

## Physical activity among cancer survivors: a literature review

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### Abstract

**Aim** Physical activity offers a variety of health benefits to cancer survivors, both during and post-treatment. The aim here is to review: the preferences of cancer survivors regarding exercise counselling and participation in a physical activity programme; adherence rates among cancer survivors to physical activity programmes; and predictors of adherence to exercise training.

**Methods** Two electronic databases, Ovid MEDLINE(R) 1950 to Present with Daily Update and SCOPUS, were used to undertake literature searches for studies examining exercise preferences of adult cancer survivors, and physical activity programmes for adults at any point of the cancer trajectory.

**Results** Studies suggest that, while physical activity levels are low among cancer survivors, most are interested in increasing their participation. Preferences and adherence to physical activity programmes differ across a range of demographic, medical, and behavioural variables, suggesting the importance of tailoring exercise programmes to patient-specific and disease-specific needs.

**Conclusions** Current evidence supports the benefits of physical activity for improving risk factors associated with cancer prognosis. Physical activity programmes developed for oncology patients and cancer survivors need to take into account the needs of the target population in order to optimise adherence, outcomes, and long-term behavioural changes in this population.

### Impact of cancer in New Zealand

Cancer is a major public health problem in New Zealand with approximately 19,000 new cases diagnosed annually.<sup>1</sup> In 2005, the age-standardised incidence of cancer was 340.3 cases per 100,000 persons, with the highest incidence recorded for Pacific males (389.3 cases per 100,000), and the lowest for non-Māori, non-Pacific females (308.1 cases per 100,000).<sup>1</sup> The cancers of breast; colorectum and anus; prostate; malignant melanoma of skin; and trachea, bronchus and lung are the most common cancers in New Zealand accounting for 61% of the incident cancers.<sup>1</sup>

Although cancer remains the leading cause of death in New Zealand, accounting for a third of all deaths,<sup>1</sup> survival rates have improved over the last two decades.<sup>2</sup> The overall cumulative relative 5-year survival rate across all cancers and all disease stages is currently estimated at 61%,<sup>3</sup> although the chances of survival are greater if diagnosed with early-stage disease.<sup>3</sup>

The number of survivors to 5 years in New Zealand is estimated to be approximately 60,000,<sup>3</sup> which represents 1.5% of the New Zealand population. Continued advances in early diagnosis and treatment are likely to further increase the number of cancer survivors.

As the population of cancer survivors in New Zealand grows, it is important to acknowledge that surviving cancer is associated with several distinct health issues. Compared with persons who have not had cancer, cancer survivors have an increased lifetime risk of developing new primary cancers,<sup>4-6</sup> cardiovascular disease,<sup>6-9</sup> diabetes,<sup>8,9</sup> osteoporosis,<sup>10</sup> and functional decline.<sup>8,11,12</sup>

Furthermore, the risk of cancer recurrence is high among cancer survivors.<sup>13-18</sup> These risks are believed to result from cancer treatment, genetic predisposition, or common lifestyle factors.<sup>11,19-21</sup> Most of these adverse physiological and quality of life outcomes can be reduced by healthy lifestyle practices, including regular exercise.<sup>8,9</sup>

## Physical activity

Despite methodological limitations and modest sample sizes, existing evidence strongly suggests that physical activity both during and post-treatment can improve cardio-respiratory fitness,<sup>22-26</sup> flexibility,<sup>12</sup> muscular strength,<sup>26</sup> physiological outcomes,<sup>22</sup> vigour,<sup>22,26</sup> cancer-related fatigue<sup>23,26-30</sup> and other cancer-related symptoms,<sup>22,28</sup> nausea,<sup>12</sup> physical well-being,<sup>12</sup> physical functioning,<sup>23,26,28,30</sup> anxiety,<sup>12</sup> and overall quality of life.<sup>12,23,25,30,31</sup> Furthermore, physical activity appears to minimise functional decline in cancer survivors,<sup>32</sup> improve immune system function,<sup>33</sup> maintain or minimise bone loss,<sup>34,35</sup> and reduce cancer-related chronic diseases.<sup>8,9</sup>

Evidence from prospective observational studies suggests that regular physical activity is associated with improved cancer prognosis, although data are few and limited to breast and colon cancer survivors. Specifically, breast cancer survivors who engage in at least 8–10 metabolic equivalent (MET)-hours a week of physical activity (approximately 3 hours of walking per week at a moderate pace) compared with less active survivors have a 40% to 50% reduced risk of death from breast cancer,<sup>36,37</sup> a 24% to 67% decreased risk of overall mortality,<sup>36-40</sup> and a 26% to 43% decreased risk of recurrence of breast cancer,<sup>37</sup> although this finding is not unanimous.<sup>40</sup>

Similarly, physically active colon cancer survivors (at least 9 MET-hours/week) appear to have a 43% to 61% lower risk of colon cancer mortality compared with less active survivors,<sup>41</sup> and a 29% to 63% lower risk of overall mortality.<sup>41,42</sup> Physical activity may also protect against the development of primary cancers,<sup>43</sup> although this is less clear in cancer survivors.

Physical activity has been shown to play a role in weight management as it appears to positively affect body composition<sup>12,24,28</sup> and facilitate weight loss<sup>44</sup> in oncology patients and cancer survivors. This is of importance because being overweight may increase the risk of cancer recurrence and decrease survival for many cancers.<sup>45-51</sup> Furthermore, recent results from some,<sup>50,52</sup> but not all,<sup>53</sup> large prospective studies have indicated that weight gain after cancer diagnosis may be associated with poorer prognosis.

Indeed, weight gain post-diagnosis in large cohorts of breast cancer survivors appeared to increase the risk of death from breast cancer by up to 78%,<sup>50,52</sup> and the risk of breast cancer recurrence by up to 53%.<sup>52</sup> Furthermore, for each 5-kg gain in weight, the risk of mortality from breast cancer may increase by 13%.<sup>50</sup> This is of particular concern because weight gain is common in breast cancer survivors.<sup>54-56</sup>

Whether weight reduction in overweight or obese cancer survivors would improve the disease outcomes is still under debate. Kroenke et al. and Nichols et al. found that post-diagnosis weight loss was not associated with breast cancer mortality<sup>50,52</sup> or recurrence<sup>52</sup> in breast cancer survivors.

In contrast, Caan et al. reported that breast cancer survivors who lost at least 10% of their body weight post-diagnosis had an increased risk of breast cancer recurrence, although this relationship was no longer significant once women who recurred within a year of study entry were removed from the analysis thus this finding should be interpreted with caution.<sup>53</sup> It is clear, however, that weight management via regular physical activity should be emphasised as a key part of the strategy to prevent the recurrence and cancer death in survivors.<sup>57</sup>

Preventing weight gain and achieving and maintaining a healthy weight in oncology patients and cancer survivors may also be important in reducing the risk for co-morbid conditions associated with excess weight for which this population is at particularly high risk.<sup>6-9</sup>

Physical activity may also reduce or avert cancer cachexia,<sup>58</sup> which is a common yet often undiagnosed multi-factorial syndrome that is characterised by loss of skeletal muscles and subcutaneous fat, fatigue, anorexia, abnormal metabolism, and decreased muscle strength.<sup>59,60</sup> Resistance exercise training in particular may attenuate or prevent muscle wasting in those affected by cancer cachexia, although the evidence for this is still limited.<sup>58,61-63</sup>

Several mechanisms have been proposed to explain the links between physical activity and cancer outcomes. Physical activity may improve cancer prognosis through reducing the amount of adipose tissue, which in turn may reduce circulating levels of sex hormones, decrease the production of inflammatory cytokines in adipose tissue, increase adiponectin levels, improve insulin resistance, reduce hyperinsulinaemia, and enhance immune function.<sup>64-66</sup>

Physical activity has also been shown to directly reduce systemic inflammation, improve immune function, reduce sex hormones production, improve insulin sensitivity and glycaemic control, thus positively affecting cancer prognosis without changes in body composition.<sup>64</sup>

## **Objectives**

Current evidence supports the benefits of physical activity for improving the risk factors associated with cancer prognosis. Therefore, for long-term cancer survivors, regular physical activity should be a priority to improve post-treatment quality of life and help reduce the risk of cancer recurrence, second primary cancers, chronic diseases, and cancer-related mortality and overall mortality. For interventions emphasising regular physical activity to be effective, however, the specific needs of this population must be considered.

The aim of this article is therefore to review the following:

- The preferences of cancer survivors regarding exercise counselling and participation in a physical activity programme;
- Adherence rates among cancer survivors to physical activity programmes; and
- Predictors of adherence to exercise training. Current availability of exercise counselling and programmes for oncology patients and cancer survivors is also briefly discussed.

## Methods

Two electronic databases, Ovid MEDLINE(R) 1950 to Present with Daily Update and SCOPUS, were used to undertake literature searches for studies examining exercise preferences of adult cancer survivors, and physical activity programmes for adults at any point of the cancer trajectory. The searches were conducted between 1 July 2009 and 1 December 2009. The terms used to identify relevant studies are shown in Table 1 below.

**Table 1. Summary of literature review strategy**

Keyword	Articles retrieved	
	Ovid MEDLINE(R)	SCOPUS
Neoplasm	217,040	1,581,834
Survivors	9,115	12,617
Exercise	49,100	209,656
Physical activity	57,571	67,057
Adult	3,301,584	4,358,443
Neoplasm AND Survivors AND Exercise	60	289
Neoplasm AND Survivors AND Exercise AND Adult	22	178
Neoplasm AND Survivors AND Physical activity	17	229
Neoplasm AND Survivors AND Physical activity AND Adult	9	162
Neoplasm AND Survivors AND (Exercise OR Physical activity)	76	400
Neoplasm AND Survivors AND (Exercise OR Physical activity) AND Adult	31	265

The searches were subsequently limited to studies published in the English language. In addition, reference lists of the retrieved original and review articles were searched in order to identify any other relevant studies.

## Exercise preferences of cancer survivors

Several cross-sectional studies have examined exercise preferences of cancer survivors across a range of cancer types.<sup>67-79</sup> Although cancer survivors were aware of the many benefits of being physically active,<sup>73,76,79</sup> their levels of physical activity decreased during cancer treatment and remained low following treatment.<sup>69,70,74-79</sup>

Indeed, although 34–42% of survivors reported to engage in at least 150 minutes of moderate-to-vigorous activity before diagnosis,<sup>70,78</sup> only 7–16% retained this level of activity during treatment,<sup>69,78</sup> and 19–41% post-treatment.<sup>70,74,75,77,78</sup> Furthermore, 31–54% of survivors reported to be sedentary and not to engage in any type of physical activities.<sup>67,70,74,75,77</sup>

In female breast cancer survivors, this low participation in physical activities was due to soreness after surgery, lack of motivation, cost, work responsibilities, family commitments, health-related barriers (e.g., side effects from medication, other illness), psychological barriers (e.g., self-consciousness due to surgery), and uncertainty about which types of exercise were safe, and when it was safe to return to physical activity.<sup>73,76,79</sup>

Despite this apparent lack of engagement in physical activity, most studies reported that an overwhelming majority of cancer survivors would have liked to receive exercise counselling or information about participating in an exercise programme at some stage during their cancer experience.<sup>67,69–72,74,75,77,78</sup>

Furthermore, many cancer survivors felt that they should receive exercise counselling from either an exercise specialist or from a health professional such as a nurse, physician, or an oncologist,<sup>69,71,72,74–76,79</sup> and that face-to-face counselling was the preferred mode of counselling.<sup>69,71,72,74,75</sup> Moreover, most survivors indicated that they were interested in an exercise programme,<sup>67,71,72,74,75,77,78</sup> were able to participate in such a programme,<sup>70–72,74,75,77,78</sup> and most would have preferred to initiate an exercise programme after treatment.<sup>69–72,77,78</sup>

A high proportion of cancer survivors, regardless of the type of cancer they had, indicated that they would have preferred to exercise in the morning,<sup>69,71,72,74,75,77,78</sup> on weekdays,<sup>75</sup> at moderate intensity,<sup>69,71,72,74,75,78</sup> unsupervised,<sup>69,72,74,75,78</sup> in the company of friends, family or other cancer survivors,<sup>69–72,74,75,77–79</sup> and at home.<sup>69–72,74,75,77</sup> Walking was undoubtedly the most preferred type of exercise both in the summer and winter.<sup>69–72,74–78</sup>

Many survivors were interested in physical activity programmes that were scheduled in terms of day and time,<sup>69,71,78</sup> and many would have liked to perform the same type of activity each time they exercised.<sup>69,72,75</sup> However, not all these findings were consistent across all studies. The majority of cancer survivors in some studies stated that they would have preferred to exercise alone,<sup>72,74,75</sup> engage in unscheduled physical activity,<sup>72,75</sup> and perform different activities each time they exercised.<sup>72,78</sup>

Consistent with the literature in the general population,<sup>80,81</sup> physical activity preferences appeared to be associated with a range of demographic, medical, and behavioural variables. Age,<sup>69,70,72,74,77</sup> level of education,<sup>68,69,71,72,74,75,77,78</sup> current exercise behaviour,<sup>69–72,75,77,78</sup> body mass index (weight in kg divided by height in m<sup>2</sup>),<sup>68,71,72,78</sup> type of treatment,<sup>68,70–72</sup> and household income<sup>71,72,75,77</sup> were the most commonly identified variables to moderate exercise programme and information preferences.

## **Adherence rates and predictors of adherence to exercise programmes among oncology patients and cancer survivors**

**Programmes**—A number of randomised controlled trials have evaluated physical activity programmes offered to adults at any point of the cancer trajectory.<sup>23,44,82–86</sup>

The programmes varied considerably in duration, ranging from 2 weeks<sup>44</sup> to 1 year,<sup>23,86</sup> although most programmes lasted between 3 and 6 months.<sup>23,44,82–87</sup>

The studies offered supervised exercise training,<sup>23,44,82,83</sup> home-based training,<sup>23,44,85,86</sup> or programmes including both supervised and home-based components.<sup>23,44,84</sup> Many programmes recommended that participants engage in moderate-intensity physical activity that increased progressively to at least 5 days a week for at least 30 minutes per day (i.e., an equivalent of at least 7.5 MET-hours/week).<sup>23,44,82–86</sup>

Most programmes focused on aerobic exercise,<sup>23,44,84–86</sup> some trials offered resistance training,<sup>23,44</sup> and in some studies cancer survivors received a combination of aerobic and resistance training.<sup>23,44,82,83</sup> The intensity of the aerobic training showed considerable variability with study participants required to exercise from at least 40% to no more than 85% of estimated maximum heart rate.<sup>23,44,82–84,86</sup>

**Adherence to physical activity programmes**—Although the uptake of exercise programmes was varied with only 63% (range 12% to 100%) of the approached patients agreeing to undertake the exercise intervention,<sup>87</sup> adherence rates to exercise programmes were good, ranging from 68% to 98% for supervised programmes,<sup>23,44,82,83</sup> 70% to 94% for home-based programmes,<sup>23,44,85,86</sup> and 81% for programmes that included both supervised and home-based components.<sup>84</sup>

The required level of intensity of aerobic training did not appear to affect adherence rates.<sup>23,82–84</sup> In general, the programmes were effective in that the study participants increased their physical activity levels from 1.5–4.9 MET-hours/week at baseline<sup>84–86</sup> to 6.2–16.8 MET-hours/week at the end of an exercise programme.<sup>84–86</sup>

**Predictors of adherence to physical activity programmes**—Lower body mass index,<sup>82,84</sup> a higher degree of readiness to change physical activity behaviour,<sup>84</sup> better self-efficacy scores at baseline,<sup>86</sup> higher physical activity levels before commencing an exercise programme,<sup>86</sup> higher aerobic fitness,<sup>83</sup> more advanced disease stage,<sup>83</sup> lower depression,<sup>83</sup> younger age,<sup>82</sup> and more positive attitude towards exercise<sup>82</sup> have been identified as predictors of better adherence to physical activity programmes. These findings, however, have not been observed consistently across studies.<sup>82–84,86</sup>

## **Availability of physical activity counselling and programmes for oncology patients and cancer survivors**

Despite the desire for the availability of exercise programming for cancer survivors, relatively little exercise programming is available specifically for this population, either within the cancer-care setting or elsewhere.<sup>88</sup>

The limited programmes that have been developed for cancer survivors include written information such as the guidebook 'Exercise for Health: an Exercise Guide for Breast Cancer Survivors' in Canada,<sup>89</sup> as well as individualised or small-group structured programmes that are often subsidised such as the 'Cancer Survivors Program' in Australia<sup>90</sup> or 'Pink Pilates' in New Zealand.<sup>91</sup>



Recent surveys of oncologists<sup>92</sup> and oncology nurses<sup>88</sup> found that although most oncologists had positive attitudes towards recommending exercise to patients with cancer during treatment, and most oncology nurses had positive attitudes towards providing exercise rehabilitation services for patients with cancer, only 42% of cancer survivors indicated that exercise was discussed at their treatment consultation with their oncologists, and only 28% of discussions were initiated by the oncologist.<sup>93</sup> Furthermore, an exercise programme was recommended to only 28% of patients,<sup>92</sup> and few cancer-care hospitals provided an exercise programme for their patients.<sup>88</sup>

This lack of exercise discussions and programme availability was due to a lack of awareness and familiarity with the exercise literature as well as scarce resources.<sup>88</sup> In fact, the majority of oncology nurses surveyed reported their familiarity with the exercise oncology literature as 'none' or 'low', and nearly a fifth of oncology nurses were unaware that a body of research in this area existed.<sup>88</sup>

## Discussion

Exercise during or after cancer treatment has been shown to improve the risk factors associated with cancer prognosis. Despite the known benefits of physical activity, exercise rates decrease drastically during cancer treatment and remain low even after treatment is completed.<sup>69,79,94-98</sup> Furthermore, about half of cancer survivors are sedentary and do not engage in any type of physical activities.<sup>67,70,74,75,77</sup>

Nevertheless, most patients with cancer and cancer survivors have been shown to be motivated to receive exercise advice, have interest in participating in an exercise programme, and have also indicated that they are interested in an exercise program designed specifically for them. Although, it appears that cancer survivors are unlikely to continue or initiate an exercise programme without a structured intervention.<sup>69,79,94-97</sup>

Several exercise behaviour change interventions for adult patients with cancer and cancer survivors have been shown to effectively increase overall activity levels.<sup>23,44,82-86</sup> Many study participants, however, remained inactive or did not achieve the recommended activity levels.<sup>84,85</sup> Furthermore, nearly 40% of oncology patients or survivors who were approached to participate in an exercise programme declined to undertake it.<sup>87</sup>

The low uptake of exercise interventions and low number of participants achieving the recommended activity levels might have been due to the fact that many programmes did not reflect the most frequently reported programme preferences among cancer survivors. The same physical activity can not be used across survivors of different tumour types, because cancer diagnosis, side effects associated with different treatments, different experiences of cancer survivors, cancer-site-specific barriers, patient position on the cancer spectrum, or patient demographics affect exercise behaviours and attitudes towards physical activity and therefore need to be taken into consideration when developing physical activity programmes specifically for oncology patients and cancer survivors.<sup>99</sup>

Tailoring of exercise programmes to patient-specific and disease-specific needs is thus essential for optimising adherence, outcomes, and long-term behavioural changes in oncology patients and cancer survivors.<sup>100</sup>

Application of behaviour change theories may be particularly useful during this process. Behaviour change theories may be used for understanding physical activity in various cancer survivor groups,<sup>75,76,82,83,101,102</sup> identifying the main beliefs about physical activity in cancer survivors that are necessary for developing physical activity interventions for this population,<sup>75,76,82,83,101,102</sup> and may be used for actually developing effective physical activity interventions for specific groups of cancer survivors.<sup>85,86</sup>

In conclusion, research efforts are needed to develop physical activity programmes specifically for oncology patients and cancer survivors. Such programmes should take into account the programme preferences of the target population.

It is evident that a number of factors influence the exercise preferences of cancer survivors. Whether the needs of New Zealand oncology patients and cancer survivors in relation to continuation or initiation of physical activity are similar to those of North American or European survivors is uncertain and requires investigation. Furthermore, there is a need to examine whether tailoring of exercise programmes is associated with improved long-term adherence and exercise outcomes in New Zealand patients with cancer and cancer survivors.

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