# Fit for life after cancer: does exercise timing matter?

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## Abstract

**Objectives:**

To assess the effects of a single exercise session per week for 6 weeks on quality of life, fatigue and exercise participation in male and female cancer survivors with follow up at 6-months. A secondary aim was to identify if the timing of exercise delivery determined its effect.

**Methods:**

An exploratory prospective cohort study design was implemented. Twenty-five patients undergoing, or who had completed cancer treatment (11 active treatment; 14 completed treatment) undertook exercise and educational sessions (Fit for Life) 1x/week. The Brief Fatigue Inventory (BFI), the European Organisation for Research and Treatment of Cancer Quality of Life C30 (EORTC QLQ C-30), and the Godin Leisure Time Exercise Questionnaire (GLTEQ) were used to assess fatigue, QoL and exercise levels respectively. Participants were evaluated before and after the intervention, and after 6 months.

**Results:**

There was a significant group x time interaction for the GLTEQ at 6-month post in favour of exercising during active treatment ($p=0.01$). No other group x time interactions were observed across the EORTC QLQ C-30 or BFI. There was a significant main effect for time for EORTC QLQ C-30 Global with a significant increase observed between pre-and 6-month post.

**Conclusions:**

Exercise 1x/week delivered during treatment may impact on long-term exercise participation in adult cancer survivors. This lower volume programme may improve QoL, but has minimal effect on fatigue suggesting an insufficient exercise dosage to impact this variable. This study generates interesting proof of concept results and may be helpful in the development of larger RCT's.

**Keywords:** cancer; exercise; rehabilitation interventions; follow up; exercise timing.

Cancer survivors often suffer from impaired quality of life (QoL), fatigue and reduced exercise engagement [1–3]. Exercise has been shown to help combat the physical and psychosocial side effects of treatment with both time of exercise delivery (during treatment (DT) vs post treatment (PT)) and training frequency (sessions/week) highlighted as possible determinants of the response noted. Recent reviews have suggested that exercise provides physical benefits when delivered both during and after cancer treatment [4,5], but may have an additional psychosocial impact when delivered during treatment [6]. In addition, a training frequency of 3x/week has been recommended as optimal for improving quality of life (QoL) and outcomes associated with QoL such as aerobic capacity ($VO_{2peak}$) and fatigue [6]. However, exercise participation amongst cancer survivors remains poor. In addition, the expectance that sedentary cancer survivors can achieve ~150mins/week of exercise may be unrealistic with barriers to participation such as lack of time commonly reported [7]. Therefore, we aimed to assess the effects a single weekly exercise session (60mins) provided as part of a clinical service for oncology patients on QoL, fatigue and exercise participation over 6-weeks with follow up at 6-months' post (6-m POST). A secondary aim was to identify if the timing of the delivery of the exercise intervention determined its effect.

## METHODS

**Experimental Design**: An exploratory prospective cohort study comprising of a 6-wk training and education intervention. Outcomes were measured at PRE, POST and 6-m POST.

**Participants**: Following institutional ethical approval, 25 male and female cancer survivors volunteered to participate (See *Table 1*. for clinical characteristics). Individuals were screened for eligibility which included; 1) undergoing or having completed treatment for cancer; and 2)

an Eastern Cooperative Oncology Group status (ECOG) of 0-2. Individuals were excluded if; 1) they required assistance to mobilise; 2) were <6-wk post-surgery; or 3) had dementia or a psychiatric illness which may preclude informed consent and/ or active exercise participation. The intervention was provided as a clinical service to patients attending for cancer treatment and physiotherapy services; therefore, allocation to the groups was not-randomised. Point of commencement (DT vs PT) was self-selected, with patients offered access to the programme at all treatment stages when attending hospital appointments. Participants were fully informed of all experimental procedures prior to providing written informed consent.

**Training Intervention**: Supervised exercise and educational sessions (1x/week for 6-wks). *Exercise sessions*: Cardiovascular, resistance and balance exercises. Sessions lasted 60-mins (12 exercise stations – 2.5-min per exercise x 2). *Educational sessions*: Exercise pacing (x2), healthy eating (x2), stress management (x1), and behaviour change (x1).

**Assessments**

*Fatigue*: Assessed by the Brief Fatigue Inventory (BFI), comprised of 9 questions under 4 headings. Each question was rated on a scale 1-10. A mean BFI score of 0, 1-3, 4-6 and 7-10 indicates no fatigue, mild fatigue, moderate fatigue and severe fatigue respectively (Mendoza et al, 1999).

*Quality of life (QoL)*: Assessed by the European Organisation for Research and Treatment of Cancer QoL C-30 (EORTC QLQ C-30). A change in subscale score of >10 is acknowledged as clinically meaningful.

*Exercise participation*: Assessed by the Godin Leisure Time Exercise Questionnaire (GLTEQ). Individuals self-report the frequency and duration of mild, moderate and strenuous exercise over a 1-wk period.

Table 1 Demographic and clinical characteristics of participants

| Characteristics | N (%) |
|---|---|
| Age (years) | |
| 20-40 | 1 (4) |
| 40-65 | 20 (80) |
| >65 | 4 (16) |
| Sex | |
| Female | 20 (80) |
| Male | 5 (20) |
| Diagnosis | |
| Breast | 20 (80) |
| Prostate | 4 (16) |
| Lung | 1 (4) |
| Treatment stage | |
| Active treatment | 11 (44) |
| Completed treatment | 14 (56) |
| Treated with chemotherapy | |
| Y | 5 (5) |
| N | 20 (80) |

**Statistical Analysis**

Data were analysed using a 2 x 3 repeated analysis of variance (ANOVA) with between-factors "group" (i.e. DT vs PT) and within-factor "time" (i.e. PRE, POST, 6-m POST) using SPSS. Significance was set at $p < 0.05$. Significant interactions and main effects were analysed using Tukey post hoc tests.

**RESULTS**

Twenty-five participants completed the study (age= 57.24 ± 10.5 years). *Fatigue:* The BFI demonstrated no significant main effect for time (p=0.08) or significant interaction for group x time (p=0.06). At POST, fatigue increased (+49%) and decreased (-15%) in the DT and PT groups respectively. Fatigue decreased at 6-m POST vs POST in both groups (DT, -48%; PT, -7%). *QoL:* No significant main effect for time for Function-QoL (p=0.08) or Symptom-QoL (p=0.11) was noted. However, there was a significant main effect for time for Global-QoL (p=0.015). Pairwise comparison showed a significant increase between PRE-and 6-m POST time intervals (57.89 ± 20.93 vs 70.13 ± 16.89, +21%) (p=0.01). There was no significant interaction for group x time (p>0.05). At POST, Global-QoL decreased by 13% and increased by 19% in DT and PT groups respectively. At 6-m POST, Global-QoL increased by 35% in the DT with no change in the PT compared to POST. *Exercise participation:* The GLTEQ demonstrated no significant main effect for time (p=0.12). A significant interaction for group x-time (p=0.01) was noted with the DT group showing a significantly greater GLTEQ score at 6-m POST (50.97 ± 26.57) vs PT group (35.62 ± 14.87) (*Figure1*). At POST, GLTEQ decreased by 22% and increased by 30% in DT and PT respectively. At 6-m POST, GLTEQ increased by 70% and 2% vs POST in DT and PT respectively.

**DISCUSSION**

These results suggest that an exercise-based intervention delivered 1x/weekly for 6-wks may have minimal impact on fatigue levels, but may lead to significant long-term improvements in Global-QoL. Overall the intervention delivered demonstrated no long-term effect on exercise participation but these preliminary results indicate that there was a significantly larger increase in long-term exercise participation in those who began exercising during active cancer treatment when compared to those who engaged after treatment.

Fatigue is a common side effect associated with cancer and can negatively impact QoL and exercise participation (2). Therefore, strategies which can attenuate fatigue may positively impact survivorship. In the current study, exercise delivered 1x/week for 6-wks had no significant effect on fatigue levels irrespective of the timing of the intervention delivery. Of note, while non-significant in this preliminary study, DT demonstrated an increase in fatigue (+49%) from PRE-to POST, whilst fatigue levels fell in PT (-15%) over the same period. Similar observations have previously been reported with better fatigue responses observed in groups exercising post-treatment [8], most likely explained by increases in fatigue noted in response to ongoing cancer treatment/s [9].

At 6-m POST, fatigue levels had fallen in both groups but this did not reach statistical significance. Previously, an 8-week (60 mins 3x/week) deep-water exercise programme led to reductions in fatigue when measured at 8-weeks and 6-months [10]. Current recommendations for improving outcomes such as fatigue [6] suggest a training frequency of 3x/week. Therefore, the training frequency in the current study may have been too low to exhibit an improvement in this measure. Further research with adequate numbers to confer statistical power in outcomes of fatigue are required to fully elucidate the exercise frequency/volume question.

The present study demonstrates that exercise and education delivered 1x/week for 6-weeks can lead to long-term improvements in Global-QoL with significant improvements seen at 6-m POST, independent of group. This is in line with findings from a recent systematic review [4] which concluded that additional exercise, when compared with normal care can lead to significant improvements in Global-QoL at 6 month follow-up. Interventions which exhibit sustained and longer-term health benefits warrant careful consideration, particularly given the increasing life expectancy in cancer survivorship [11].

In the current exploratory study, the prescribed exercise programme improved Global-QoL, but had no impact on QoL subscales of function and symptom. This could be related to the lack of change in fatigue, as fatigue may substantially impact QoL [12]. Indeed, a recent study in prostate cancer survivors identified disruption of daily living and increased dependency on others as negative factors associated with fatigue [13]. Therefore, exercise and educational programmes developed to improve QoL should be sufficiently tailored to address fatigue to impact on the multidimensional aspects of QoL.

Long-term exercise engagement is an important lifestyle choice and is considered essential for the maintenance of long-term health [14]. The current study demonstrated that a low intensity exercise and education based intervention completed during treatment led to greater long-term lifestyle change (F*igure 1*). A cancer diagnosis is a period in which patients may show greater motivation for lifestyle changes [15]. It is possible that participants who received an exercise-based intervention during treatment were more receptive to the health promotion message, in what has been previously referred to as the teachable moment [16], and therefore found it easier to maintain lifestyle changes upon completion of treatment. In addition, increased patient/doctor contact for the DT group may have encouraged continued exercise engagement.

The influence of the oncologist on exercise participation has previously been noted in the literature [17]. However, in this study, oncologist contact time was not recorded so this potential confounding factor cannot be controlled for in the analysis conducted.

## STUDY LIMITATIONS

The main study limitations were the small number of participants and the non-randomised allocation of the exercise timing. In addition, as the exercise intervention was provided as part of oncology care services, individuals self-selected when to commence the intervention suggesting that more motivated individuals may have chosen during "active treatment". However, despite these limitations, the results generate interesting, proof of concept results that may be helpful in the development of larger RCTs in the area.

## CONCLUSION

In summary, Global-QoL at 6-m POST increased following 6-wks of exercise 1x/week, independent of treatment stage. Beginning exercise during treatment appears to be more effective for improving long-term exercise participation possibly due to greater motivation for lifestyle changes, but increased fatigue levels during the intervention period were noted. Further research in this area is warranted to confirm these findings.

**Competing Interests:** None declared.

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**Contributorship:** CM and AD were responsible for study design and data collection. DO'C analysed the data and wrote the manuscript. OL critically reviewed the manuscript. All authors have read and approved the final version of the manuscript.

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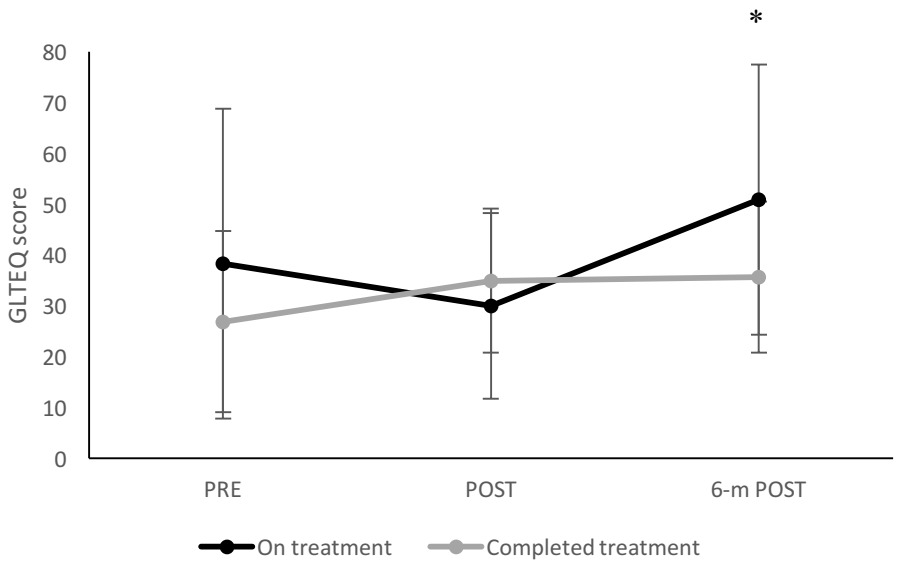


**Figure 1.** Changes in GLTEQ scores. * indicates P<0.05 for interaction of group x time.

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