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Original Research Article

Do Activity Patterns And Body Weight Change After A Cancer Diagnosis? A Retrospective Cohort Study

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ABSTRACT

Introduction: Increased physical activity (PA) levels and a healthy body weight (BW) are associated with improved health outcomes, decreased fatigue and an improved quality of life in cancer survivors. The aim of this study was to determine what impact (if any) a cancer diagnosis would have on survivors' activity levels and body weight.
Materials and Methods: Changes in PA patterns and BW throughout the first 12 months after diagnosis were assessed using a self-reported questionnaire. One hundred and sixty participants commenced the 15 question self-reported retrospective questionnaire and 90 complete data sets were analysed.
Results: There were significant decreases in self-reported PA patterns in the 12 months post diagnosis, when compared with pre diagnosis patterns. Sixty percent of participant's reported an increase in their BW in the 12 month post diagnosis period. Participants reported increasing sleep duration from 7.61± 1.02 h to 9.02± 2.16 h ($p<0.01$) and increased their time spent doing sedentary activities from 8.23± 3.30 h to 9.31± 3.25 h ($p=0.03$) per day. Participants decreased their vigorous PA levels from 1.28± 1.86 h to 0.60 ± 1.17 h ($p<0.01$), and their light PA levels from 5.00± 2.79 hto 3.6± 2.26 h ($p<0.01$) per day.
Conclusion: This study sought to investigate whether PA patterns and BW change following a cancer diagnosis. Results suggest that in the 12 months post-diagnosis, cancer survivors increased their sleep time and reduced their levels of both vigorous and light PA. This may or may not be related to the increases in BW, which was observed for 60% of the participants.

Key words: Cancer, physical activity, body weight, health, cancer survivors.

INTRODUCTION

Cancer survivorship has increased steadily for the last decade due to improvements in treatment and early detection. In Australia, survival rates have improved from 47% in the period 1982-1987 to 66% between 2006-2010; it is predicted that this rate will continue to improve. [(1,2)] With increased survival, those previously diagnosed with cancer are now at greater risk of dying from other chronic diseases rather than from the cancer itself. [(3)]

The definition of physical activity (PA), according to the World Health Organisation (WHO) is any body movement produced by the skeletal muscle that uses energy which includes sports, exercise and activities such as playing, walking, doing housework, gardening and dancing. [(4)] Globally, one in four adults is not sufficiently physically active. [(4)] Physical activity guidelines from the American College of Sports Medicine (ACSM) and the American Heart Association (AHA)

state that people should participate in30 minutes of moderate activity on at least five days per week, or 20 minutes of vigorous activity three days a week, a combination of moderate and vigorous activity can be performed to meet this recommendation. [5,6] The WHO also recommends that adults aged between 18-64 years should participate in at least 150 minutes of moderate-intensity activity a week or do at least 75 minutes of vigorous-intensity activity or an equivalent combination of both. [4]

The burden of diseases including cancer that can be contributed to limited physical activity, will continue to have a major impact on the health and wellbeing of people and as a consequence an impact on life expectancy. [7] Physical inactivity is a modifiable risk factor for chronic diseases and there is strong evidence to suggest that increasing PA can reduce the burden in apparently healthy people. [7] A growing body of evidence suggest that cancer survivors who participate in regular PA decrease the risk of developing chronic disease. [8,9] This is in part due to improvements in their body composition, physical function and physical fitness. By increasing the PA in cancer survivors they will also improve their mental health and quality of life. [9]

The growing body of evidence supporting PA and the reduction of cancer related side effects and chronic disease led to the development of cancer specific PA and exercise guidelines for survivors in a number of countries such as Australia, USA and the UK. [10-12] All guidelines highlight that a reduction in sedentary behaviour in the cancer population is beneficial for health outcomes, such as; increased fitness, reduced body mass index (BMI), improved quality of life. [9] Improved PA levels have also been shown to decrease the risk of developing chronic co-morbidities, [8] reduce the likelihood of cancer reoccurrence [13-15] and lower the risk of mortality [16] in cancer survivors.

Despite the growth of evidence supporting the positive effects of PA and exercise during and after cancer treatment, PA is not commonly prescribed for cancer survivors as part of their treatment plan. The lack of PA prescription at an identifiable teachable moment at diagnosis may lead to the misconception that PA is not important or necessary. For many reasons the importance of remaining physically active is not conveyed to or taken seriously by cancer survivors, demonstrated by the fact that the majority of people diagnosed with cancer are decreasing their PA levels after diagnosis. [17-19] The current study demonstrates that a cancer diagnosis negatively impacts on PA patterns and body weight (BW) of cancer survivors. Therefore the aims of this study was to 1) identify if peoples PA levels change and 2) explore if their BW changed across the 12 month period after their diagnosis and if this may be related to a decline in PA levels.

MATERIALS AND METHODS

In this cross sectional retrospective study cancer survivors were asked to complete an on-line questionnaire to determine their PA patterns from pre to post cancer diagnosis. Pilot testing was carried out by a group of 20 cancer survivors and feedback from the group was used to make minor adaptations to the questionnaire. Participants were recruited via social media, email and word of mouth. Interested participants contacted the primary investigator, who then provided the participant information and questionnaire link, which included the informed consent. The questionnaire was adapted from the short retrospective questionnaire for PA in women. [20] The procedures followed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. The study received approval from the institutions Human Research Ethics Committee (UCHREC13-153).

One hundred and sixty participants commenced the questionnaire, and 105 participants completed the questionnaire.

Five participants reported more than 24 hours of activity within a 24 hour period and as such their data was excluded from the analysis. Ten participants were within three months of diagnosis and their data was omitted to assist in determining activity patterns post the acute treatment phase. Analysis was conducted on a total of 90 complete questionnaires.

The questionnaire aimed to determine PA levels and weight changes from pre to post diagnosis. Along with basic demographical details (age, sex, cancer type, and time since diagnosis) the questionnaire comprised of a comprehensive, 24 hour breakdown of the average physical activity levels and intensities which a person is likely to participate in over the course of a day. The questions relating to PA were broken down into categories, totaling 24 hours, and included sleep, sedentary (SA), light (LA), moderate (MA) and vigorous (VA) activity patterns. For each category a number of examples of typical daily activities were specified as examples, to assist the participant in determining the most accurate categories. (See supplementary material)

Statistical analysis

Results are expressed as means with standard deviations. PA data was analysed using repeated measures analysis of variance and where appropriate a Bonferroni post-hoc test. Pre-post diagnosis sleep data was analysed using a Wilcoxon-Signed ranked test. Significance was set at $p<0.05$ for all analyses. The data was analysed using SPSS IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

RESULTS

Participants

This study included survivors of breast cancer (n = 68) unknown primary (3), two participants with anal, cervical, lymphoma, skin, thyroid and one participant with appendix, bowel, oesophageal, gastrointestinal, lung, myeloma, ovarian, neuroendocrine and uterine.

Twenty six percent of the participants were under the age of 40 years, with the majority of participants aged between 41 and 50 years (36%) (Table 1). Ten percent of participants were male.

Thirty two percent of participants were diagnosed three to12 months before completing this questionnaire. Sixty eight percent of participants were at least 12 months post diagnosis (table 1).

Table 1: Participants age and time since diagnosis

Age	n	%	Time since diagnosis	n	%
21-30	6	7	3-6m	12	13
31-40	17	19	6-12m	17	19
41-50	33	36	12m-2y	27	30
51-60	18	20	2-5y	22	25
61-70	16	18	>5y	12	13

Forty percent of participants self-reported to have lost weight (n = 23) (26%) or remained the same (n = 13) (14%) and 20% (n = 18) of people reported gaining less than 5kgs in the 12 months after diagnosis. Twenty eight percent of people (n = 25) gained 5-10kgsand 12% (n = 11) gained more than 10 kg within 12 months post diagnosis (Figure 1).

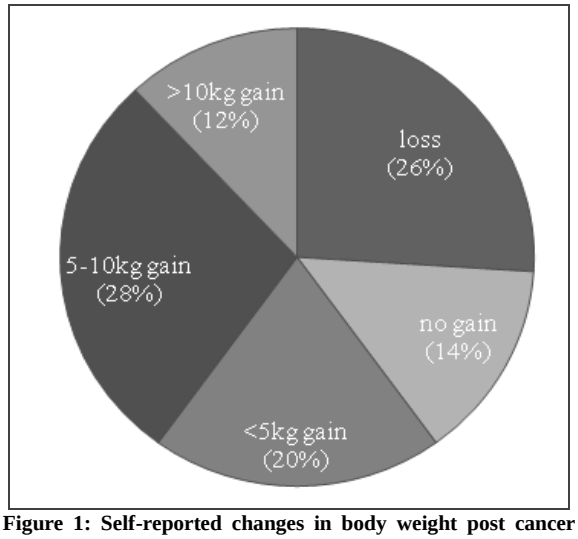

Figure 1: Self-reported changes in body weight post cancer diagnosis

Physical Activity Levels

Pre diagnosis, cancer survivors reported sleeping 7.61h± 1.02h per day, participating in SA 8.23h± 3.30 h per day, participating in VA 1.28h± 1.85 hand undertaking MA 1.89h ± 1.50 hper day. Time spent participating in LA levels was reportedly 5.00h± 2.79 hper day.

Post diagnosis participants reported an increase in sleep [9.02 ± 2.16 h (p <0.01)], and an increase in their SA [9.31 ± 3.25 h (p = 0.03) per day]. Participants reported a decrease in their VA [0.60 ± 1.17 h (p <0.01)], and their LA [3.6 ± 2.26 h (p < 0.01) per day] (see Figure 2).MA levels went from 1.89 ± 1.50 h to 1.42 ± 1.20 h per day (p=0.078).

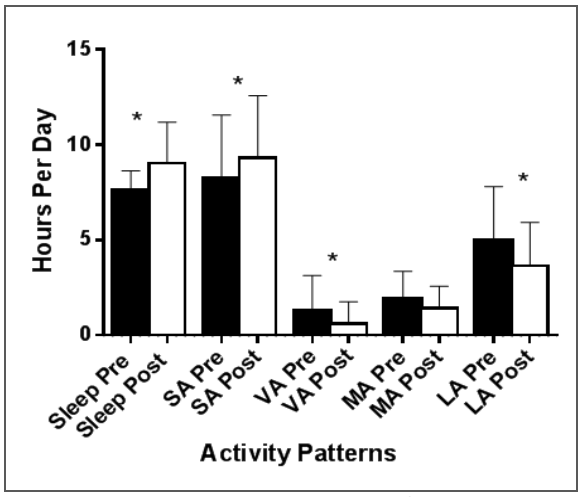

Figure 2: Changes in activity patterns from pre to post diagnosis.
(SA = sedentary activity, VA=vigorous activity, MA = moderate activity, LA = light activity. *p<0.05)

DISCUSSION

Globally, physical inactivity continues to be a major contributor to the increased prevalence of chronic disease including cancer. [(7)] Cardiovascular disease (CVD) now competes with cancer as the leading cause of death for cancer survivors. [(21)] It has been reported in studies conducted that less than half of cancer survivors were physically active. [(22)] Due to these findings exercise programs are becoming increasingly prevalent in the community. Organisations such as, the American Cancer Society, Breast Cancer Network Australia and the Cancer Council's advocate and coordinate exercise programs to increase participation in structured exercise to enhance PA in cancer survivors. Many programs also provide education to survivors regarding the benefits of exercise during and after treatment [(23)] the primary purpose of this study was to identify if cancer survivors, upon reflection, altered their PA levels after a diagnosis. Results from this study suggest that cancer survivors significantly reduce their PA levels from pre to post diagnosis, which places them at an increased risk of chronic diseases. Additionally, 60% of participants reported increasing their weight within 12 months after their diagnosis, which may or may not be due to the reported reduction in energy expenditure through reduced PA levels. Participants reportedly decrease their LA and VA and increased their sleep and SA, compared to the 12 months before the diagnosis, ultimately putting them at a higher risk of health issues such as CVD.

An increase in body weight is important to monitor and consider after a cancer diagnosis due to the multitude of co morbidities associated with excess body weight, and the increased risk of being over weigh and cancer reoccurrence. [(13)] Increases in BW can negatively affect recovery from cancer treatment, by impacting on the progression of the cancer. [(24)] Increased adiposity increases the risk of mortality in cancer survivors, [(25)] therefore, cancer survivors benefit positively from eating a healthy diet and increasing their levels of PA.A healthy body weight improves quality of life and reduces post treatment fatigue, [(26)] and remaining physically active after diagnosis decreases in the risk of mortality by 30%. [(25)]

There is strong evidence of an inverse relationship between low levels of PA and higher levels of mortality in patients with cancer, [(26)] yet only 45% or more of cancer survivors are reportedly physically active, according to the minimum PA guidelines. Although not included in the present study it is important to address some of the reasons that cancer survivors remain inactive or reduce their PA levels. Cancer survivors frequently report reducing PA due to health problems (directly or indirectly caused by treatment); fatigue, weakness, lack of time and motivation and access to facilities. [(27-29)] An increase in age and body weight, low education, co morbidities and smoking are contributing factors to cancer survivors becoming physical inactive after

treatment. Higher education levels have been associated with a change from inactive to active following a cancer diagnosis; therefore, education is important to get cancer survivors moving following a diagnosis. [32] Education could potentially be a facilitator of PA for people going through cancer treatment, which may assist in improving PA levels post treatment. Identifying teachable moments could improve the PA levels and BW to ensure positive outcomes for people diagnosed with cancer.

The results of the current study suggest that despite the importance of PA, people are still becoming less active following a diagnosis. A common reported reason for this reduction in PA is that people are unsure or confused about the type and amount of PA those they should partake in, in order to achieve positive health outcomes. [30,31] It has been suggested that the current guidelines for cancer survivors are too generic and non-specific and that the multiple guidelines published on PA are causing confusion. [30] This may influence practitioners' discussions with patients about the importance of PA and exercise. [32] Little evidence exists about the discussions between patients and practitioners and whether they occur at diagnosis. Early diagnosis may not be the most appropriate time to have this conversation because there is so much information being absorbed by the patient, even though it has been identified as a teachable moment. [33] The general public, including cancer survivors are unlikely to receive the message about the importance of PA and exercise from the health professionals that they perceive as experts such as Oncologists. [31] If Oncologists do not see these discussions as a high priority, it leaves cancer survivors to source their own information on lifestyle changes, which may or may not come from a reliable source. Therefore it is likely that patients might seek assistance from inappropriately qualified personnel, such as Personal Trainers, potentially leading to an increase in confusion about the right type of PA, injury and furthermore a decreases in participation. An increase in PA and exercise has many benefits and the reasons behind an individual's choice to exercise or not is complex. Research has reported that in a cohort of breast cancer survivors, fear was a strong contributing factor to low levels of PA. [30] People who were already active were not afraid to participate in PA and exercise; inactive participants however, reported that lymphoedema and knowledge about the safety and effectiveness of exercise negatively influenced their choices on whether to be physically active. [30] Much evidence exists on fatigue and a reduction of PA in cancer survivors, but less is available on the effects of sleep in relation to PA.

Poor sleep quality is commonly reported by patients with cancer. [34] On average participants in the current study reportedly spent 18 out of 24h per day sleeping or participating in SA such as sitting, eating, watching TV and reading. From the limited research available, sleep disturbances is a concern for cancer patients and survivors and it is often directly related to fatigue, restlessness, low mood, diagnosis concerns and recent cancer surgeries. [35] Difficulty sleeping can significantly impact a patient mental health with the development of depression and a decrease in quality of life in cancer survivors a common side effect. [34] Exercise and increases in PA can improve mood, increase quality of life and potentially improve sleep [36] and therefore should be further addressed in this cohort.

In apparently healthy people, short amounts of sleep (<6.5 hours) and insomnia have been associated with chronic co morbidities such as depression and CVD, which increases the risk of mortality. Sleeping over 8 hours per night in duration has also been shown as a mortality hazard, due to the negative effect sedentary activity has on a person's health. [37,38] Sedentary behaviour has also been linked to shorter duration sleepers; [37] consistency disturbed sleep patterns in the apparently healthy people is shown to decrease activity levels.

[39,40] People are in bed for on average seven hours, but sleep around six hours per night, researchers expect this will decrease further into the future, [40] people will therefore become less active and more at risk of chronic co morbidities. The current study shows that people with a cancer diagnosis are increasing their sleep and sedentary activities after diagnosis, therefore increasing their risk of developing co morbidities and associated health problems in the future.

Favourable health outcomes have been identified in those who understand and participate in higher levels of PA. [8,9] The manner in which education and PA prescription to cancer survivors is delivered needs to change, based on the mounting literature that cancer survivors are decreasing their PA or remaining physically inactive after a cancer diagnosis, which increases their risk of developing other chronic diseases, including cancer reoccurrence.

CONCLUSION

Despite the compelling body of evidence of the benefits of increasing PA levels, this study suggests that a cancer diagnosis negatively impacts on individuals' PA profile and BW. Future prospective studies should be explored to look at the changes in PA levels pre and post cancer diagnosis, determining the correct prescription for maximum health benefits. The way in which we provide, educate and refer patients into programs to improve their PA profiles and body weight should also be addressed. Specifically, future studies should investigate when the appropriate point in time is to be educating patients about the importance of exercise, exploring exactly when PA drops off after diagnosis. When weight gain occurs post diagnosis should be investigated, this time point can also be targeted as a time to educate patients on the importance of PA.

Limitations

It is possible that participants are likely to overestimate their actual levels of PA and intensity thereof in self-reported measures, when compared with objective measures, [41] based off this the actual levels of PA may have been even lower than the reported amounts. Recall bias could also be a cause of error. A gap between objective and subjective reporting of PA levels is evident in previous studies [6] and should be addressed in research moving forward.

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APPENDIX

	Questionnaire Questions
1.	By ticking the box below you have read the informed consent and agree to participate
2.	Cancer type
3.	Current age
4.	Following diagnosis was there any change to your weight?
5.	Period of time since you were diagnosed
	12 months before diagnosis:
1.	On a typical week day how many hours did you spend sleeping? (during the night or napping in the day)
2.	On a typical weekday how many hours did you spend doing predominantly sedentary activities? (sitting, eating, watching TV, reading, doing needlework, in the car, bus or train)
3.	How many hours did you spend on a typical weekday doing physically vigorous activity? (lifting or carrying heavy objects, heavy gardening, climbing stairs, cycling uphill, jogging, circuit training, fast swimming, activities that make you feel physically tired after a short period)
4.	How many hours did you spend on a typical weekday doing physically moderate activity? (fast walking, cycling flat roads or without resistance, cleaning windows, mopping, vacuuming, moderate gardening, light gym, leisurely swimming)
5.	How many hours did you spend on a typical day doing physically light activities? (cooking, washing the dishes, ironing, dusting, cleaning, standing, light walking) this will be the remaining hours left in the 24 hour period.
	12 months after diagnosis:
1.	On a typical week day how many hours did you spend sleeping? (during the night or napping in the day)
2.	On a typical weekday how many hours did you doing predominantly sedentary activities? (sitting, eating, watching TV, reading, doing needlework, in the car, bus or train)
3.	How many hours did you spend on a typical weekday doing physically vigorous activity? (lifting or carrying heavy objects, heavy gardening, climbing stairs, cycling uphill, jogging, circuit training, fast swimming, activities that make you feel physically tired after a short period)
4.	How many hours did you spend on a typical weekday doing physically moderate activity? (fast walking, cycling flat roads or without resistance, cleaning windows, mopping, vacuuming, moderate gardening, light gym, leisurely swimming)
5.	How many hours did you spend on a typical day doing physically light activities? (cooking, washing the dishes, ironing, dusting, cleaning, standing, light walking) this will be the remaining hours left in the 24 hour period.

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