracture risk, thus preventing disability [25]. It has also been demonstrated that improved physical function in older cancer patients can increase tolerance to treatments, reduce side effects of therapies through immune-modulation, and decrease symptom burden, such as fatigue and depressive and anxiety symptoms [26]. Therefore, a significant improvement in QoL and advances in the care of older people may be achieved by improving their functional capacity. Cancer-related fatigue is

a distressing and persistent sense of physical, emotional, and/or cognitive tiredness or exhaustion related to cancer or cancer treatments [27], which can last many years after cancer diagnosis and usually remains undertreated. A recent systematic review and meta-analysis focused on the effectiveness of exercise models on cancer-related fatigue, aerobic and/or resistance exercise, and showed a positive trend in reducing cancer-related fatigue during chemotherapy in a population with a mean age of 52.6 ± 11.3, and including 82% of women [28]. Brownstein et al. investigated physiological and psychosocial correlates of cancer-related fatigue in cancer survivors, finding that peak oxygen consumption, maximal voluntary contraction force, pain intensity, and pain severity were associated with fatigue severity [29]. This finding supports the notion that fatigue correlates with measures of functional capacity, which improve with exercise. A systematic review by Chen et al. found that exercise interventions are a workable approach to improving cancer-related fatigue and QoL among cancer patients, with an aerobic exercise intervention of less than 12 weeks, three times per week [30]. In our study, reduced symptoms of fatigue were observed in the intervention group compared with the control group. Although statistical significance was not reached for quality-of-life measures, the intervention group showed trends towards improvement in functional scales and global health measures. This suggests that the exercise program may offer additional benefits, potentially enhancing the overall well-being and quality of life of older cancer patients.

Moreover, our study found that the individualised multicomponent exercise program was safe, supporting its potential for broader implementation in oncology. Given the lack of significant adverse events reported, healthcare providers should consider incorporating similar exercise programs into standard care for hospitalised older adults with cancer. None of the patients interrupted the intervention because of the side effects of physical exercise. The high dropout rate in both the control and intervention groups was related to the underlying medical conditions of the patients, which acutely worsened in some cases or significantly improved after a few days in others, thus leading to early discharge. In a systematic review by Mizrahi et al., the reported average withdrawal rates were 28% and 24% in exercise and control groups, respectively [9]. In our study, the dropout rate was even higher; however, it is reasonable if we consider that the mean older age of our population was higher and the setting in which the study was conducted was acute, recruiting patients at a high risk of sudden clinical worsening of their medical conditions. Nevertheless, it is true that the recruitment and inclusion of this type of patient in such a study was a major challenge, given the differences compared to patients traditionally recruited in geriatric departments, with additional psychological aspects beyond the purely medical issues and issues related to the interaction of complementary treatments with baseline treatments, such as chemotherapy.

This study has several outstanding strengths: it is the first RCT testing individualised physical exercise on older cancer patients acutely hospitalised; the inclusion of patients with different types of solid cancers and stages supports the need to address all patients with cancer, independent of their severity level; the consideration of Patient-Reported-Outcome Measure (PROMs), such as fatigue and other quality-of-life measures, provides insight into the patients' perspective beyond the traditionally measured objective parameters; the main outcome of the study is functional status, which is the parameter of major concern among older adults, with significant clinical implications and notable impact on health-related quality of life. Some limitations should be noticed as well. First, the small sample size of the study, with a higher-than-expected dropout rate, may partially affect the reliability of our results, suggesting that larger multicentre trials are needed to validate the results, even though it is worth noting that recruiting such a complex population of acutely hospitalised older adults with cancer is particularly difficult. Second, this study did not explore the long-term effects of exercise interventions on functional capacity, quality of life, and survival in older patients with cancer, which could be explored in future studies. Third, this study did not investigate the sustainability and cost-effectiveness of these exercise programs, which could be useful for informing future clinical guidelines and care pathways. Future research should investigate the optimal types, intensities, and durations of exercise for this population to determine their potential for widespread adoption.

In conclusion, this RCT suggests that a brief multicomponent exercise program may offer benefits in improving physical function, mobility, and fatigue in hospitalised older adults with cancer. By considering the incorporation of personalised exercise interventions into clinical practice, healthcare providers might enhance patient outcomes and contribute to more comprehensive care for older cancer patients. The adoption of a new approach model for cancer patients could help shift the focus toward functional abilities rather than solely on the disease, potentially paving the way for adjustments in the current oncogeriatric management of patients hospitalised for acute medical conditions.

Authors' contributions

Methodology: AG, NMV, MCF
Data Curator and formal Analysis: AG
Assessment of patients: AC, MD, VA, IM, RVG
Intervention with patients: FbZF, MLFGR
Writing - Original Draft: MCF, NMV, FrZF, RVG
Review & Editing: All authors.

Generative AI

AI has been used to help us with English grammar (Paperpal).

Funding

Open Access funding provided by Universidad Pública de Navarra. This research was funded by the Instituto de Salud Carlos III-FEDER through project grant (PI21/01117).

Conflicts of interest

The authors have declared no conflicts of interest.

Acknowledgements

We acknowledge patients who accepted to participate in this study and their caregivers who were of invaluable support for them.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jnha.2024.100424.

References

[1] Baxter MA, O'Hanlon S. Oncological trials-designed for result or clinical relevance? Age Ageing 202251:, doi:http://dx.doi.org/10.1093/ageing/afac103.
[2] Pitkala KH, Strandberg TE. Clinical trials in older people. Age Ageing 2022;51: afab282.
[3] Hassan M, Banka R, Castro-Añón O, Mercer RM, Bedawi EO, Asciak R, et al. Physical activity and sedentary behaviour in patients with malignant pleural effusion undergoing therapeutic pleural interventions (the ASPIRE study). Arch Bronconeumol 2021;57:656–8.
[4] Bernabei R, Landi F, Calvani R, Cesari M, Del Signore S, Anker SD, et al. Multicomponent intervention to prevent mobility disability in frail older adults: randomised controlled trial (SPRINTT project). BMJ 2022;377:e068788.
[5] Ferrara MC, Pérez LM, Sole AR, Villa-García L, Ars J, Soto-Bagaria L, et al. Sustained improvement of intrinsic capacity in community-dwelling older adults: the +AGIL Barcelona multidomain program. J Intern Med 2023;294:730–42.
[6] Stathi A, Greaves CJ, Thompson JL. Effect of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: the REACT (Retirement in Action) randomised controlled trial. The Lancet Public Health 2022;7: e316–26.
[7] Casas-Herrero Á, Sáez de Asteasu ML, Antón-Rodrigo I, Sánchez-Sánchez JL, Montero-Odasso M, Marín-Epelde I, et al. Effects of Vivifrail multicomponent intervention on

functional capacity: a multicentre, randomized controlled trial. J Cachexia Sarcopenia Muscle 2022;13(2)884–93, doi:http://dx.doi.org/10.1002/jcsm.12925 Epub 2022 Feb 11. PMID: 35150086; PMCID: PMC8977963.
[8] Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, Sáez de Asteasu ML, Lucia A, Galbete A, et al. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: a randomized clinical trial. JAMA Intern Med 2019;179:28–36.
[9] Mizrahi D, Lai JKL, Wareing H, Ren Y, Li T, Swain CTV, et al. Effect of exercise interventions on hospital length of stay and admissions during cancer treatment: a systematic review and meta-analysis. Br J Sports Med 2024;58:97–109.
[10] Martínez-Velilla N, Arrazubi V, Zambom-Ferraresi F, Morilla-Ruiz I, Sáez de Asteasuu ML, Ramírez-Vélez R, et al. Tailored prevention of functional decline through a multicomponent exercise program in hospitalized oncogeriatric patients: study protocol for a randomized clinical trial. J Nutr Health Aging 2023;27:911–8.
[11] Martínez-Velilla N, Abizanda P, Gómez-Pavón J, Zambom-Ferraresi F, Sáez de Asteasu ML, Fiatarone Singh M, et al. Effect of an exercise intervention on functional decline in very Old patients during acute hospitalizations: results of a multicenter, randomized clinical trial. JAMA Intern Med 2022;182:345–7.
[12] Izquierdo M, Casas Herrero Á, Martínez Velilla NI, Alonso Bouzón C, Rodríguez Mañas L. Un ejemplo de cooperación para la implementación de programas relacionados con el desarrollo de ejercicio en ancianos frágiles: programa europeo Erasmus + «Vivifrail». Rev Esp Geriatr Gerontol 2017;52:110–1.
[13] Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85–94.
[14] Western MJ, Malkowski OS. Associations of the Short Physical Performance Battery (SPPB) with adverse health outcomes in older adults: a 14-year follow-up from the English Longitudinal Study of Ageing (ELSA). Int J Environ Res Public Health 2022;19:16319.
[15] Rantanen T, Guralnik JM, Foley D, Masaki K, Leveille S, Curb JD, et al. Midlife hand grip strength as a predictor of old age disability. JAMA 1999;281:558–60.
[16] Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age Ageing 2011;40:423–9.
[17] Laukkanen P, Heikkinen E, Kauppinen M. Muscle strength and mobility as predictors of survival in 75-84-year-old people. Age Ageing 1995;24:468–73.
[18] Martínez De La Iglesia J, Onís Vilches MC, Dueñas Herrero R, Albert Colomer C, Aguado Taberné C, Luque Luque R. Versión española del cuestionario de Yesavage abreviado (GDS) para el despistaje de depresión en mayores de 65 años: adaptación y validación. Medifam 200212:, doi:http://dx.doi.org/10.4321/S1131-57682002001000003.
[19] Tombaugh TN. Trail making test A and B: normative data stratified by age and education. Arch Clin Neuropsychol 2004;19:203–14.
[20] Aaronson N, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez N, et al. 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.
[21] Watson G, Coyne Z, Houlihan E, Leonard G. Exercise oncology: an emerging discipline in the cancer care continuum. Postgrad Med 2022;134:26–36.
[22] Ligibel JA, Bohlke K, May AM, Clinton SK, Demark-Wahnefried W, Gilchrist SC, et al. Exercise, diet, and weight management during cancer treatment: ASCO guideline. J Clin Oncol 2022;40:2491–507.
[23] Cormie P, Atkinson M, Bucci L, Cust A, Eakin E, Hayes S, et al. Clinical Oncology Society of Australia position statement on exercise in cancer care. Med J Aust 2018;209:184–7.
[24] Jacobsen PB, Le-Rademacher J, Jim H, Syrjala K, Wingard JR, Logan B, et al. Exercise and stress management training prior to hematopoietic cell transplantation: Blood and Marrow Transplant Clinical Trials Network (BMT CTN) 0902. Biol Blood Marrow Transplant 2014;20:1530–6.
[25] Winters-Stone KM, Horak F, Jacobs PG, Trubowitz P, Dieckmann NF, Stoyles S, et al. Falls, functioning, and disability among women with persistent symptoms of chemotherapy-induced peripheral neuropathy. J Clin Oncol 2017;35:2604–12.
[26] Campbell KL, Winters-Stone KM, Wiskemann J, May AM, Schwartz AL, Courneya KS, et al. Exercise guidelines for cancer survivors: consensus statement from International multidisciplinary roundtable. Med Sci Sports Exerc 2019;51:2375–90.
[27] Berger AM, Mooney K, Alvarez-Perez A. Cancer-related fatigue, version 2.2015. J Natl Compr Canc Netw 2015;13:1012–39.
[28] Herranz-Gómez A, Cuenca-Martínez F, Suso-Martí L, Varangot-Reille C, Prades-Monfort M, Calatayud J, et al. Effectiveness of therapeutic exercise models on cancer-related fatigue in patients with cancer undergoing chemotherapy: a systematic review and network meta-analysis. Arch Phys Med Rehabil 2023;104:1331–42.
[29] Brownstein CG, Twomey R, Temesi J, Wrightson JG, Martin T, Medysky ME, et al. Physiological and psychosocial correlates of cancer-related fatigue. J Cancer Surviv 2022;16:1339–54.
[30] Chen X, Li J, Chen C, Zhang Y, Zhang S, Zhang Y, et al. Effects of exercise interventions on cancer-related fatigue and quality of life among cancer patients: a meta-analysis. BMC Nurs 2023;22:200.