

Review

# Evaluation and outcome of behavioural changes in the rehabilitation of cancer patients: a review<sup>☆</sup>

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## Abstract

The global increase in the number of newly diagnosed cancers has led in most affected countries to increased numbers of cancer survivors, who have specific needs for physical and psychosocial rehabilitation. In spite of recent progress, little is known about the specific rehabilitation measures that could increase the quality of life for cancer survivors. We reviewed published interventions that focussed on changing known risk factors for cancer recurrence and improving physical well-being; those we selected were exercise, smoking, alcohol consumption, diet and the use of sun screens. The published trials varied in the quality of the methods used, often had inadequate sample sizes and showed difficulty in validating outcomes. We conclude that there is still insufficient evidence to assess the importance of these behavioural risk factors in the rehabilitation of cancer patients. Future interventions should be designed to assess the separate effects of dietary changes, exercise and psychosocial interventions.

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**Keywords:** Cancer; Rehabilitation; Exercise; Smoking; Alcohol consumption; Diet; Sun screens

## 1. Introduction

Cancer is diagnosed in more than 10 million persons throughout the world each year, and the World Health Organisation has predicted that this number may increase by as much as 50% over the next 20 years. As detection and cure rates are also improving steadily, a further increase in the life expectancy of patients with newly diagnosed cancer – and hence a larger number of cancer survivors – can be predicted [1,2]. The 5-year survival rates are greater than 75% in most developed countries [3], and, in the United States of America (USA) alone, up to 9 million people have lived with cancer for 5 years or more [4]. Such increases in the size of the ‘survivor’ group mean that cancer must now be man-

aged as a chronic disease, and the community must be taught to adapt treatment for long- and short-term survivors.

Cancer survivors face a diversity of physical and emotional sequelae, of which the most important include the recurrence of cancer, decreased quality of life and psychosocial effects after treatment. These side-effects are more and more commonly addressed through physical and psychosocial rehabilitation. In 1978, Lehman and colleagues [5] stated that up to 59% of cancer patients might have impairments or limitations that could potentially be improved by rehabilitation. Today, it is difficult to estimate how many cancer patients require rehabilitation, as there are large national and international differences in the timing and type of rehabilitation offered. Nevertheless, it is generally accepted that any form of rehabilitation is likely to have positive effects on psychological and physical problems in cancer patients e.g. [6,7]. Apart from the obvious gains for the

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patient, cancer rehabilitation can also be important in socioeconomic terms, by reducing demands on health system resources and increasing the working population.

In the past, rehabilitation was targeted mainly at cancer patients with visible disabilities. However, research since the early 1970s has shown that even patients without physiological effects are preoccupied about their disease and future health [8], often leading to psychological disturbances [9]. Rehabilitation has many aspects, ranging from psychosocial interventions to more concrete forms, such as lifestyle changes. Ideally, they should be combined or targeted to specific patient needs in order to achieve the major goal: restoration of vocational, social, familial and sexual life, primarily through self-help programmes [10].

Optimising life after a diagnosis of cancer and treatment has become a significant subject of research, but knowledge about how to streamline post-treatment opportunities and tailor rehabilitation to patients' needs is still lacking. A common problem with regard to cancer survivors is identifying behavioural risk factors related to the cancer and finding ways to modify their behaviour after diagnosis. We sought to identify rehabilitation measures that might reduce the risk for cancer recurrence and possibly increase survival. This was done by reviewing intervention studies conducted among cancer patients and survivors that focussed on behaviour patterns known to be related to the risk for cancer: exercise, smoking, alcohol consumption, diet and use of sun screens.

## 2. Patients and methods

We searched PubMed for studies published in English since January 1975 to April 2004 in which interventions of changes in exercise, smoking, diet, alcohol and sun screens in cancer survivors (or patients) were investigated. Although interventions with a psychosocial outcome are highly relevant to this article, they were not included in the search as they have already been reviewed extensively elsewhere in references [11–13].

For the search, the words *cancer*, *cancer rehabilitation* and *cancer survivor* were used in combination with *exercise*, *physical activity*, *smoking*, *tobacco*, *alcohol*, *diet*, *nutrition*, *sun*, *sun screen* and *solar radiation*. This strategy of mutually overlapping searches was used to ensure the widest possible coverage of the subject. For studies to be included in the review, they had to be intervention studies with a pre- and post-test design or case-control comparisons; all cross-sectional and retrospective studies were thus excluded. A second inclusion criterion was a sample size larger than 50. For interventions with respect to smoking, the sample size was lowered to 20, as there was only one trial with a sample size greater than 50.

The original search identified 90 853 references based on keywords alone. Of these, only 69 studies were interventions in the areas of interest. A total of 27 studies fulfilled the sample size criterion, but four of these were interventions in people without cancer and were subsequently dropped from the review.

## 3. Results

### 3.1. Exercise

Exercise is considered to be highly effective in relieving side-effects of cancer such as mood swings, weight gain, sleep problems, poor body image and fatigue [14–16]. In populations other than cancer patients, exercise has been shown to have a positive effect against anxiety, depression and self-image e.g. [17,18], probably through a combination of direct and psychological effects.

The primary literature search revealed 37 interventions with exercise in cancer patients. Of these, only eight fulfilled the second selection criterion (Table 1), and 78% of the studies identified had less-than-optimal sample sizes. For instance, although Mock and colleagues [19] reported decreased anxiety, depression, fatigue and nausea among patients who participated in a structured exercise programme, the sample of only nine cases and five controls is much too small to derive statistically valid results. A similar problem was found in other published trials e.g. [20,21]. Other common disadvantages were a lack of randomisation, a too short or non-existent follow-up period [22] or no control groups [23].

When considering the trials reviewed (Table 1), patients in the intervention groups seem to experience reduced distress and improved well-being. However, in these studies it is difficult to quantify the exercise dose and also to attribute the observed effects to exercise alone, making it difficult to properly evaluate the outcome. We conclude that the evidence for the beneficial effect of exercise on cancer survivors is still patchy and the subject needs further investigation.

### 3.2. Diet

The link between cancer and dietary habits has been the subject of much interest over the past few decades. Much of the published literature has focussed on the prevention of cancer through changes in diet, such as eating more fresh fruit and vegetables and less saturated lipids and alcohol [26]. If these lifestyle factors have an impact on the initial development of cancer, they will probably also affect the adjustment and survival of cancer patients.

Table 1  
Studies that assessed the outcomes of physical therapy interventions on cancer patients

Author [reference]	Sample size (cancer type)	Intervention	Outcome	Result (intervention <i>vs.</i> control)	Main limitations
Berglund and colleagues [24,25]	199 (mainly breast)	Physical training, information and coping	Mood, physical strength and activity	Improved physical strength, decreased sleeping problems and body avoidance, increased fighting spirit	Difficult to evaluate effect of exercise only
Courneya and colleagues [63]	108 (mainly breast)	Home-based moderate-intensity exercise	Physical fitness and quality of life	Increased functional well-being and quality of life and decreased fatigue	Difficult to quantify exercise dose
Courneya and colleagues [67]	102 (colorectal)	Home-based moderate intensity exercise	Physical fitness and quality of life	Increased quality of life	Contamination in control group
Berglund and colleagues [68]	60 (mainly breast cancer)	Physical training, information and coping	Anxiety, depression, physical strength and problems	Increased satisfaction, physical training and social activities	Non-randomised
Dimeo and colleagues [66]	59 (various)	Cycle ergometer training	Psychological distress and fatigue	Improvement in several scores of psychological distress, decreased fatigue	Non-randomised
Courneya and colleagues [62]	52 (breast)	Cycle ergometer training	Peak oxygen consumption and quality of life	Increased peak oxygen consumption and overall quality of life	Small sample size
Pickett and colleagues [64]	52 (breast)	Home-based brisk walking exercise	Self-reported activity levels and occurrence of side-effects	No significant differences	Self-evaluation of outcomes
Mock and colleagues [65]	52 (breast)	Home-based moderate walking exercise	Symptoms, physical function and quality of life	Less fatigue and emotional distress, higher functional ability and quality of life	Difficult to quantify exact exercise dose

In spite of the attention that has been paid to the subject, the literature search identified only six intervention studies of dietary patterns that met the inclusion criteria for this review (Table 2). All the trials were conducted in women with breast cancer and were designed to examine the impact of instruction in 'healthy eating'. The results generally suggest that dietary counselling can lead to significant changes in the consumption of vegetables, fruit, fibre and fats [27–29]. Although this observation is encouraging, the studies reviewed mostly relied on self-reported assessments which are subject to bias. Additionally, no evidence was reported for an effect on cancer recurrence or patient survival, which are the main outcomes of interest for interventions of this type. A longer follow-up period would be needed in order to detect the occurrence of residual cancer or death.

However, an effect of nutritional changes on cancer recurrence and patient survival can be inferred from observational studies. For instance, Ingram and colleagues [30] found a positive relationship between fruit and vegetable consumption and the prognosis of recurrent cancer, and higher intakes of  $\beta$ -carotene and fibre have been associated with reductions in breast cancer

recurrence [31,32]. The large-scale Women's Healthy Eating and Living study in North America should allow an assessment of the effects of dietary changes on breast cancer recurrence, owing to the size of the study population and the sound randomised controlled design [29]. Long-term follow-up results are expected in late 2006.

### 3.3. Smoking

There is convincing evidence that smokers have significantly increased risks for developing cancers at various sites [33] as well as other major health problems. Smoking rates among patients with smoking-related cancers are much higher than among other cancer patients; for instance, 95–99% of lung cancer patients have a history of smoking [34]. It has been demonstrated repeatedly that former smokers have a significantly lower risk for cancer than subjects who still smoke e.g. [35,36], and further evidence suggests that patients are less likely to experience a recurrence of cancer if they stop smoking [37]. Other studies have found no difference in smoking rates between cancer survivors and subjects without cancer e.g. [38,39], suggesting that smoking continues to be

Table 2  
Studies that assessed the outcomes of dietary interventions on breast cancer patients

Author [reference]	Sample size (cancer type)	Intervention	Outcome	Result (intervention <i>vs.</i> control group)	Main limitations
Pierce and colleagues [69]	2970 (breast)	Individual telephone counselling	Self-reported dietary assessments and plasma carotenoid concentration	Increased fruit, vegetable and fibre intake. Decreased fat intake. Increased plasma carotenoids.	Self-reported dietary assessments may be subject to bias
Rock and colleagues [70]	393 (breast)	Individual telephone counselling	Self-reported dietary assessments and plasma concentrations of lipids, cholesterol and apoproteins	Decreased fat intake; increased carbohydrate and fibre intake (self-reported) Decreased HDL cholesterol and apoprotein-A1	Self-reported dietary assessments may be subject to bias However, these are confirmed by the lipid responses
Chlebowski and colleagues [71]	290 (breast)	Individual dietary instruction	Dietary assessments, serum, lipids, anthropometric data	Reduced fat intake, weight loss	
Kristal and colleagues [72]	144 (breast)	Individual and group dietary counselling	Dietary assessments, body weight	Decreased fat intake, increased carbohydrate intake and weight loss	No control for exercise
Pierce and colleagues [28]	93 (breast)	Individual dietary counselling	Dietary assessments, serum, lipids, anthropometric data	Increased vegetable, fruit and fibre intake; increased carotene intake	Large loss to follow-up
Nordevang and colleagues [27]	240 (breast)	Individual dietary counselling	Dietary assessments	Reduced fat intake, increased vegetable and fruit intake	Bias possible Only 2% of intervention group completed 2-years of follow-up

HDL, high density lipoprotein.

a problem for adult cancer survivors [40,41]. However, several studies on adolescent cancer survivors have shown low frequencies of 'risky' behaviour, such as smoking and alcohol consumption [42,43], in comparison with the general adolescent population.

The literature review identified seven studies of the effect of smoking cessation on cancer patients (Table 3). The sample size was greater than 50 in only four, and two studies did not include smoking habits as an outcome, but rather measured intention or motivation to stop smoking [44,45]. None of the studies showed a significant difference in abstinence between the control and intervention groups. Tyc and colleagues [44] reported less intention to smoke in the intervention group, but – as in all of the studies reviewed – the finding was based of self-reported assessments, which may have resulted in bias. Overall, the

findings either confirm the earlier observation that cancer survivors do not quit smoking or reflected the fact that most of the trials had inadequate sample sizes, leading to inconclusive results [38].

### 3.4. Alcohol

Excess alcohol consumption has been associated with multiple diseases and, in particular, cancers at a range of sites, such as the oral cavity, oesophagus, bowel, liver, larynx, colon-rectum and breast [46,47]. The most reliable evidence is based on correlations between alcohol consumption and breast cancer incidence in observational studies e.g. [48,49], in which high intake of alcohol was related to an enhanced risk for breast cancer, regardless of smoking status, parity and other known risk factors. As for smoking, it has been shown that only

Table 3  
Studies that assessed the outcomes of smoking interventions in cancer patients

Author [reference]	Sample size (cancer type)	Intervention	Outcome	Result (intervention <i>vs.</i> control group)	Main limitations
Gritz and colleagues [77]	186 (head and neck)	Smoking cessation counselling	Point prevalence smoking, abstinence, cotinine confirmation	No difference	Inclusion of recent ex-smokers in treatment group could have diluted effect
Tyc and colleagues [44]	103 adolescents (various cancers)	Advice about risks of smoking, counselling, goal setting, video demonstrations	Self-reported knowledge, perceived vulnerability and intentions	More knowledge, less intention to smoke.	Self-reported assessment may cause bias No actual measure of smoking habits
Gritz and colleagues [73]	105 (head and neck)	Smoking cessation counselling	Self-reported measures of quality of life	No difference	Unreliable self-reported measures
Hollen and colleagues [45]	64 adolescents (various cancers)	Workshop on survivorship, decision-making, risky behaviour and social support	Decision-making, risk motivation, risky behaviour	No effect on smoking motivation	No actual measure of smoking habits Programme not focussed on smoking cessation only
Wevers and colleagues [76]	30 (various cancers)	Smoking cessation counselling and phone calls	Self-reported abstinence, cotinine confirmation	No difference	Small sample, no long-term follow-up (5–6 weeks)
Griebel and colleagues [74]	28 (various cancers)	Smoking cessation counselling and phone calls	Self-reported abstinence, cotinine confirmation	No difference	Small sample, no long-term follow-up (6 weeks)
Stanislaw and Wevers [75]	26 (various cancers)	Smoking cessation counselling and phone calls	Self-reported abstinence, cotinine confirmation	No difference	Small sample, no long-term follow-up (5 weeks)

Table 4  
Studies that assessed the outcomes of interventions in sun-seeking behaviour on cancer patients

Author [reference]	Sample size (cancer type)	Intervention	Outcome	Result (intervention vs. control group)	Main limitations
Robinson and Rademaker [53]	61 (basal cell carcinoma)	Isotretinoin and recommendations on sun protection	Skin examinations, sun exposure (self-assessed or recalled)	Significantly lower sun exposure and new carcinomas	Difficult to validate sun exposure; controls might have used additional sun screen

a relatively small proportion of adult cancer patients reduce their alcohol intake after diagnosis and completed treatment; however, again there is some suggestion that adolescent cancer survivors are more prepared to modify their alcohol consumption [39].

The literature search identified no intervention trials in adult cancer patients focussed solely on alcohol consumption. One study was identified in which the effect of smoking and alcohol cessation advice was measured in 64 adolescent cancer survivors [45]. The authors concluded that the intervention with regard to alcohol use was significantly effective after 1 month and marginally effective after 6 months. Thus, interventions to reduce alcohol consumption might be more effective in younger cancer survivors, but the effect on cancer recurrence and survival remains unclear.

### 3.5. Sun screens

The incidence of the most common forms of skin cancer is significantly linked to excess solar exposure, probably because strong ultraviolet radiation damages human DNA [50]. A number of attempts have been made to examine the relationship between sun protection measures and the risks for the three major forms of skin cancer: basal cell carcinoma, squamous cell carcinoma and melanoma. There is convincing evidence that applying sun lotion can reduce the risks for basal cell and squamous cell carcinoma, but not those for melanoma [51,52].

The literature search identified four relevant studies on the effect of sun screen application on the appearance of new skin lesions [51,53,78,79], but only one was conducted in patients in whom cancer had already been diagnosed (Table 4). Trials in persons without cancer showed that application of sun screen significantly reduced the emergence of benign and malignant skin lesions and this was confirmed in the study on cancer patients. The main limitation with such trials are the difficulty to validate self-reported sun exposure and controlling for the potential sun screen use in the control group. On the basis of these results, we suggest that information on sun screen application should be included in cancer rehabilitation to reduce the risk for further lesions and that more intensive research is needed before proper guidelines can be developed.

## 4. Discussion and conclusions

The rapid but short-lived success of the Cancer Rehabilitation Planning Report and associated rehabilitation programmes in the USA in the 1970s [54] taught us a number of important lessons. These are used today in the nationwide programmes in Germany and the USA,

where most cancer patients are offered rehabilitation after diagnosis or completed treatment [55,56]. In other parts of the world, rehabilitation consists of single government- or institution-funded programmes, which are offered as a standard to cancer patients only occasionally [57,58]. This review showed that, in spite of the existence of these large rehabilitation programmes, which could potentially provide a large pool of data, there has been little scientific verification of the effects of specific lifestyle changes for cancer patients. The literature suggests that the benefits might include prolonged survival, lower prevalences of anxiety and depression and an overall improvement in the quality of life [11,16], but more large studies conducted with sound methods are needed [13]. An important lesson for the future is to study more varied cancer populations, as most published results focus on breast cancer patients.

Numerous suggestions have been published for the optimal design of psychosocial and physical rehabilitation intervention trials. It would be important to assess the types of rehabilitation offered (e.g. education *vs.* behavioural training), and it is our view that standardised guidelines are needed for the approaches most suitable for certain groups of patients. With regard to the overall design of the trials, the most important points are (1) preliminary screening of eligible patients, (2) randomised allocation to intervention or control group and (3) use of a suitably long follow-up period.

Pre-screening of patients to determine whether they need psychosocial or physical rehabilitation is a relatively new topic [38,13]. Such selection could identify the patients on whom the greatest impact could be made and thus enhance the observed effects on variables of interest. Many of the published interventions failed to demonstrate an effect of rehabilitation, despite adequate sample sizes and sound methods. Selection strategies could be based on published indications of adjustment to cancer in different patient groups. For instance, a history of psychiatric disturbance has been reported to predict poor psychological adjustment to cancer [59], and factors such as age, socioeconomic status and extent of social network have been found to be important in determining how patients adapt to their disease [11,59].

Another important focus for future studies is the perennity of the effects of rehabilitation. In one study, although patients reported significant benefits at the end of a rehabilitation programme, their functional and psychological well-being had returned to pre-rehabilitation levels 6 months later [56]. Thus, a follow-up period of at least 6 months should be included to detect such changes as this would also enable us to more confidently assess the risks of recurrence. Post-rehabilitation back-up could be provided, in the form of support groups connected via telephone, mail or the Internet [60].

Cancer patients should thus make limited or significant lifestyle changes, depending on the diagnosis and individual factors, to decrease the risk for cancer recurrence and probably increase their survival. Up to 50% of breast cancer survivors believed that diet and a healthy lifestyle were responsible for the absence of cancer recurrence [61]. It is highly likely that dietary rehabilitation and cessation of smoking and alcohol consumption are beneficial, not only by directly reducing mortality and the risk for recurrence, but also by improving the psychological well-being of patients, who know that they are doing something positive to adjust and regain control over their lives.

As for other aspects of cancer rehabilitation, more studies are needed to demonstrate an effect of lifestyle changes on adjustment by cancer survivors. Trials should be designed to assess the separate effects of dietary changes, exercise and psychosocial interventions, preferably also in populations other than breast cancer patients. The results should provide further guidance for optimal cancer rehabilitation programmes.

### Conflict of interest statement

None declared.

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