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Perspectives

Perspectives on prehabilitation for older adults with cancer: A report from the International Society of Geriatric Oncology (SIOG) rehabilitation group

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1. Introduction

Continuing developments in oncology treatment and survivorship have emphasized rehabilitation as a recognized component of cancer care delivery [1]. Traditionally, cancer rehabilitation aims to restore physical, psychosocial, and cognitive functioning during and after cancer treatment [2]. However, rehabilitation may also be used to prevent or minimize the severity of anticipated treatment-related impairments [2].

Preventative rehabilitation, more recently described as *prehabilitation*, occurs between cancer diagnosis and the beginning of acute treatment [2]. Prehabilitation assesses impairments and provides personalized interventions to optimize physical and psychological health prior to cancer treatment, aiming to reduce the risk of further complications [3].

Prehabilitation is mostly discussed in the context of surgery, but prehabilitation approaches can optimize physical and mental health and should begin as early as possible prior to any cancer treatment (e.g., neoadjuvant chemotherapy) [2,4]. The three main components of multimodal prehabilitation are: (1) exercise training; (2) nutrition optimization; and (3) psychological support, which is often accompanied by behavior change strategies to facilitate smoking cessation and reduce alcohol consumption [2]. Both unimodal (e.g., exercise training alone) and multimodal (i.e., the combination of two or more modalities) prehabilitation models can positively impact patient outcomes. A multimodal approach is recommended to synergize rehabilitative

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components prior to cancer treatment [2].

Prehabilitation may be particularly important for older adults with cancer as they have a higher risk of postoperative complications after cancer surgery than younger patients [5]. The increased risk of adverse postoperative outcomes in older patients is multifactorial and may be attributed, in part, to the presence of comorbidities and/or geriatric syndromes, such as frailty and sarcopenia. For example, older adults with cancer are more likely to be frail, and frailty is a strong prognosticator of adverse postoperative outcomes after cancer surgery [6]. Additionally, older adults often experience profound declines in muscle mass and function due to age- and disease-related adverse effects, predisposing them to worse postoperative outcomes [7].

The objectives of this paper are to (1) describe the effects of prehabilitation on fitness and clinical outcomes in older adults prior to cancer surgery, (2) summarize the components of prehabilitation interventions used in older adults with cancer, (3) delineate the role of geriatric assessment in tailoring prehabilitation interventions based on the unique needs of the older patient, and (4) describe common barriers to prehabilitation and potential solutions that may increase accessibility and adherence to prehabilitation in geriatric oncology.

2. Effects of Prehabilitation among Older Adults with Cancer

Meta-analytic data corroborate the role of multimodal prehabilitation in improving postoperative outcomes in geriatric oncology, particularly in frail older adults [8–11]. A meta-analysis of nine randomized controlled trials (RCTs), of which eight included older adults awaiting major abdominal surgery for various cancers, demonstrated lower postoperative complications and improvements in the 6-min walk distance before and after surgery in favor of prehabilitation participants [10]. However, no differences were found in Clavien-Dindo grade ≥ 3 postoperative complications, length of hospital stay (LOS), 30-day visits to the emergency department, or hospital readmissions between prehabilitation and usual care participants [10]. According to the authors of this meta-analysis, the benefits of prehabilitation may have been blunted by the inclusion of younger and more fit patients, as clinically significant improvements may be harder to detect in this population, emphasizing the need to focus on frail older adults [10].

The effects of prehabilitation appear to be more pronounced in frail older adults with cancer than their more fit counterparts of the same age. Another meta-analysis of nine RCTs consisting of $n = 1313$ *frail* older adults undergoing elective cancer surgery (mean/median age $\geq$ 65 years) found significantly fewer total and severe postoperative complications, shorter LOS, and lower 30-day postoperative mortality rates in favor of prehabilitation participants compared to controls [9]. However, no significant between-group differences were found for hospital readmissions within 30 days and three months after surgery or three-month mortality [9]. Further meta-analytic data in frail older adults (mean/median age $\geq$ 65 years) awaiting colorectal cancer surgery demonstrated fewer postoperative complications and a shorter LOS after prehabilitation compared to usual care [8]. Notably, prehabilitation in five of the six studies of this meta-analysis was unimodal, consisting of aerobic training alone or combined with resistance training [8]. A more recent meta-analysis of 16 studies, of which 14 included frail patients (mean/median age $\geq$ 65 years) undergoing major abdominal cancer surgery, demonstrated better preoperative functional capacity, a one-day reduction in LOS, and less severe postoperative complications in prehabilitation participants compared to controls [11].

The current state of the literature suggests that prehabilitation can lead to clinical benefits in older adults undergoing cancer surgery, particularly those who are frail [8,9,11]. Given the lack of formal guidelines for prehabilitation programming in geriatric oncology, important questions arise when creating a prehabilitation intervention for older adults with cancer. These pertain to parameters including the duration of prehabilitation, the exercise prescription, the types of dietary interventions, and the necessity of psychological strategies prior to cancer-related treatments. Below, we summarize the components of prehabilitation interventions used in geriatric oncology.

3. Core Components of Prehabilitation Programs in Older Adults with Cancer

There is no consensus on the optimal duration of a prehabilitation intervention – evidence supports at least 3–4 weeks. Short-term prehabilitation (i.e., $\leq$3 weeks) may lead to improved postoperative outcomes compared to usual care, but further research is warranted due to conflicting findings [12,13]. The Frequency, Intensity, Time, and Type (FITT) principles of the preoperative exercise program should be individualized based on the unique needs and physical fitness of each older adult. For example, core strengthening is a critical type of exercise for those preparing for major abdominal surgery. Most studies in patients (mean/median age $\geq$ 65 years) awaiting cancer surgery used a combined aerobic and resistance training intervention with sessions three to five days per week [8–11]. The intensity during aerobic and resistance training was moderate to vigorous [8–11]. Aerobic exercise intensity was determined/monitored using participants' heart rate reserve (HRR), maximum heart rate (HRmax), and/or their rate of perceived exertion (RPE), while resistance exercise intensity was determined based on participants' one-repetition maximum or RPE [8–11]. Most studies prescribed aerobic training for 15–30 min and resistance training for 20–30 min per session. Types of aerobic exercises included brisk walking, jogging, cycling on a recumbent cycle ergometer, and swimming. Resistance training involved elastic bands, body weight exercises, and strength training machines [8–11]. Exercise guidelines for individuals with geriatric syndromes (e.g., frailty and sarcopenia) [14] and cancer survivors [15] are also available for clinician use. In addition to exercise training, personalized dietary and psychological interventions can better prepare the older adult to withstand the physiological – and often psychological – stress induced by surgery and other cancer treatments. To optimize nutrition, most studies in older adults prior to cancer surgery focused on education and/or provision of protein supplements to achieve 0.8–1.9 g of protein intake per kg of body weight per day [8–11]. Lastly, psychological support involved coping strategies and breathing exercises to address preoperative anxiety and depression, as well as counseling regarding smoking cessation and alcohol use [8–11].

Multimodal prehabilitation may not be feasible for all older adults awaiting cancer surgery or other treatments depending on their unique needs, the time until cancer treatment, and the available clinical resources. Geriatric assessment (GA) presents an excellent opportunity for clinicians to identify patients' needs in the context of prehabilitation, as discussed below.

4. The Role of Geriatric Assessment in Personalizing Prehabilitation Interventions

GA is best practice in geriatric oncology and is recommended for all older adults ($\geq$65 years) diagnosed with cancer. GA is the comprehensive and systematic set of standardized assessments designed to identify frailty and other deficits in health and wellbeing in the following aging-related domains: functional status, physical performance, nutrition, falls risk, cognitive function, mood, social support, comorbidities, and medication optimization [16,17]. According to Carli and Baldini, the assessment of these domains, in addition to the older adult's age, functional capacity, and surgical invasiveness, should be used in risk stratification prior to surgery in frail older patients [18]. A systematic review found that GA led to positive changes in the cancer treatment plan, promoted the integration of supportive care, improved provider-patient communication and goals-of-care conversations, and contributed to lower toxicity rates [19]. The heterogeneity in health, function, and wellbeing among older adults with cancer underscores the need for GA-based individualized care planning to optimize outcomes and prevent or

Table 1
Prehabilitation considerations based on impairments in geriatric assessment domains.

Geriatric Assessment domains	Recommended assessment tool (s)	Clinical cutoff for impairment	Referral considerations	Prehabilitation considerations
Functional status	ECOG PS Older Americans Resources and Services (OARS) Activities of Daily Living (ADL) and Instrumental ADL (IADL)	≥2 ≥1 ADL or IADL item as needing assistance or unable	Occupational Therapist (OT) Physiotherapist (PT)	Functional impairment correlates with increased risk of adverse postoperative outcomes and systemic anti-cancer treatment toxicity. OT/PT assessment and intervention with the aim of achieving a reduction in number of ADL/IADL items of dependency (i.e. increasing independence with daily activities), thereby facilitating participation in prehabilitation. OT can provide environmental assessment to allow for a more accessible home or work environment that supports daily activities.
Muscle strength and physical performance	Muscle strength: Grip strength test Physical performance: • Short Physical Performance Battery (SPPB) • Gait speed	Grip strength: EWGSOP2: • Men: <27 kg Women <16 kg FNIH: • Men: <26 kg Women: <16 kg SDOC: • Men: <35.5 kg Women: <20 kg SPPB: ≤9/12 Gait speed: <0.8 m/s	Qualified exercise professional (e.g., PT, Clinical Exercise Physiologist, Registered Kinesiologist)	Muscle strength and physical performance below clinical cutoffs may be suggestive of frailty and/or sarcopenia. Improvements in muscle strength and function with resistance training might be necessary for older patients with poor strength and physical performance prior to engaging in aerobic training. For patients with low muscle strength and physical performance, follow expert consensus exercise guidelines for older patients with geriatric syndromes [14]. For older patients who have the capacity to safely engage in a multimodal exercise program, aim to achieve the ACSM exercise guidelines for cancer survivors [15]. Start with low to moderate intensity then scale as tolerated per the principle of overload.
Nutrition	Mini Nutritional Assessment, including calf circumference	• Normal nutritional status: 24–30 • At risk: 17–23.5 • Malnourished: <17	Registered Dietitian	Interventions can include weight management to facilitate healthy, gradual weight loss while preserving lean mass or nutrition support to increase overall energy intake. Emphasis is placed on achieving sufficient protein intake to mitigate the risk of peri- and post-treatment complications as well as catabolism. Typically, protein recommendations in older adults range between 1.2 and 1.5 g/kg/d. However, in severe illness or marked malnutrition, recommendations could increase to 2 g/kg/d (where there are no renal issues). Correction of nutritional deficiencies and ensuring adequate hydration are also considerations, to maximise the success of other prehabilitation interventions.
Falls risk	Screening questions: Has fallen in the past year? Feels unsteady when standing or walking? Worries about falling.	Any positive answer leads to in-depth fall risk assessment	Geriatrician PT OT Clinical Exercise Physiologist, Registered Kinesiologist	Focus on improving lower body strength and function with resistance and functional exercises. Incorporate balance training and neuromotor exercises (e.g, Tai-Chi). Seated aerobic exercises are recommended (e.g., recumbent cycle ergometer). OT can provide an environmental assessment to remove objects that contribute to falls in the home or work environment.
Cognitive function	Mini-Cog Montreal cognitive assessment (MoCA)	<4/5 MoCA score < 26 points	Geriatrician, Geriatric Psychiatrist, Neurologist, Neuropsychologist, OT, Social Work, Nursing, Advanced Practice Nurse, Nurse Navigator	Older patients with severe cognitive impairment may not be able to participate in and adhere to a prehabilitation program. Simplify exercises for patients with mild cognitive impairment. Supervised exercise is recommended to ensure appropriate technique to minimize the risk of an injury while promoting intervention adherence. Offer metacognitive strategy training approaches, problem solving therapy, or behavioral activation to compensate for cognitive decline.

(*continued on next page*)

Table 1 (*continued*)

Geriatric Assessment domains	Recommended assessment tool (s)	Clinical cutoff for impairment	Referral considerations	Prehabilitation considerations
Mood	For depression: Geriatric Depression Scale-15 (GDS-15) Patient Health Questionnaire 9 (PHQ-9) For anxiety: Generalised Anxiety Disorder (GAD-7)	GDS-15: ≥5PHQ-9: ≥ 10GAD-7: ≥ 10	Psychologists, Psychiatry, OT	Clinically-relevant levels of anxiety and/or depression indicate the requirement for psychosocial support prior to cancer treatment. Coping strategies (e.g., cognitive restructuring, mindfulness, progressive muscle relaxation) and breathing exercises may reduce symptoms of pre-treatment anxiety and depression. Consider counseling regarding smoking cessation and alcohol reduction if necessary.
Social support	Medical outcomes study (MOS) social support survey (instrumental and emotional subscales). Social history including living conditions, marital status, educational level, financial resources, and caregiver burden.	If any of the following are selected for either scale: None, a little, some of the time	Social Work, Nurse Navigator, Social Prescribing, and other community programs	Understanding social needs may help to promote participation and adherence to prehabilitation. For example, factors related to transportation, costs, time, and safety at home, impact an older adult's ability to participate in exercise at a facility or at home. Caregivers should be considered in this phase to anticipate their needs and provide available supports.
Comorbidities	Cumulative Illness Rating Scale-Geriatric (CIRS-G) Charlson comorbidity index	At least one comorbidity rated ≥grade 3 (severe) Low: 0–1 Moderate 2–3 High ≥4	Various specialists, Primary Care, Pharmacist, Nursing	The presence and severity of comorbidities along with associated symptoms should inform exercise prescription based on established relative and absolute contraindications. The presence of chronic kidney disease should inform the daily recommended dose for protein.
Medication optimization	Brown bag review of all medications. Potentially Inappropriate Medication Use in Older Adults: Beers 2023 criteria Or STOPP/START V3 Drug-drug, drug-food, drug-drink and drug-disease interactions Iron deficiency supplementation (coefficient of transferrin saturation) with or without anemia (hemoglobin) +supplementation of other deficiency (B9 B12) Vitamin D deficiency	Clinician judgment. Discontinue the medications listed in the STOPP list, prescribe the recommended prescriptions according to the START criteria. Discontinue, when possible, the medication inducing major interaction detected on https://www.drugs.com/drug_interactions.html	Nurse practitioner, General Practitioner, Geriatrician and pharmacist	The objective is not to reduce polypharmacy but to improve the quality of prescription. Deprescribe, if possible, inappropriate medications, such as fall-risk-increasing drugs, such as benzodiazepines, antipsychotics, anticholinergics, and diuretics. These medications are also associated with postoperative delirium, increased length of stay, and unplanned readmissions. Intravenous (IV) Ferric carboxymaltose infusion supplementation when serum coefficient of transferrin saturation < 20 % Corrective vitamin D protocol with 50000UI/week for 4 weeks when 20–30 ng/ml, 8 weeks when <20 ng/ml.

ECOG PS= Eastern Cooperative Oncology Group Performance Status; EWGSOP2 = European Group on Sarcopenia in Older People 2; FNIH = Foundation for the National Institutes of Health; SDOC = Sarcopenia Definitions and Outcomes Consortium.

attenuate functional decline and frailty. Nonetheless, GA is not the standard of care in most oncology settings globally, highlighting the critical need for further work in GA implementation.

Although time constraints may prevent addressing every health deficit prior to treatment, GA can provide valuable information to a healthcare team for designing a prehabilitation intervention tailored to the needs of the older patient. The role of each GA domain in informing prehabilitation considerations is described in Table 1.

5. Barriers to Prehabilitation and Potential Solutions

Despite evidence supporting prehabilitation as an important supportive care intervention, its generalizability in older adults with cancer is variable. There are multi-level and intersectional barriers that influence access, delivery, and use of prehabilitation in geriatric oncology care [20,21]. Table 2 provides a comprehensive overview of the barriers at the patient, provider, and system levels.

Key barriers – awareness of prehabilitation, time constraints, service availability, and individual factors – often co-exist [20,21]. 'Awareness of prehabilitation' considers patient and provider knowledge and understanding of prehabilitation, their motivation to participate, and their underlying beliefs. 'Time constraints' refers to the capacity to schedule prehabilitation considering treatment initiation, competing appointments immediately following diagnosis, and the additional time burden it places on patients (e.g., travel, caregiver support) [22]. For older adults, initiating prehabilitation following diagnosis may be overwhelming considering the urgency to begin treatment and limited education on its benefits [20,21]. From a provider and system perspective, time to referral depends on adequate screening to identify priority patients in a timely manner, scheduling complexity, care coordination across multidisciplinary team members, and insurance coverage or preauthorization (if applicable). 'Service availability' impacts the patient, provider, and health system. Prehabilitation can be resource intensive for both the patient and health system in terms of time, cost, and availability across clinic locations. Prehabilitation services are not available in every cancer center or community clinic. Older adults and caregivers may be less willing to accept extensive commutes to services or use of telehealth-based prehabilitation services [21,23]. Furthermore, providers and health systems must weigh availability of prehabilitation workforce, location of services, mode of delivery, and scheduling availability to prioritize patients based on stage of diagnosis, baseline functional impairment levels, and waitlists [21,23]. Older adults with cancer may be disadvantaged in this prioritization process compared to younger patients due to ageism and ableism in cancer care [24]. 'Individual factors' relate to physical and psychological symptoms that may undermine the ability of older adults to participate in prehabilitation [20].

Overarching strategies (Table 2) to overcome barriers include: (1)

Table 2
Barriers and potential strategies to support access to and delivery of prehabilitation programs in older patients with cancer.

Barriers	Potential Solutions
Patient-Level	
Lack of or limited information, awareness, and knowledge about prehabilitation [23,25]	– Convey evidence that supports benefits of prehabilitation as an essential component of treatment plan (educational leaflet/booklet) – Individualize prehabilitation program with each patient – Physician-direct discussion about prehabilitation to reduce patient uncertainty
Individual factors (physical, psychosocial, personal) [20]	– Patient-reported outcomes and screening of social determinants of health to identify potential limiting physical or psychosocial limitations related to participation – Provider and caregiver (formal/informal) incentive support to reduce patient uncertainty and provide external motivation toward prehabilitation
Dependence on caregiver support	– Coordinate prehabilitation services on the same day as routine oncology care – Telehealth or hybrid appointment options
Cost Burden (Time and Financial) [20,25]	– Use of a financial navigator to project costs and identify supportive payment programming that would enable participation in prehabilitation services
Environmental Barriers [25]	– Coordinate prehabilitation services on the same day as routine oncology care – Physical co-location of prehabilitation services within medical, radiation, or surgical oncology clinics in addition to clinics in remote areas – Offer, if possible, telehealth-based interventions or hybrid appointment options – Development of a home-based prehabilitation program
Provider-Level	
Lack of awareness about services or benefit, and/or ageists attitudes [20,25]	– Convey evidence that supports benefits of prehabilitation as an essential component of treatment plan for older adults with cancer (educational leaflet/booklet) – Include prehabilitation providers in continuing education and presentations to tumor board teams and oncology clinics about prehabilitation services – Identification of clinician champion to advertise and support prehabilitation programming – Integrate standardized referral pathways for specialized prehabilitation programming – Establish a feedback loop from prehabilitation program to the providers to reiterate patient progress
Scheduling limitations [22]	– Coordinate prehabilitation services on the same day as routine oncology care – Offer telehealth or hybrid appointment options
Timing of Referral [20,22]	– Offer follow-up calls with nurse navigators following initial diagnostic appointment to allow patient time to process diagnosis – Consider complexity of medical scheduling and how it supports integrating prehabilitation opportunities. – Initiate pre-operative or pre-treatment multidisciplinary prehabilitation consultation meetings – Use prehabilitation assessment/outcomes to inform treatment planning/timing
Health System - Level	
Limited Evidence	– Adopt or implement evidence-based models that serve or mimic current care coordination at hospital center to support continuation of efficacious outcomes – Track patient-reported and quality care outcomes associated with prehabilitation program implementation to continuously develop evidence – Use of geriatric assessment to screen for and identify patients who would benefit from prehabilitation services
Lack of referral systems [1]	– Embedding electronic health record algorithms that support “one-click” referrals to programming – Active follow-up using patient-navigation or nurse navigation services
Insurance Limitations (Country – Specific) [25]	– Use of a financial navigator to project costs and identify supportive payment programming that would enable participation in prehabilitation services – Use of exercise oncology programs in a stepped care model – Physical co-location of prehabilitation services within inpatient and outpatient medical, radiation, or surgical oncology clinics
Limited health system or community-based programs [25]	– Should a hospital or clinic not be able to offer prehabilitation services specifically, development of materials that convey information about organizations, physical fitness gyms, and online services that can support patients in the community – Partnerships with Lifestyle Medicine to support delivery of health behavior interventions (e.g., smoking cessation, physical activity, diet and nutrition) – Adaptability of prehabilitation services to be unimodal or multimodal based on patient preference

education for patients, providers, and health systems on the benefits and utility of prehabilitation [25]; (2) physical co-location of prehabilitation and/or flexible delivery of services (telehealth, in-person, or hybrid approaches) [25]; and (3) systematic GA screening and triage for patients who would benefit the most. To successfully implement prehabilitation in geriatric oncology, we must demonstrate its value in aligning with patients' and providers' goals; we must also improve providers' motivation to refer to prehabilitation and patients' willingness to participate.

Accessibility of services (physical co-location or scheduling in tandem with other clinician appointments), adding telehealth or hybrid programming, and having a practice environment that eliminates multiple hospital visits and long-distance commutes may facilitate interest in and adherence to prehabilitation [23]. Finally, embedding GA driven-referral recommendations or systematic screening systems with clinical thresholds for prehabilitation into the clinical workflow or electronic health record systems will more readily identify prehabilitation needs and facilitate ease of referral.

6. Conclusion

Prehabilitation may improve postoperative outcomes, particularly in frail older adults with cancer. GA can be used to inform treatment decisions and personalized prehabilitation interventions based on the needs of older adults prior to cancer therapy. While prehabilitation may confer clinically relevant benefits, several barriers may hinder its implementation, underscoring the importance of identifying feasible strategies for enabling older patients to access and adhere to prehabilitation services. Future research should assess the feasibility and impact of prehabilitation during neoadjuvant treatment in older adults with cancer.

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