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Abstract

Goals The aim of this study was to examine the effect of a cancer diagnosis on the health behaviors of cancer survivors and their family and friends, and to determine whether a cancer diagnosis could be a teachable moment for intervention. **Materials and methods** This was a cross-sectional study of the health behaviors of individuals taking part in a cancer fundraising event. The questionnaire was completed by 657 participants. **Main results** Participants were 81.4% women, had a mean age of 46 years, and comprised of 17.2% cancer survivors. For cancer survivors, 31.3% reported an increase in physical activity, 50% of smokers quit, and 59 to 72% reported dietary improvements within 1 month of diagnosis. Significant differences in behavior change were found by age, but not by gender or education. For individuals without cancer, 24.3% reported improved physical activity and the majority reported some dietary changes. A greater proportion of family and friends who perceived they were at greater risk of developing cancer increased physical activity and sun-smart behavior but did not improve dietary habits. **Conclusions** The results indicate that the cancer survivors made significantly more positive health behavior changes compared to the non-cancer group. For this sample, a personal diagnosis of cancer, or a diagnosis in a family member or friend, may have acted as a 'cue to action' to improve lifestyle health behaviors. This field of research is still at an early stage, and further studies are needed to confirm if this situation could be useful as a 'teachable moment' for intervention purposes.

Keywords

health, cancer, friends, impact, survivors, their, family, diagnosis, behaviors

Disciplines

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The impact of a cancer diagnosis on the health behaviors of cancer survivors and their family and friends

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Abstract

Goals

The aim of this study was to examine the effect of a cancer diagnosis on the health behaviors of cancer survivors and their family and friends, and to determine whether a cancer diagnosis could be a teachable moment for intervention.

Materials and methods

This was a cross-sectional study of the health behaviors of individuals taking part in a cancer fundraising event. The questionnaire was completed by 657 participants.

Main results

Participants were 81.4% women, had a mean age of 46 years, and comprised of 17.2% cancer survivors. For cancer survivors, 31.3% reported an increase in physical activity, 50% of smokers quit, and 59 to 72% reported dietary improvements within 1 month of diagnosis. Significant differences in behavior change were found by age, but not by gender or education. For individuals without cancer, 24.3% reported improved physical activity and the majority reported some dietary changes. A greater proportion of family and friends who perceived they were at greater risk of developing cancer increased physical activity and sun-smart behavior but did not improve dietary habits.

Conclusions

The results indicate that the cancer survivors made significantly more positive health behavior changes compared to the non-cancer group. For this sample, a personal diagnosis of cancer, or a diagnosis in a family member or friend, may have acted as a 'cue to action' to improve lifestyle health behaviors. This field of research is still at an early stage, and further studies are needed to confirm if this situation could be useful as a 'teachable moment' for intervention purposes.

Keywords: Cancer Physical activity Exercise Diet Health behavior

Introduction

An ageing population combined with advances in early detection and treatments have resulted in an ever-increasing number of cancer survivors. The number of new cancer diagnoses each year is estimated at 1.3 million in the USA [1] and 85,000 in Australia [5]. Recent improvements in diagnosis and treatment have meant that more people are surviving cancer, and the survival rate for breast and prostate cancer has reached 85% in Australia [44]. As a consequence, there are currently 9.6 million cancer survivors in the USA [1] and 268,000 in Australia [5], and these numbers are expected to rise by 25% over the next decade [44]. Unfortunately, many cancer treatments are toxic in nature, increasing the risk of other medical problems such as cardiovascular disease, osteoporosis, and diabetes [21]. Survivors are also prone to cancer recurrence [39], impairments in functional capacity [26], sleep disturbances [7, 20, 22], depression [16, 20, 41], and poor quality of life. Furthermore, a recent Australian study compared non-cancer mortality rates of cancer patients to those of the general population and found cancer patients were nearly 50% more likely to die of non-cancer causes [6]. The health and well-being of cancer survivors is, therefore, a considerable concern for health practitioners and researchers.

Research over the past decade has demonstrated that increases in physical activity and improvements in diet are practical and effective ways to reduce the health problems faced by cancer survivors [14, 17, 19, 31, 32, 35]. An important life transition or a life-threatening health problem such as cancer diagnosis has been referred to as a 'teachable moment' and can be viewed as a 'cue to action' in relation to making positive changes to health behaviors [29, 30]. The majority of cancer survivors appear concerned with improving their physical health. In a US study about cancer patients' readiness to pursue lifestyle changes, 80% indicated an interest in health promotion programs generally, with 50–60% reporting interest in the areas of diet and exercise specifically [18].

Despite this, many cancer survivors continue to engage in unhealthy lifestyle behaviors that could place them at risk of further health problems [38]. Several studies have examined the current prevalence of health behaviors post diagnosis [8, 13, 18, 36]. For example, a study of the current dietary intake found that 31% of the cancer survivors did not meet the fat intake guidelines and 58% did not eat sufficient serves of fruit and vegetables [18]. Studies of changes in behavior since diagnosis have found some changes in dietary behaviour. One study found that 50.6% had reduced their fat intake, 43.5% had increased their fiber intake, 42.9% had reduced their red meat intake, and 46% had quit smoking since diagnosis [9]; another reported that 45.1% were eating more fruit and vegetables, 26.4% eating less red meat, and 28.5% were eating less fat since diagnosis [34]. A further study found breast cancer survivors reporting a 77% increase in fruit and vegetable consumption [28], and a longitudinal study of colon cancer survivors found at 2 years post diagnosis a significant increase in vegetable intake [42].

On the other hand, studies that have examined physical activity levels in cancer survivors have reported lower proportions making improvements. One study found that 70% did not meet the minimum recommendations for physical activity [8], another found that 42% of the survivors were not routinely exercising [18], another 58% were not exercising regularly [39], another study found that 64% were not exercising regularly [2], and a further study found that only 20.8% of the survivors increased their physical activity levels since diagnosis [34], and one study reported that 30.6% had decreased physical activity levels [9].

This suggests that a cancer diagnosis may have a positive impact on some lifestyle behaviors (e.g., diet), but a negative impact on others (e.g., physical activity levels). Positive lifestyle changes are more likely to occur if the cancer survivor believes that these changes will improve their health and prevent cancer reoccurrence [40]. Because cancer survivors seem amenable to making positive changes in their lifestyles to improve their health, it has been suggested that the diagnosis of cancer could serve as a 'teachable moment' for making health behavior changes [25]. In terms of cancer, a 'teachable moment' would provide an opportunity for

targeted health programs to take advantage of these moments to improve the health and well-being of cancer survivors [8, 18, 29, 34]. More research is needed, however, examining variables that may be associated with changing health behavior so that more targeted and effective health programs can be developed.

There is also a possibility that the diagnosis of cancer could serve as a ‘teachable moment’ for the family of breast cancer survivors, as these individuals could realize the risks of cancer and be motivated to make positive lifestyle changes [4, 25, 40]. This notion has received some support as the female relatives of cancer survivors appear aware of risk factors for cancer [24], are more likely to engage in regular physical activity [4], and have regular mammograms than women without a family history of cancer [27]. Lemon et al. [25] found that 42% of the first-degree female relatives (FDFR) of women with breast cancer reported making at least one positive health behavior change in the first 6 months post diagnosis. However, in terms of smoking and fruit and vegetable intake, women at familial risk of cancer also show a trend towards more unhealthy behaviors, which is an area of concern [27]. Although limited by a small sample, Rabin and Pinto [40] also found some evidence indicating that female relatives made positive changes if they perceived cancer as a health risk to themselves.

These studies tentatively suggest that the diagnosis of cancer could serve as a ‘teachable moment’ not only for cancer survivors, but also for their family. However, this has only been examined in FDFR of breast cancer patients, and there is no indication of how a cancer diagnosis affects male family members. There is also no indication of whether the diagnosis of cancer has an impact on the friends of cancer survivors. If cancer were to represent a ‘teachable moment’ for both family and friends, it could pave the way for more targeted and effective health programs aimed at improving general health across a greater segment of the population.

The aim of the current study was, therefore, to examine the effects of cancer diagnosis on the lifestyle behaviors of cancer survivors and the family and friends of cancer survivors. Important factors such as age,

gender, time since diagnosis, education level, and marital and work status were included to investigate variables that may be implicated in behavior changes. Further, whereas most prior studies have measured the 'current dietary' intake and physical activity levels post diagnosis, few have inquired about 'changes' following diagnosis, and no studies were found that inquired about changes in sun-safe behavior. Because it is increasingly important to measure multiple behavior changes, the current study focussed on changes in diet (fat, fruit/vegetable, etc. consumption), smoking, physical activity, and sun-safe behaviors, as these are all implicated to varying degrees in cancer outcomes.

Materials and methods

Participants and procedure

Participants were recruited through a series of cancer fundraising events (Cancer Council Relay for Life) held throughout New South Wales, Australia, in 2005. The advantage of this event is that participants include cancer survivors and the friends and family of cancer survivors. It also comprises of a relatively large and diverse sample from which to recruit participants.

Approximately 5,000 surveys were made available to the organizers of the fundraising events. The survey package was sent to individuals who had registered to participate in the event. Potential participants were asked to complete the anonymous survey and then return it to the researchers in a reply-paid envelope. It is difficult to estimate the actual number of participants who received a survey package because the researchers were not actively involved in the distribution of the surveys, and some may have been lost or not distributed. A total of 657 participants completed the questionnaire, which indicated that 13.1% of the surveys were completed. Due to a lack of final distribution numbers, the true response rate is difficult to determine. The study was approved by the Cancer Council and the University of Human Research Ethics Committee.

Measures

All participants completed a questionnaire that included items measuring age, gender, marital status, education, current employment status, current physical activity levels, and changes in health behaviors. Participants were asked to indicate whether they had been diagnosed with cancer, and if so, to specify the type of cancer, whether they were still receiving treatment, and the time since diagnosis. Non-cancer participants were asked whether they had any family and/or friends who had been diagnosed with cancer, and if so, to specify the number of family and friends diagnosed, and the time since the most recent diagnosis. These participants were also asked to indicate their perceived risk of ever getting cancer on a five-point response scale [43].

The Active Australia Survey was used to measure physical activity levels and included items regarding the amount of walking, other moderate activity, and vigorous activity engaged in during the week before completing the questionnaire. These three physical activity types were summed to provide an indication of the total physical activity each week. This measure has provided reliable and valid indices of physical activity levels in previous national Australian surveys [10, 11].

Participants were then asked whether the cancer diagnosis (either their own or a family member's or friend's) influenced changes in their diet (the amount of fat, fiber, fruits, and vegetables, takeaway) and sun protection behavior and when these changes had occurred (within 1 month, 6 months, much later, or never). The participants were asked to indicate whether they did more, less, or had not changed the amount of physical activity they did since the diagnosis of cancer. These items were based on those used in a previous study [9]. The participants were also asked whether they had been smoking at the time of the diagnosis and whether or not they had quit.

Results

There were 81.4% female participants, and the mean age was 46 years (SD = 15). The characteristics of the cancer survivors and individuals without a cancer diagnosis are included in Table 1. Cancer survivors made up 17.2% of the population, and breast cancer was the most common type of cancer followed by melanoma and cervical cancer (see Table 2). For individuals without a cancer diagnosis, 18.7% reported having no family members with cancer, 27.8% one family member, 36.4% two to three family members, and 17.1% more than three family members. Furthermore, 31.4% reported having no friends with cancer, 25.1% reported one friend, 26.4% two to three friends, and 17.1% three or more friends with cancer. Only 4.3% of participants reported having no known friends or family diagnosed with cancer. In response to the diagnosis of a family or friend diagnosed with cancer, 26.9% of participants indicated that they had gone to a doctor for their own check-up.

Table 1. Characteristics of participants

	Total sample		Percent Cancer survivors		Percent Non-cancer		Percent
	N = 657		N = 113		N = 544		
Gender							
Men	122	18.6	15	13.2	107	19.7	
Women	535	81.4	98	86.7	437	80.3	
Age							
≤35	165	25.0	6	5.3	158	29.1	
36–55	295	44.9	51	45.1	244	44.9	
>55	197	30.0	56	49.6	141	25.9	
Education							
≤10 years	232	35.3	46	40.7	186	34.2	

	Total sample		Percent Cancer survivors		Percent Non-cancer		Percent	
	N = 657		N = 113		N = 544			
12 years/TAFE/trade	221	33.6	37	32.7	184	33.8		
Tertiary	193	29.4	25	22.1	168	30.9		
Work status								
Student	41	6.2	1	0.9	40	7.4		
Full-time	300	45.7	31	27.4	269	49.4		
Part-time	141	21.5	28	24.8	113	20.8		
Home/retired/volunteer	169	25.7	50	44.2	119	21.9		
Unemployed	5	0.8	2	1.8	3	0.6		

TAFE Technical and further education

Table 2. Cancer type, time since diagnosis, and treatment status

	Number Percent	
Cancer type		
Breast	42	41.6
Melanoma	15	14.9
Cervical	11	10.9
Colon/rectal	7	6.9
Ovarian	6	5.9
Other	16	19.8

Number Percent		
Time since diagnosis		
Within 3 months	3	2.7
3 months to 1 year	10	9.0
1 to 2 years	19	17.1
More than 2 years	79	71.2
Still undergoing treatment		
Yes	30	27.0
No	81	73.0

Physical activity levels of participants

Participants reported engaging in an average of 200 (SD = 190) minutes of walking, 87 (SD = 158) minutes of other moderate physical activity, and 106 (SD = 152) minutes of vigorous physical activity in the previous week (see Table 3). The average total physical activity amount was 380 (SD = 343) minutes a week.

Table 3. Mean minutes (SD) per week of each type of physical activity and by cancer diagnosis

	Walking	Other moderate activity	Vigorous activity	Total physical activity
Gender				
Males	199 (216)	146 (222)	141 (185)	470 (416)
Females	200 (183)	73 (136)	98 (152)	359 (321)
		$p < 0.01$	$p < 0.001$	$p < 0.01$
Age				

	Walking	Other moderate activity	Vigorous activity	Total physical activity
≤35	192 (196)	67 (125)	141 (188)	394 (356)
36–55	199 (190)	69 (146)	98 (145)	351 (341)
>55	208 (196)	129 (189)	87 (122)	411 (332)
		<i>p</i> < 0.001	<i>p</i> < 0.005	
Status				
Cancer	198 (175)	109 (181)	88 (146)	375 (357)
Non-cancer	200 (193)	82 (153)	110 (153)	381 (340)
Family diagnosed				
0	198 (185)	95 (162)	148 (186)	437 (362)
1	182 (173)	80 (160)	113 (148)	359 (327)
2–3	205 (191)	82 (154)	101 (144)	376 (329)
+3	220 (224)	71 (122)	83 (137)	364 (355)
			<i>p</i> < 0.05	
Friends diagnosed				
0	189 (187)	63 (124)	99 (136)	346 (305)
1	184 (184)	64 (107)	114 (161)	350 (319)
2–3	215 (197)	86 (160)	120 (172)	407 (355)
+3	215 (191)	133 (218)	102 (130)	432 (370)
		<i>p</i> < .01		

The analysis of Variance (ANOVA) was conducted to compare physical activity levels across gender and age. This revealed that men engaged in more moderate ($F_{(1, 638)} = 21.502, p < 0.001$), vigorous ($F_{(1, 636)} = 8.109, p < 0.01$), and total physical activity ($F_{(1, 654)} = 10.540, p < 0.01$) than women (see Table 3). The participants were grouped into three broad age ranges to facilitate examining the effect of age on health behaviors (see Table 3). This revealed differences in moderate ($F_{(2, 638)} = 10.394, p < 0.001$) and vigorous ($F_{(2, 636)} = 6.315, p < 0.01$) physical activity across the three age groups. Post hoc analysis indicated that individuals aged ≤ 35 years engaged in more vigorous physical activity levels than individuals aged 36–55 years ($M = 42.86, p < 0.05$) and individuals aged less than 55 years ($M = 54.28, p < 0.01$). The individuals aged > 56 engaged in more moderate physical activity than individuals aged ≤ 35 years ($M = 62.69, p < 0.01$) and individuals aged 36–55 years ($M = 60.28, p < 0.01$).

Differences in physical activity were also analysed separately in relation to the number of friends and family diagnosed with cancer. There was a significant difference in the amount of vigorous physical activity in terms of the number of family members diagnosed with cancer ($F_{(3, 520)} = 3.170, p < 0.05$; Table 3). The post hoc analyses revealed that individuals with more than three family members diagnosed with cancer engaged in less vigorous physical activity levels than individuals with no family members diagnosed ($M = 64.65, p < 0.05$).

There was also a significant difference in the amount of moderate physical activity in terms of the amount of friends individuals had who were diagnosed with cancer ($F_{(3, 523)} = 5.030, p < 0.01$; Table 3). The post hoc analyses indicated that individuals with more than three friends diagnosed with cancer engaged in more moderate physical activity than individuals with no friends diagnosed with cancer ($M = 70.13, p < 0.01$) and one friend diagnosed with cancer ($M = 69.28, p < .01$).

Health behavior changes in cancer survivors

For individuals with a cancer diagnosis, 31.3% reported an increase in physical activity, 62.5% remained the same, and 6.3% decreased physical activity level; 50% of smokers reported quitting (15.3% were current smokers at diagnosis) and 76.7% reported more sun-safe behaviors after their diagnosis. As evident in Table 4, the majority of cancer survivors also made positive dietary changes after their diagnosis. For example, 78.6% decreased their consumption of takeaway, 80% increased their intake of fiber, 81.3% decreased consumption of fat, and 84.6% increased fruit/vegetable consumption. Of those cancer survivors who made a positive health behavior change, most made changes within 6 months of their diagnosis. For example, 59.0% decreased fat, 69.1% decreased takeaway, 63.2% increased fiber, 72.7% increased fruit/vegetables, and 67.4% increased sun-safe behaviors within 1 month of diagnosis. Furthermore, 88.7% had decreased their fat intake, 85.5% decreased the amount of takeaway food, 89.7% increased their fiber intake, 90.9% increased their fruit/vegetable intake, and 87.0% increased their sun safe behaviors within 6 months of their diagnosis.

Table 4. Health behavior changes in cancer survivors by demographics and time since diagnosis (*N*, %)

	Decreased fat	Increased fiber	Increased fruit/vegetable	Decreased takeaway	Increased sun-safe	Increased activity
Treatment						
Yes	17 (81.0)	17 (73.9)	17 (81.0)	15 (78.9)	10 (71.4)	9 (30.0)
No	44 (81.5)	51 (82.3)	49 (86.0)	40 (78.4)	36 (78.3)	25 (31.3)
Diagnosis						
≤2 years	15 (75.0)	16 (72.3)	20 (83.3)	15 (71.4)	12 (70.6)	9 (30.0)
>2 years	45 (83.3)	51 (82.3)	45 (84.9)	39 (81.3)	33 (78.6)	24 (32.4)

	Decreased fat		Increased fiber		Increased fruit/vegetable		Decreased takeaway		Increased sun-safe		Increased activity
Cancer type											
Breast	25 (86.2)		27 (84.4)		26 (86.7)		21 (80.5)		17 (77.3)		14 (34.1)
Other	31 (79.5)		34 (77.3)		33 (84.6)		28 (77.8)		25 (78.1)		16 (28.1)
Age											
≤55	25 (67.6)		28 (65.1)		30 (75.0)		23 (65.7)		21 (65.6)		13 (23.2)
>55	35 (94.6)	**	39 (95.1)	**	35 (94.6)	*	31 (91.2)	*	24 (82.8)		20 (38.5)
Education											
≤10 years	18 (85.7)		24 (85.7)		22 (88.0)		18 (78.3)		13 (72.2)		11 (26.2)
12 year/trade	23 (82.1)		22 (73.3)		22 (81.5)		20 (80.0)		18 (78.3)		13 (35.1)
Tertiary	19 (76.0)		20 (80.0)		20 (83.3)		16 (76.2)		13 (76.5)		8 (28.6)
Marital status											
Single	18 (81.8)		19 (79.2)		22 (79.2)		17 (77.3)		15 (75.0)		10 (27.8)
Married	42 (80.8)		47 (79.7)		42 (82.4)		37 (78.7)		29 (76.3)		22 (31.0)
Job status											
Employed	15 (71.4)		13 (61.9)		15 (75)		13 (68.4)		12 (70.6)		7 (29.2)
Not employed	45 (84.9)		54 (85.7)	*	50 (87.7)		41 (82.0)		33 (78.6)		26 (31.0)

*p < 0.05

**p < 0.01

***p < 0.001

Differences in health behavior changes were compared across education, marital status, employment status, cancer type, time since diagnosis, and age. Due to the low numbers of men ($n = 17$), differences in gender could not be meaningfully examined. Furthermore, differences in smoking cessation were not examined given the low number of cancer survivors who reported quitting smoking ($n = 10$). To assist in examining the effects of marital status on health behavior changes, we combined the single, divorced, and widowed into one 'single' group and married and defacto into a 'married' group. No significant differences were found between groups. Similarly, there was no difference in health behavior changes depending on the time since diagnosis or education level. To compare health behavior changes as a function of age, the ≤ 35 age group with the 36- to 55-year age group were combined given the low number of individuals ≤ 35 ($N = 6$). It is unlikely that this had any major bearing on the results because four of the six individuals were aged 33 to 35. These results indicated that older cancer survivors were more likely to decrease their intake of fat ($\chi^2_{(1)} = 7.136, p < 0.01$) and amount of takeaway food ($\chi^2_{(1)} = 5.161, p < 0.05$), and increase fiber ($\chi^2_{(1)} = 9.921, p < 0.01$) and fruit/vegetable intake ($\chi^2_{(1)} = 4.219, p < 0.05$; see Table 4). An effect of employment status was also observed, with more employed individuals increasing the intake of fiber compared to those not employed ($\chi^2_{(1)} = 4.155, p < 0.05$).

Health behavior changes in individuals without a cancer diagnosis

For individuals with a friend or relative diagnosed with cancer, 24.3% reported an increase in physical activity, and 36.2% of smokers reported quitting (Table 5). The majority of individuals reported more sun-safe behavior (59.0%) and positive dietary changes. For example, 58.5% of individuals increased their intake of fruit and vegetables, 53.2% decreased fat intake, 52.8% increased fiber, and 50.4% decreased their consumption of takeaway food.

Table 5. Health behavior change in individuals without cancer by demographics and perceived risk of cancer

(N, %)

	Decreased fat		Increased fiber		Increased fruit/vegetable		Decreased takeaway		Increased sun-safe behavior		Quit smoking	Increased activity	
Men	25 (45.5)		25 (49.1)		33 (56.9)		26 (47.2)		32 (56.9)		6 (40.0)	20 (22.0)	
Women	116 (55.5)		115 (54.0)		137 (59.1)		103 (51.5)		116 (59.8)		20 (36.4)	97 (25.2)	
Age													
≤35	33 (40.2)		27 (33.8)		44 (50.0)		35 (42.2)		38 (49.4)		6 (40.0)	33 (25.6)	
36–55	66 (55.9)		71 (57.3)		77 (57.9)		57 (50.4)		72 (63.2)		20 (36.4)	51 (22.7)	
>55	42 (65.6)	**	45 (68.2)	***	49 (71.0)	*	36 (63.2)	*	35 (64.8)	***	7 (50.0)	33 (27.0)	
Education													
≤10 years	52 (56.5)		50 (54.9)		60 (61.2)		42 (51.2)		43 (56.6)		6 (28.6)	39 (23.4)	
12 years/trade	39 (44.3)		41 (46.6)		52 (52.5)		41 (46.6)		47 (56.0)		11 (39.3)	42 (27.3)	
Tertiary	48 (58.5)		50 (56.8)		56 (62.2)		43 (53.8)		53 (64.6)		8 (40.0)	34 (22.7)	
F/Friends													
≤3	55 (47.8)		53 (45.7)		65 (52.8)		48 (43.2)		57 (53.3)		10 (31.3)	43 (22.2)	
3+	86 (57.7)		90 (58.4)	****	105 (62.9)		80 (56.3)	****	88 (63.8)		15 (40.5)	72 (25.7)	
Marital													
Single	38 (46.9)		38 (45.2)		49 (54.4)		38 (47.5)		40 (53.3)		10 (38.5)	30 (26.0)	
Married	102 (55.7)		104 (56.2)		120 (60.3)		89 (51.7)		104 (61.5)		15 (34.9)	76 (23.5)	
Risk													
Less	17 (48.6)		27 (48.6)		20 (51.3)		13 (39.4)		15 (46.9)		4 (50.0)	17 (26.6)	
Average	86 (52.4)		85 (52.5)		102 (58.6)		72 (48.3)		80 (56.7)		13 (32.5)	60 (20.2)	
More	37 (57.8)		40 (56.3)		46 (62.2)		42 (60.9)		49 (70.0)	****	7 (38.9)	35 (33.3)	*
Job status													
Employed	102 (57.3)		97 (54.5)		112 (60.2)		88 (52.7)		92 (59.0)		13 (31.7)	80 (26.1)	

	Decreased fat		Increased fiber		Increased fruit/vegetable		Decreased takeaway		Increased sun-safe behavior		Quit smoking	Increased activity
Not employed	38 (44.2)	****	45 (49.5)		57 (55.3)		39 (45.9)		52 (59.1)		11 (40.7)	35 (21.0)

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

**** $p < 0.06$

Differences in health behavior changes were again examined as a function of age, gender, education, perception of cancer risk, marital status, work status, and the number of friends or family diagnosed with cancer. As the age increased the proportion of individuals reporting positive changes in health also increased. This occurred for a significant decrease in fat ($\chi^2_{(2)} = 9.851, p < 0.01$) and a near significant decrease in takeaway food ($\chi^2_{(2)} = 5.958, p = .051$). There were also significant increases in fiber intake ($\chi^2_{(2)} = 18.908, p < 0.001$), fruit/vegetables ($\chi^2_{(2)} = 7.094, p < 0.05$), and sun-safe behaviors ($\chi^2_{(2)} = 25.704, p < 0.001$) with age (Table 5).

There were no differences in health behavior changes as a function of gender, marital status or education level (see Table 5). Individuals with a greater perceived risk of cancer showed a trend to increasing sun-safe behaviors ($\chi^2_{(2)} = 5.749, p = 0.056$) and were also more likely to increase their physical activity levels ($\chi^2_{(2)} = 7.586, p < 0.05$). The effects of the number of family members and friends diagnosed with cancer were initially examined separately, and no differences in health behaviour changes were noted. This could have been confounded because participants who knew of friends diagnosed with cancer tended to also have family members diagnosed with cancer. Hence, the effects of the number of friends and family diagnosed with cancer could not be meaningfully separated. As a consequence, we combined the number of friends and

family diagnosed with cancer. The results indicated that knowing more than three family members or friends with a cancer diagnosis led to a near significant increase in fiber intake ($\chi^2_{(1)} = 3.822, p = 0.051$) and a near significant decrease in takeaway food ($\chi^2_{(1)} = 3.766, p = 0.052$).

A comparison of health behavior changes

In the final stage of analysis, health behavior changes were compared between cancer survivors and friends/family of cancer survivors. Changes in physical activity levels and smoking behavior did not differ significantly between individuals with and without a cancer diagnosis. However, cancer survivors increased their sun-safe behaviors compared to participants without a cancer diagnosis ($\chi^2_{(1)} = 21.026, p = 0.000$). Cancer survivors also differed significantly from non-cancer participants in terms of the proportion who decreased fat consumption ($\chi^2_{(1)} = 19.321, p = 0.000$), increased fiber consumption ($\chi^2_{(1)} = 18.897, p = 0.000$), increased fruit/vegetables ($\chi^2_{(1)} = 16.721, p = 0.000$), and decreased amount of takeaway ($\chi^2_{(1)} = 18.414, p = 0.000$). This indicated that cancer survivors made more positive dietary changes compared to non-cancer family and friends (Table 6).

Table 6. A comparison of health behavior changes in individuals with and without a cancer diagnosis

Health behavior change	Cancer	Non-cancer	Significance
Decreased fat	61 (82.4)	141 (53.9)	***
Increased fiber	66 (80.5)	143 (53.1)	***
Increased fruit/vegetable	65 (84.4)	170 (58.5)	***
Decreased takeaway	56 (80.0)	128 (50.4)	***
Increased sun-safe	45 (77.6)	145 (59.0)	***
Quit smoking	10 (50.0)	25 (36.2)	ns

Health behavior change	Cancer	Non-cancer	Significance
Increased physical activity	33 (30.6)	115 (32.0)	ns

***p < 0.001

Discussion

Several studies have reported that many cancer survivors engage in unhealthy behaviors such as poor diet and low physical activity levels [15, 18] that could increase their risk of other chronic disease. However, few prior studies have specifically asked about changes in dietary intake and physical activity since their cancer diagnosis as opposed to current prevalence rates. The relevant studies that have done this suggest that cancer survivors appear motivated to improve their health behaviors and that some do make health behavior changes. Lemon et al. [25] also suggested that the diagnosis of cancer could motivate the family of cancer survivors to make health behavior changes. The aim of this study was to further explore the effect of a cancer diagnosis on the health behaviors of the survivor and their family and close friends.

An increased consumption of fruit and vegetables was reported by 84% of the cancer survivors in this study. This positive finding is comparable to the results obtained by Maunsell and colleagues [28], where 72% of participants increased their consumption, but is much higher than the 45% reported by Patterson et al. [34]. This study also found that a much higher proportion of participants had decreased the amount of fat in the diet compared to the Patterson sample (81 versus 28.5%). Questions used in this study were similar to the Blanchard et al. [9] study making results more comparable. Comparison of results for this study and the Blanchard study respectively include the following: 15.3% of the survivors were current smokers with 50% quitting compared to 18% with 46% quitting, 81% reduced fat intake compared to 50.6%, 80% increased fiber intake compared to 43.5%, and 31% increased exercise compared to 15.7%.

The results of the current study, therefore, indicate that a substantial proportion of cancer survivors made positive health behavior changes after their diagnosis. Of those who made a positive health behavior change, most made this change within 6 months of diagnosis. Age was consistently associated with improving dietary behaviors, and like prior studies [9, 34], no significant differences were found between men and women. The variables that had not been previously examined for association with behaviour change following a cancer diagnosis, such as marital and work status, were not found to influence changes in health behaviour.

Differences across studies could reflect different demographics because the majority of cancer survivors in the current study were diagnosed with breast cancer. Although we did not find any evidence for differences in behavior changes due to cancer type, this could be due to a small proportion of other cancer types. For example, Patterson et al. [34] examined equal proportions of breast, prostate, and colon cancer. It is possible that health behavior changes differ across cancer types, and this should be further examined in future studies. There were also differences in recruitment strategies across studies. The sample in this study could have perhaps been more motivated as the recruitment strategy was proactive (survey had to be returned by mail), whereas the Patterson sample was contacted by telephone, and the Blanchard sample was approached in clinics.

These results suggest that cancer survivors may be motivated to make positive dietary changes to improve their health. Cancer survivors were asked to self-report whether or not they had increased exercise levels after their cancer diagnosis, and 31.3% reported an increase. Survivors (71.7%) reported currently taking part in enough physical activity to meet the recommended guidelines for health benefits [12, 45]. This is much higher than the 25% reported by Bellizzi et al. [8]. However, these authors asked about frequency and duration of moderate and vigorous activities conducted on at least 5 days week, whereas the current study additionally asked about frequency and duration of walking activity. These variations in measurement across

studies could have contributed towards the diverse results and may have resulted in the over-reporting of total physical activity in the current study. However, the active Australia survey has reported adequate test–retest reliability [3]. It is also possible that the current sample could reflect a group that is more active than the general population. The results were more comparable to a study of breast cancer survivors, where 42% reported having increased exercise participation due to their cancer, and 67% currently engaged in a moderate intensity exercise [37].

A diagnosis of cancer did appear to act as a ‘teachable moment’ for increasing physical activity among this sample of cancer survivors. However, the majority of cancer survivors maintained the same level and a small proportion even decreased physical activity post diagnosis. This is concerning because physical activity is a practical and effective way to combat many side effects of cancer treatment and also to improve quality of life [31–33]. It is possible that many health practitioners encourage cancer survivors to make positive changes in their diets and to quit smoking, but may not be as encouraging with regards to physical activity. The importance of physical activity after a cancer diagnosis may not be as widely recognized as dietary change. Alternatively, dietary changes may seem easier to cancer survivors and may be viewed as more crucial for protection from risk of further illness compared to physical activity. The non-cancer group was younger than the cancer group, and this could explain why changes in physical activity did not differ significantly, whereas the cancer group made many more dietary changes.

The secondary aim of the current study was to determine whether cancer diagnosis served as a teachable moment or a ‘cue to action’ for the friends and family of cancer survivors to improve health behaviors. A strength of this study was that 81.3% of the participants reported having one or more immediate family members and 68.6% having at least one friend diagnosed with cancer. This resulted in a unique opportunity to compare any changes in health behaviors of family and friends against those of cancer survivors.

For individuals with a friend or relative diagnosed with cancer, the majority made improvements to their diet. This would suggest that the diagnosis of cancer does motivate the friends and family of cancer survivors to make positive dietary changes (50 to 59%) and is consistent with, although a lot higher than, the trends observed by Lemon et al. [25] in FDFR (20 to 22%). However, more cancer survivors made positive dietary changes compared to the friends and family of the cancer survivors, which suggests that cancer had more impact on the survivor as would be expected.

We also found that 24% of the friends and family reported an increase in physical activity, and 36% of those who smoked had quit. These results are more consistent with the increases in physical activity (25%) and smoking cessation (21%) reported by Lemon et al. [25]. The differences in physical activity levels between the cancer survivors and the non-cancer participants were not significant.

The number of family members or friends was not found to influence changes to health behaviors in family and friends, and as for the cancer group, significant differences were found by age, but not by gender or education level. Although smaller proportions of the non-cancer group reported making changes to health behaviors as would be expected compared to the cancer survivors themselves, quite substantial improvements in diet were reported. Again, dietary changes may seem easier and may be viewed as crucial for protection from risk compared to increasing their physical activity habits. A possible explanation for the greater proportion reporting dietary change among the older age group is the high salience of their mortality, and/or the likely age of known family member/friends diagnosed.

Interestingly, a greater proportion of family and friends who perceived they were at greater risk of developing cancer themselves had increased physical activity and sun-smart behavior but had not improved dietary habits, although a trend in this direction was shown. Contrary to expectations, the length of time since the family member or friend was diagnosed was not found to be predictive.

There were several limitations to this study. Respondents were attending a walking event, and this could have resulted in a sample that was motivated to improve health behaviors. However, this gave us access to a large number of non-cancer people associated with individuals that did have cancer. The proportion of respondents with cancer was much smaller than the proportion without cancer, and the majority of respondents were women with breast cancer. This limited some analyses and may also limit the generalizability of findings.

Conclusions and future research

The health belief model could serve as a useful framework for future research investigating health behavior changes in family and friends of cancer survivors [23]. This model posits that health behavior changes are influenced by a range of psychological factors, such as 'self-efficacy', 'perceived susceptibility', and 'cues to action'. The current results suggest that 'perceived susceptibility' could have been related to increased physical activity and improved sun-safe behavior. It is also possible that important 'cues to action' such as the effect of the media and cancer symptoms could also be important within the context of cancer as a 'teachable moment'. These factors should be addressed in future research.

For the sample in this study, a personal diagnosis of cancer, or a diagnosis in a family member or friend, may have acted as a 'cue to action' to improve lifestyle health behaviors. This field of research is still at an early stage, and further studies are needed to confirm if this situation could be useful as a 'teachable moment' for intervention purposes. Longitudinal studies, in particular, will gauge more accurately any changes made since diagnosis. A cancer diagnosis may be an advantageous moment for an effective intervention as motivation to change lifestyle behaviors may be heightened. Whether it can be a 'teachable moment' in family and friends will depend on the extent to which the cancer diagnosis prompts a strong emotional response, whether the individual's perception of their risk for cancer increases, and whether they believe a behavior change will help reduce the risk.

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