

## Cancer prehabilitation – a short review

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**Summary** Cancer prehabilitation uses the pretreatment time period to prevent a treatment-related functional decline and its subsequent consequences, and therefore occurs between the time of cancer diagnosis and the beginning of acute cancer treatment. This intervention has been shown to improve functional status, physical and psychological health outcomes and decrease overall health care costs. Currently there are several unimodal and one multimodal cancer prehabilitation regimens. Unimodal cancer prehabilitation includes exercise only, and multimodal cancer prehabilitation regimens are combinations of different interventions such as exercise, patient information and education, nutrition, psychologic counseling such as psycho-oncology, smoking cessation and reduction of alcohol consumption. Both approaches have the goal to improve physical capacity and mental health and to enable cancer patients to cope with the upcoming stress of the specific cancer-related treatment they need. Furthermore, cancer prehabilitation can support cancer patients to better participate in cancer rehabilitation after cancer treatment and maintain their ability to engage in premorbid activities. A growing body of scientific evidence confirms the importance of cancer prehabilitation. Further research is needed to study effectiveness and efficiency as well as clinical aspects of unimodal and multimodal cancer prehabilitation interventions.

**Keywords** Cancer · Prehabilitation · Exercise · Unimodal · Multimodal

### Background

During the last few decades, modern cancer treatment with increasing survival rates has put the focus on rehabilitation in cancer survivorship, and cancer rehabilitation has been shown to play an important role in the cancer care continuum by improving quality of life, functional performance, and participation [1, 2]. Within the cancer care continuum, cancer rehabilitation starts in most cases after cancer treatment. For the time period during cancer treatment, there are existing supportive strategies (perioperative therapy after surgery), which are so-called early rehabilitation strategies with the intention to mobilize patients and to improve their functional status at an early stage. Rehabilitation concepts for cancer patients are individual and include patient information, nutrition, psycho-oncology and physical modalities such as physiotherapy and exercise [1, 2].

Several years ago the term of “prehabilitation” was introduced to describe an intervention with the aim to support cancer patients in the pretreatment time period [3, 4]. Cancer prehabilitation is a kind of pretreatment regimen with the intention to improve the functional status of patients diagnosed with cancer, but before starting cancer treatment. It is therefore a quite modern strategy in the continuum of cancer care, with the aim of improving the ability of cancer patients to obtain necessary cancer treatment, but also to increase their compliance and adherence concerning all rehabilitation efforts during and after cancer treatment [3–6]. One definition of cancer prehabilitation is “identifying impairments and offering exercises aimed at strengthening and stabilizing potential at-risk organ systems prior to this treatment” [4]. It

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has also been described to be “a systematic process of improving the physical, psychosocial, and nutritional status of cancer patients between diagnosis and post treatment recovery to increase the ability to cope with the upcoming physiological stress of the specific cancer-related therapy” [4, 5]. This narrative, short review aims to give a survey about this quite modern intervention.

### Cancer prehabilitation within the cancer care continuum

Prehabilitation is an intervention that uses the pre-treatment time period to prevent or attenuate a treatment-related functional decline and its subsequent consequences [3–5]. Therefore, cancer prehabilitation occurs during the waiting period for testing and/or treatment before the onset of necessary cancer treatment. In this time period, namely after the diagnosis, a prehabilitation plan can be offered. This plan can include elements such as exercise, nutrition and dietary modification, mental stabilization, and other lifestyle modifications like smoking cessation and reduction of alcohol consumption [3–5]. After these interventions, cancer patients can reach a better functional status (such as endurance capacity, muscular strength, mental health) and can withstand any efforts during and after surgery, radiation, chemotherapy and/or modern oncological treatment better than cancer patients without cancer prehabilitation and thus with a poorer functional status [3–5].

Most prehabilitation exercise interventions aim to improve endurance capacity (cardiovascular health) and muscle strength before (and during) treatment and are mainly presurgical interventions [6–14]. Presurgery prehabilitation interventions have been the most commonly studied and have been shown to have several benefits for patients with different cancer entities [6–14]. Until now, the efficacy and benefits of cancer prehabilitation have been studied in several cancer survivor populations, and a way has been identified to reduce treatment-related morbidity, increase cancer treatment options, and improve physical and psychological health outcomes [3, 4, 6].

### Exercise and the two main approaches in cancer prehabilitation

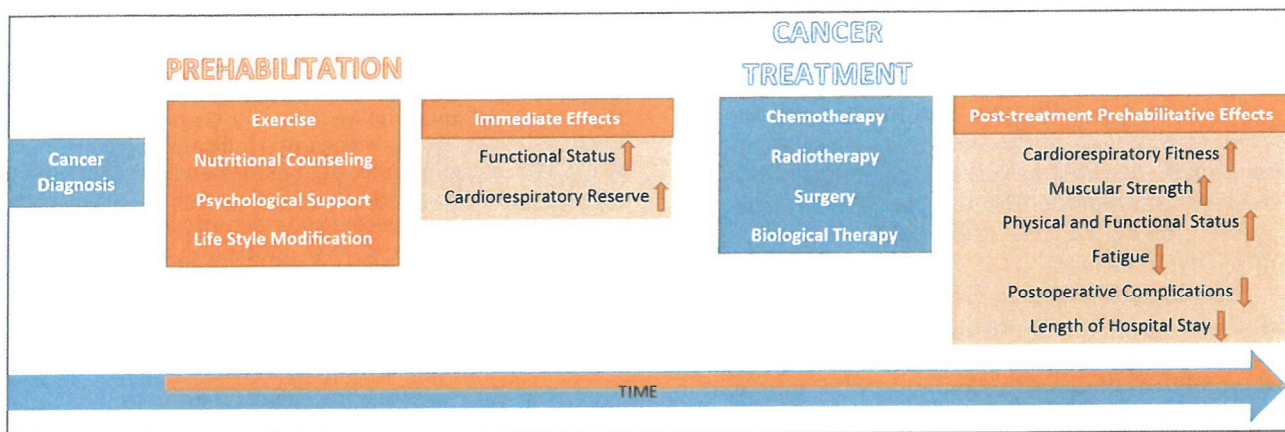
There are different prehabilitation regimens, but two typical cancer prehabilitation approaches, namely a unimodal and a multimodal cancer prehabilitation regimen [3–6]. Regular physical activity such as exercise is part of both approaches in prehabilitation and has been shown to be very relevant in the treatment and rehabilitation of cancer patients over the last 25 years [1, 2, 5, 15–19]. Exercise can improve functional health, which has positive effects on physical performance, mental health, and quality of life and—in some types of cancer—also on

survival [15, 16]. For cancer patients, individually tailored (targeted) exercise is safe and feasible, even in cases of complex health profiles [1, 2, 5, 15–19]. Therefore, most patients can benefit through exercise, regardless of individual circumstance (comorbidities, medications) or the burden of disease [1, 2, 5, 15–19]. Today, exercise can be seen as a kind of medicine in oncology [15, 16]. A multidisciplinary and multiprofessional approach is required, with all members of the team promoting physical activity to ensure that patients benefit from it [15, 16, 19]. It has been shown that most cancer patients can benefit from exercise and therefore should start to be physically active as soon as possible [1, 2, 15–19].

Unimodal cancer prehabilitation regimen, which consist of exercise only have been most frequently cited, showing effectiveness in reducing postoperative stress and complications, duration of hospital stay, and improving clinical outcomes by optimizing cardiopulmonary reserve prior to surgery [5–14, 20–23]. There is growing scientific evidence supporting the effects of exercise in cancer prehabilitation [5–14, 20–23]. Regarding exercise, it is important to mention that each patient has unique and individual comorbidities and individual physical performance capacity. Therefore, exercise has to be recommended on an individual basis to meet these specific needs [1, 2, 5, 19]. A thorough medical history, clinical examination, some laboratory parameters, ECG and echocardiograph findings, exercise testing, spirometry, and in some cases radiographic findings and bone scans are the basis for planning individual exercise programs for prehabilitation [1, 2, 5, 15, 16, 19]. Therefore, the exercise plan has to be based on an adequate baseline assessment, for example, exercise testing and echocardiography in endurance exercise. Furthermore, patients should be supervised during prehabilitative medical exercise. To our opinion, telerehabilitative (tele-prehabilitative) tools could also be very useful for monitoring patients—not only, but especially during the pandemic [1, 2, 5, 19].

Exercise aimed at strengthening skeletal muscles and to increase muscle mass, and exercise to increase endurance capacity have proven benefits for cancer patients [1, 2, 5, 15, 16, 19]. Endurance exercise, especially high-intensity interval training (HIIT, exercise) is a modern, promising option in the prehabilitation of cancer patients. HIIT seems to be safe and effective in rehabilitation but also during the pretreatment (prehabilitation) time period [5, 18].

In the field of cancer rehabilitation, there are existing tumor boards in order to plan rehabilitation and supportive strategies. Very challenging cases are discussed in an interdisciplinary and multiprofessional setting to determine whether they are able to perform exercises [1, 2, 19]. In our opinion, such an interdisciplinary and multiprofessional team process (a so-called “prehabilitation board”) could be an option to improve exercise interventions in prehabilita-



**Fig. 1** Prehabilitation in the cancer care continuum

tion. Such a prehabilitation board should define individual prehabilitation (especially exercise) concepts for “challenging” cancer patients with their individual functional deficits, medical conditions and risks. For patients who are not allowed to perform active exercise in the pretreatment time period (e.g., due to immobilization, severe cardiovascular comorbidity or very high risk of seizures or pathological fractures), neuromuscular electrical stimulation (NMES) seems to be a useful supportive treatment to increase muscular strength and endurance capacity prior to acute cancer treatment [1, 2, 19].

The second approach, the multimodal cancer prehabilitation regimen, represents a combination of treatments and consists of various parts such as patient education and information, exercise, nutrition, psychologic counseling such as psycho-oncology, smoking cessation and reduction of alcohol consumption. Most experts seem to prefer this multimodal approach. Nevertheless, there can be obstacles to applying the concept, such as urgency in cancer diagnosis and treatment [3, 4]. There are already opportunities to further improve access to and provision of multimodal prehabilitation concepts [3, 4, 6].

### Benefits and prescription of cancer prehabilitation

Cancer prehabilitation aims to prevent complications of necessary cancer treatment by applying exercise alone or using a multimodal strategy with a mix of exercise, patient education, psychologic counseling, nutrition, smoking cessation and reduction of alcohol consumption [3, 4, 6]. Once cancer has been diagnosed, the goal of cancer prehabilitation is to bring the functional status, namely physical capacity and mental health, to a higher level, which enables the patient to receive all necessary cancer treatments that are essential for cancer-specific survival [3, 4, 6]. Some examples are the reduction of pulmonary complications in postoperative patients with abdominal cancer, a reduced incidence of respiratory complications

and use of intercostal catheter, as well as a reduced length of hospital stay in lung cancer patients. In prostate cancer patients, a reduction of complications and postoperative incontinence following prostatectomy were found [5–14, 20–23]. It has been shown that prehabilitation improves chemotherapy dose tolerance in breast cancer patients with higher degree of chemotherapy completion [12, 13]. Furthermore, prehabilitation can lead to better mobility of the shoulder girdle with increased range of motion of the shoulder in breast cancer patients, which is necessary for the application of chemotherapy, and can lead to a better tolerance of radiation treatment [12, 13]. Fig. 1 shows several prehabilitative health effects which have already been observed in the oncological setting.

Prehabilitation also focuses on psychological issues such as limitations in everyday activities especially in male patients, anxiety and worries especially in female patients, as well as dysthymia and motivation problems [24].

Patient education and information, smoking cessation and alcohol reduction (better cessation) as additional prehabilitation modules aim to reduce risk factors in most cases of multimorbid patients [3, 4].

In addition, cancer prehabilitation offers the opportunity for cancer patients to become proactive during the pretreatment time period in order to improve their own physical and psychological health outcomes [4].

There are two different approaches, both including exercise with the aim to improve physical capacity and mental health and to enable cancer patients to cope with the upcoming stress of the necessary specific cancer-related treatment strategies. In addition, cancer prehabilitation supports cancer patients to participate more easily in cancer rehabilitation after cancer treatment and to preserve their ability to engage in pre-morbid activities. For the future, optimal prescription and implementation of prehabilitation interventions have to be determined for daily clinical routine. These prehabilitation interventions will vary for the different cancer entities, stages and their consequent cancer treatments. Furthermore, there will be differ-

ences regarding the included modalities and the duration of the individual prehabilitation regimen during the individual pretreatment time period.

However, depending on the duration of the prehabilitative phase, it should be kept in mind that the growth of the respective cancer manifestations is closely monitored. The resectability of aggressive, rapidly growing cancers must not be jeopardized by supportive measures.

Thus, in addition to an improved functional status, which leads to better effectiveness of the necessary cancer treatments, an improvement in mental health and quality of life, a reduction in morbidity (and mortality), and reduced health care costs can be seen as further expected benefits of cancer prehabilitation in cancer patients [3, 4, 6]. Nevertheless, there is a kind of selection bias, namely the application of the intervention in the “better off” subpopulation which seems to be typical for all exercise interventions in prehabilitation but also in rehabilitation.

## Conclusions

Cancer rehabilitation is the process in the continuum of cancer care that occurs between the time cancer is diagnosed and the onset of (acute) cancer treatment. Cancer prehabilitation programs have been shown to be able to improve functional status, physical and psychological health outcomes, and reduce overall health care costs. A growing body of scientific evidence confirms the importance of cancer prehabilitation. Nevertheless, further research is urgently needed on (1) effectiveness and efficiency and clinical aspects of exercise (training) recommendations (and the various other components of the multidimensional approach to cancer rehabilitation), (2) effectiveness and efficiency and clinical aspects of holistic and comprehensive multimodal cancer rehabilitation, (3) strategies for handling of barriers, and (4) the way in which widespread interdisciplinary and multi-professional of cancer prehabilitation is implemented (including tele-prehabilitative measures).

## Take home message

Cancer prehabilitation uses the pretreatment time period to prevent a treatment-related functional decline and its subsequent consequences, and has been shown to be able to improve functional status and physical and psychological health outcomes. Furthermore, it seems to be a good basis for later (early and posttreatment) rehabilitation.

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