



Conference on ‘Diet, nutrition and the changing face of cancer survivorship’ Symposium 4: Wider public health implications for life beyond cancer

Dietary interventions for cancer survivors

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This review evaluates evidence on dietary interventions for cancer survivors giving an overview of people’s views and preferences for service attributes and provides a narrative review. After cancer, people often want to change their diet and there is a plethora of evidence why dietary optimisation would be beneficial. However, cancer survivors have different preferences about attributes of services including: place, person and communication mode. Randomised control trials have been reviewed to provide a narrative summary of evidence of dietary interventions. Most studies were on survivors of breast cancer, with a few on colorectal, prostate and gynaecological survivors. Telephone interventions were the most frequently reported means of providing advice and dietitians were most likely to communicate advice. Dietary assessment methods used were FFQ, food diaries and 24-h recalls. Dietary interventions were shown to increase intake of fruit and vegetables, dietary fibre, and improve diet quality in some studies but with contradictory findings in others. Telephone advice increased fruit and vegetable intake primarily in women with breast cancer and at some time points in people after colorectal cancer, but findings were inconsistent. Findings from mail interventions were contradictory, although diet quality improved in some studies. Web-based and group sessions had limited benefits. There is some evidence that dietary interventions improve diet quality and some aspects of nutritional intake in cancer survivors. However, due to contradictory findings between studies and cancer sites, short term follow-up and surrogate endpoints it is difficult to decipher the evidence base.

Cancer: Survivorship: Dietary interventions: Fibre

The number of people living beyond a cancer diagnosis in the UK is currently estimated at 2 million people⁽¹⁾. It is predicted to increase in the UK and estimated that by 2024 nearly a quarter of people aged over 65 years will be a cancer survivor⁽¹⁾. These figures are mirrored internationally with the number of people surviving cancer currently at 14.5 million in North America, which is set to reach 19 million by 2024⁽²⁾. People are living longer after a cancer diagnosis due to a higher incidence of cancers being diagnosed and treated in the ageing population combined with improvements in anticancer therapies⁽²⁾. The health and wellbeing of cancer survivors has subsequently become an important topic for both healthcare professionals and researchers⁽³⁾.

Healthcare needs of those who have survived cancer reflect the needs of those in other chronic diseases and are often complex^(4,5). It is therefore becoming essential to act to meet the needs of this growing population due to the estimated increased demand for healthcare resources and societal impact^(6,7). These include direct health care costs, out of pocket costs for patients and their families, informal carer costs and productivity losses as well as decreased health related quality of life⁽⁷⁾.

Even though there are similarities with other chronic conditions, people living after cancer have been shown to have increased levels of motivation for a healthier life style⁽⁸⁾. Experiencing cancer is often seen as a critical

Abbreviations: DQI, diet quality index; DCE, discrete choice experiments; RCT, randomised control trials.

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life changing event that acts as a catalyst for people to change their priorities⁽⁹⁾ and 50–80 % of post-treatment cancer survivors have been shown to make positive lifestyle modifications⁽¹⁰⁾. This is often termed the ‘teachable moment’ and refers to a time healthcare professionals may be able to positively intervene coined ‘riding the crest of the wave’⁽¹¹⁾. This has led to a surge of research targeting this time point aiming to capitalise on increased motivation required for altering lifestyle behaviours in relation to both diet and activity^(12–14).

Increased motivation or intention to act is not always translated into healthier lifestyle choices, as has been demonstrated in a large prospective study showing that people after cancer did not change their behaviour in relation to smoking, alcohol or physical activity⁽¹⁵⁾. This indicates that more needs to be done to capitalise on motivation with specific targeted interventions. Diet is part of a healthy lifestyle and there are specific nutritional recommendations for the prevention of cancer that are mirrored for people living after cancer⁽¹⁶⁾. Risk of death is inversely related to these recommendations and this has been demonstrated in an analysis of 378 863 participants that shows people who followed a greater number of these recommendations had a 34 % lower hazard ratio than those following only a few⁽¹⁷⁾.

The association between dietary intake and a number of cancers is now well established from epidemiological data on dietary patterns associated with elevated risk⁽¹⁶⁾.

High fat, low dietary fibre, low consumption of fruit and vegetables and high refined carbohydrate are well documented dietary patterns associated with increased risk^(18–20). A high BMI has also been shown to increase risk of some cancers⁽²¹⁾. Recommendations are based on large cohort studies and meta-analyses for the prevention of cancer and these recommendations are also relevant for people who have survived a cancer diagnosis. However, evidence from randomised control trials (RCT) demonstrating clinical benefit from dietary interventions in terms of mortality and morbidity are limited in cancer survivors⁽²²⁾. Nonetheless, there have been some positive outcomes for cancer survivors with regard to lowering BMI and improvements have been shown in dietary intake and anthropometry, aligned to cancer prevention recommendations⁽²³⁾.

The rationale for dietary manipulation alone or in conjunction with lifestyle modifications is based not only on evidence for cancer prevention but also on information relating to individuals’ experiences of living beyond cancer. People who have survived cancer have a higher incidence of CVD, diabetes and secondary malignancies after cancer and treatment^(24,25), and 47 % were found to have at least one or more co-morbidities in addition to cancer^(4,26). The occurrence of at least one or more chronic conditions was higher in those after cancer compared with age–sex matched controls with the greatest differences in heart disease, respiratory disorders, psychological disorders and urogenital conditions⁽²⁷⁾. CVD is greater in people after anti-cancer therapy and this is now well established in a number of studies, which concentrate on different cancer sites including breasts, endometrial, testicular, brain and

head and neck tumours^(28–30). On-going health care problems that exist secondary to cancer and its treatments can now be assessed using validated tools such as the Cancer Survivors Core Set to allow identification of health care issues⁽³¹⁾.

A greater number of general practitioners visits, more medical prescriptions and home visits were observed in people who had a cancer diagnosis when compared with controls⁽²⁷⁾. The combination of a higher rate of co-morbidities and an increased need for utilising healthcare resources leads to increase costs for the provision of healthcare for those who have survived cancer⁽²⁵⁾.

The rationale for promoting healthy lifestyles in people who have survived cancer has been outlined with justifications based on clinical outcomes from cohort studies and evidence gained from epidemiological studies on diet and cancer⁽³²⁾. Thus further discussion in this review will develop to give an overview of data surrounding motivation for change in cancer survivors and individuals’ preferences for the provision of dietary interventions after cancer. Finally, a narrative overview is presented of RCT on dietary interventions for people after a cancer diagnosis.

Motivation for change

It has been established that people living beyond cancer change their dietary intake and seek information to enable them to make healthier lifestyle choices. Women living after breast cancer were found to increase their intake of fruit and vegetables, whole grains and lean sources of protein, and decreased their intake of fat, sugar, red meat, coffee and some alcoholic drinks⁽³²⁾. The use of supplements also increased to 62 %, albeit, 56 % of women prior to diagnosis were already taking a supplement; those most frequently taken were fish oils, multivitamin and minerals, and evening primrose oil⁽³²⁾. Dietary modifications were observed in women after being diagnosed with breast cancer in Malaysia; two-thirds were found to have decreased energy, protein, total fat and vitamin E, and increased carotene and vitamin C⁽³³⁾. Similar results have been found in people who survived cancer in the USA and UK^(34,35). Women with a diagnosis of breast cancer were motivated to change dietary behaviours because they were advised by their doctor, they received advice from a dietitian or stated they wanted to help cure their cancer⁽³³⁾.

Qualitative evidence

From semi-structured interviews in people living after colorectal, breast and prostate cancer it has been found that people actively engage in meal planning and healthy food choices after surgery. Whilst, others engaged family members for support or focused on dietary health messages about decreasing fat and increasing fruit and vegetables^(36,37). Conversely, a minority reported that they were reluctant to engage in any dietary modification⁽³⁶⁾. From these interviews people after a diagnosis



of colorectal cancer were classified as active, reluctant and resistant changers. Those classed as active changers were knowledgeable about healthy eating and some mentioned dietary messages specific to colorectal cancer quoting advice to decrease processed meat products and red meat, whilst others took a more holistic approach to their diet involving multiple food groups. Those classed as reluctant changers reported that they felt change was necessary. However, they embraced dietary modification with a degree of apprehension and out of a sense of need. Those classed as resistant changers did not report any diet or lifestyle changes and justified their reasoning.

The majority of those interviewed were positive about dietary modifications and were classified as active changers having made positive behavioural changes; only a few had not changed their behaviour, and some reluctant changers indicated they had made changes, albeit out of necessity or family pressure. Quotations that are reflective of responses for the active, reluctant and resistant changers are shown in Table 1. The quotations demonstrate that people after cancer were knowledgeable about dietary intake and cancer prevention and had actively engaged in positive change. The common food groups changed included red meat, processed foods, fruit and vegetables. Quotations from cancer survivors support other documented evidence of high levels of motivation in people after cancer relating to dietary behaviours⁽³⁷⁾.

What are cancer survivors' preferences for healthy eating interventions?

It is acknowledged that a large proportion of people seek information after a cancer diagnosis, although few studies have asked survivors their preferences for obtaining information. One method of eliciting peoples' preferences for healthy eating and lifestyle advice is by using discrete choice experiments (DCE). Best worst choice DCE is a research method derived from health economics that determine which aspects of healthcare delivery are preferred by the user^(38–40). They use a set of scenarios with difference levels, which can include how, where, who and arbitrary costs that denote willingness to pay.

People's preferences for dietary interventions after colorectal cancer (n 179) were explored with DCE. The responses showed that most participants' preferred dietary advice provided by a bowel specialist nurse, at hospital and by an individual discussion either face-to-face or on the telephone⁽⁴¹⁾. The majority of participants did not like the scenario where advice was given by a general nurse, by email or in a group. From further analysis of the best worst DCE it was noted that there were inconsistencies within the data that were evident by contradictory findings between the best and worst preferences indicated by participants.

These contradictory findings were explored and showed that different groups could be identified within the cohort of colorectal cancer survivors. People who indicated they were meeting most of the dietary

recommendations and indicated they were low risk, were most likely to be young males and indicated they preferred to receive dietary information via email in their own home. People who were older preferred to access services locally and preferred one-to-one advice and were strongly averse to receiving information via email. Whereas, people who reported they were following fewer healthy eating recommendations preferred direct in-person communication at their own doctor's surgery and were averse to email and telephone modes of provision⁽⁴¹⁾.

DCE are an innovative way of exploring people's preferences for healthcare and demonstrate that different people had a variety of preferences for service attributes. This is important information as aligning service provision to cancer survivors' preferences may lead to increased uptake and effectiveness of interventions.

Dietary interventions

Dietary interventions that have been evaluated in the literature for people who have survived cancer include group sessions, face-to-face sessions, telephone and mailed interventions. Dietary interventions have focused on either weight management strategies or healthy eating recommendations.

This narrative review is limited to adults and people who had completed all cancer treatment and were disease free. However, it is noteworthy that the most desirable point for providing the lifestyle intervention is somewhat controversial. Some trials have recruited people prior to treatment for cancer from colorectal cancer screening programmes⁽⁴²⁾, whilst others have attempted to pin point the 'teachable moment'⁽⁴³⁾. Moreover, now with new biological therapies people with cancer are actively treated after standard therapies to prolong survival for long periods of time, so are living with cancer⁽⁴⁴⁾. The only comparisons discussed are those including dietary interventions compared with control or usual care. There have been a variety of outcomes reported in dietary intervention studies and these are shown in Table 2.

The main mode of providing information found within RCT are telephone, mail, web-based, individual face-to-face or group sessions. The most frequently used primary delivery modes for reviewed studies are outlined in Fig. 1. However, the majority of dietary interventions described used more than one mode to deliver dietary advice. The primary intervention identified for each study was the mode assessed as being most labour intensive in relation to staffing resources or that most frequently delivered to participants. All the dietary interventions described for each study are outlined in Table 3.

Behavioural change theory has been included in some of the dietary interventions used in the clinical trials undertaken to evaluate dietary interventions in people surviving cancer. The transtheoretical model with social cognitive theory was used in four studies^(45–48). Social cognitive theory was used in six studies, which was the

Table 1. Quotations from people after colorectal cancer**Active changers**

'I'm very careful to make sure I have the five fruit or veg a day. I used to try before but now I definitely make sure that I do and I don't eat as much red meat.' (69-year old lady who had survived colon cancer).

'I make a point of trying to have my...at least five a day. Yeah. Less rubbish and I don't... eat processed foods very much' (84-year old man after colon cancer).

'I cut out meat, I didn't cut it out altogether but I stopped eating a lot of meat because I associated that with the cancer' (73-year old man after colon cancer).

Reluctant changers

'I tried to eat broccoli and all that, I never ate it before, you know, more veg. I wasn't all that keen on it, you know' (74-year old lady who survived colon cancer).

'Err yes, try to eat more healthy stuff, I am still eating the bad stuff like crisps and chocolate and stuff but not really to the extent I was doing before' (47-year old man who survived colon cancer).

Resistant changers

'It's just one of them things, you know, it's, um, it's very genetic, it's just no matter what food you eat' (70-year old lady, who survived colon cancer).

'It's pretty hard to say it's not going to come back, or try to prevent it, unless they can say it was this what gave me the cancer, it was this food what gave me the cancer, then you would probably leave that food alone. So I'm not quite sure how you're going to prevent it the cancer from coming back' (62-year old man with rectal cancer).

Table 2. Dietary outcomes reported in the included studies

Author	Primary delivery	Energy	Fruit	Veg	Fruit and veg	Fibre	DQI/HEI	Other
Befort ⁽⁷³⁾	Telephone							
Bloom ⁽⁶⁶⁾	Group					✓		Frequency of non-fat, low fat foods
Bourke ⁽⁵⁵⁾	Group	✓				✓		Fat, CHO, SFA, MUFA, starch, PUFA, alcohol cholesterol, sugars Vitamins E and C
Demark-Wahnefried ⁽⁵⁸⁾	Telephone				✓		✓	Percentage kJ from fat
Demark-Wahnefried ⁽⁴⁹⁾	Mail	✓					✓	
Demark-Wahnefried ⁽⁴⁶⁾	Telephone				✓		✓	Percentage energy from fat, SFA
Djuric ⁽⁵⁰⁾	Group, Individual	✓						Fat
Ghavami ⁽⁷⁴⁾	Individual							
Greenlee ⁽⁴⁷⁾	Group	✓			✓	✓		Protein, wholegrains percentage of energy from fat, SFA, PUFA, MUFA
Greenlee ⁽⁶⁵⁾	Group	✓	✓	✓	✓			
Gruenigen ⁽⁵¹⁾	Individual	✓	✓	✓	✓			
Harrigan ⁽⁵²⁾	Individual				✓	✓		Fat, sugar
Hawkes ⁽⁵⁹⁾	Telephone		✓	✓	✓	✓		Fat, SFA, alcohol
Kanera ⁽⁶⁹⁾	Web			✓				
Kim ⁽⁶²⁾	Telephone						✓	
Mefferd ⁽⁷¹⁾	Telephone							
Morey ⁽⁶⁰⁾	Telephone				✓			
Park ⁽⁴³⁾	Mail				✓			Fat
Pierce ⁽²²⁾	Telephone	✓	✓	✓	✓	✓		
Reeves ⁽⁵⁶⁾	Telephone	✓		✓				Fat, SFA, carbohydrates
Scott 2013 ⁽⁶⁸⁾	Individual	✓						Protein, carbohydrate, percentage energy from fat
Sheppard ⁽⁵⁷⁾	Telephone	✓				✓		Percentage energy from fat, fat
Swisher ⁽⁷⁵⁾	Individual							
Yun ⁽⁶¹⁾	Telephone				✓			
Zick ⁽⁵³⁾	Telephone	✓	✓	✓				Wholegrains, fish, nuts, seeds

DQI, diet quality index; HEI, healthy eating index; CHO, carbohydrate.

most frequently reported behavioural change theory used^(22,49–53). Other methods reported included acceptance and commitment theory, transtheoretical model used on its own and cognitive behavioural therapy. It is surprising that some studies conducted over the past decade failed to incorporate behavioural change theory in

light of the evidence supporting the integration of psychological theory into interventions that require substantial behavioural change for individuals⁽⁵⁴⁾.

Dietitians delivered the dietary interventions in seven of the studies and a mixture of other professional groups and trained personnel provided interventions in the other

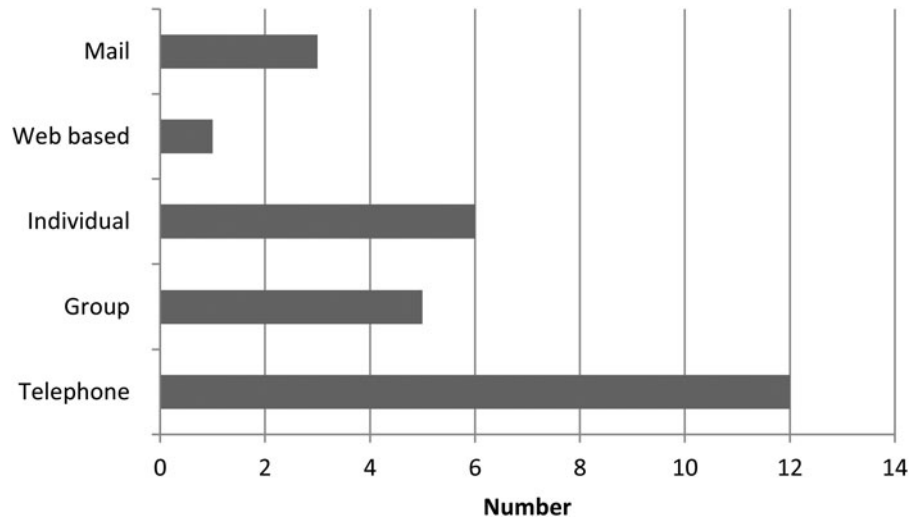


Fig. 1. Modes of providing dietary advice in all comparisons.

Table 3. All modes of providing dietary intervention in the studies

Author	Telephone	Mail	Web-based	Individual face-to-face	Group face-to-face (workshop)
Beford ⁽⁷³⁾	*				
Bloom ⁽⁶⁶⁾					✓
Bourke ⁽⁵⁵⁾			✓		✓
Demark-Wahnefried ⁽⁵⁸⁾	✓	✓			
Demark-Wahnefried ⁽⁴⁹⁾		✓			
Demark-Wahnefried ⁽⁴⁶⁾		✓			
Djuric ⁽⁵⁰⁾		✓		✓	✓
Ghavami ⁽⁷⁴⁾				✓	*
Greenlee ⁽⁴⁷⁾					✓
Greenlee ⁽⁶⁵⁾					✓
Gruenigen ⁽⁵¹⁾		✓		✓	
Harrigan ⁽⁵²⁾	✓			✓	
Hawkes ⁽⁵⁹⁾	✓	✓			
Kanera ⁽⁶⁹⁾			✓		
Kim ⁽⁶²⁾	✓				✓
Mefferd ⁽⁷¹⁾	*				*
Morey ⁽⁶⁰⁾	✓	✓			
Park ⁽⁴³⁾		✓			
Pierce ⁽²²⁾	✓	✓			✓
Reeves ⁽⁶⁶⁾	✓				
Scott ⁽⁶⁸⁾				✓	
Sheppard ⁽⁵⁷⁾	✓				
Swisher ⁽⁷⁵⁾				*	*
Yun ⁽⁶¹⁾	✓				
Zick ⁽⁵³⁾	✓			✓	

*Studies provided dietary intervention but outcomes were not reported.

trials (Fig. 2). Some interventions were delivered by the internet or mailed so did not require any personnel to facilitate provision. The dietary assessment methods included in RCT with food or nutritional outcomes varied considerably between studies. The most frequently used method to provide dietary intervention was by telephone contact, whilst a few used mail, individual face-to-face, group sessions or seminars and finally a few studies used web-based interventions (Fig. 3).

Telephone interventions

Dietary intervention provided by telephone assessed energy intake in five studies^(22,53,55-57). Two studies reported data after 3 months and there was no difference between the intervention and control arms^(53,55). After 6 and 12 months in one study including 3230 women after breast cancer there was again no difference between groups for energy intake⁽²²⁾. One study reported a trend

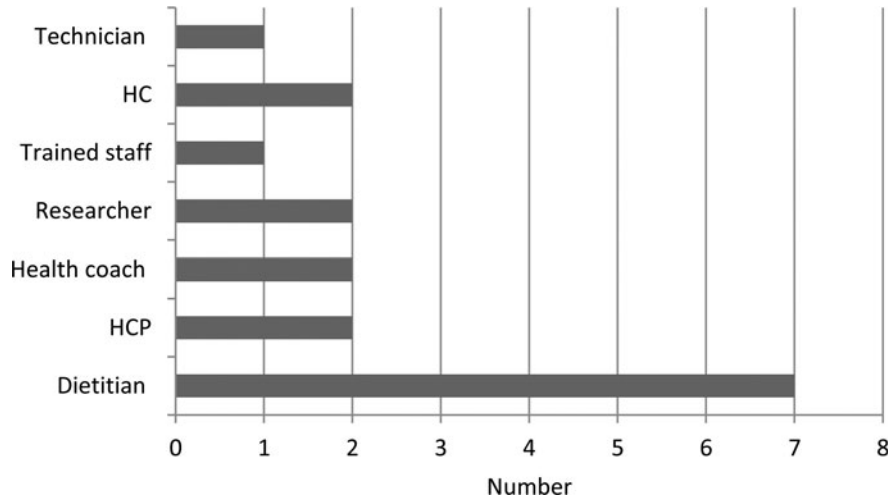


Fig. 2. Personnel providing dietary intervention in included studies. Four studies had no personnel; data from twenty three studies. HCP, health care professional; HC, health counselor.

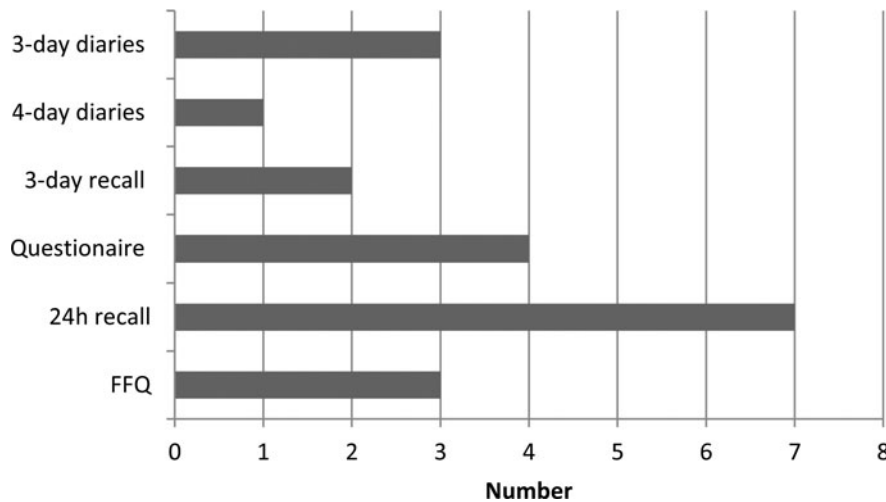


Fig. 3. Dietary assessment method used to assess food intake in the included studies.

towards reduction of energy in the intervention group after 3 months compared with baseline in obese black women after breast cancer (mean difference -867.34 kJ, $P=0.06$), albeit in a small sample size ($n=22$)⁽⁵⁷⁾. Evidence is showing that after cancer in studies recruiting people with difference types of cancer, there was no effect seen in the majority of studies in relation to energy intake. This finding was consistent even in a study targeting overweight or obese cancer survivors⁽⁵⁶⁾ although in one study a trend for a decrease in energy consumption was reported in obese black women who had survived breast cancer⁽⁵⁷⁾.

Fruit and vegetables servings were reported separately daily in women after breast cancer and an increase was seen at 6 and 12 months for vegetable intake, but for fruit there was no difference at 6 months but an increase after 12 months⁽²²⁾. This increase in fruit and vegetables

was seen in a large number of women after breast cancer in a well conducted trial, interestingly it was an intensive intervention combined with social cognitive theory⁽²²⁾. Similarly, the total number of fruit and vegetable portions were reported in people after colorectal, breast and prostate cancer⁽⁵⁸⁾ and no differences were demonstrated at 6- or 12-month follow-up. Fruit and vegetable intake were reported separately in 410 participants after colorectal cancer and no differences were shown for fruit after 6 and 12 months but vegetable intake increase after 6 months, although was not sustained at 12 months⁽⁵⁹⁾. Conversely, a study including participants with cancer at a number of sites including breast, colorectal and prostate in 641 cancer survivors measured daily servings of fruit and vegetables and showed a difference between the intervention group and control groups with older overweight long-term cancer survivors⁽⁶⁰⁾.

In two studies including women with breast cancer, change in fruit and vegetable intake was reported after 6 months and an increase was demonstrated in the intervention group in sixty-seven cancer survivors⁽⁵²⁾. However, the number of women who consumed more than five portions of fruit and vegetable daily⁽⁶¹⁾ was similar within groups at all time points reported.

Four studies reported dietary fibre intake^(22,52,57,59). One study⁽⁵⁷⁾ reported fibre intake at baseline in the intervention arm only (3 months 19.2 g SD 12.2 v. baseline 13.1 g SD 2.8, *n* 22). One study reported data at 6 months and 12 months⁽²²⁾ and an increase in dietary fibre intake was shown at both time points in a large number of women after breast cancer.

Two studies reported data as change scores, one at 6 months⁽⁵²⁾ where an increase in fibre was shown as grams per 1000kcal in the intervention compared with the control group. Albeit, these results were refuted in another study that showed no differences in dietary fibre intake at 6- or 12-month follow-up⁽⁵⁹⁾.

Diet quality index (DQI) was reported by two studies^(58,62). These studies used different DQI scores. In one study⁽⁵⁸⁾ higher scores on the DQI indicated a better quality diet⁽⁶³⁾ and data were reported at 6 months where an increase in diet quality was reported but not sustained at 12 months. In another study⁽⁶²⁾ the DQI was used and lower scores⁽⁶⁴⁾ indicated a better diet quality. The results were reported after 3 months in forty-five participants and no difference was seen.

From the studies reviewed in this narrative it was found that dietary intervention provided via the telephone did not influence energy intake. There were also inconsistencies in reporting fruit and vegetables but there was evidence from a large study that showed an improvement in fruit and vegetable intake in women after breast cancer⁽²²⁾. In three studies dietary intervention provided by the telephone was found to increase dietary fibre^(22,52,57) although one study found contradictory results⁽⁵⁹⁾. Some benefits were shown in diet quality at 6 months but not maintained at 12 months⁽⁵⁸⁾.

Workshops/seminars/group interventions

Five studies^(47,50,55,65,66) used primarily workshops, seminars or groups to deliver dietary interventions. Four of these studies reported on energy intake. One study reported energy intake at 3 months⁽⁵⁵⁾; one study reported energy at 6 months⁽⁴⁷⁾ and two studies after 12 months of follow-up and all showed no differences between groups^(47,65). In a further study⁽⁵⁰⁾, energy intake was reported after 12 months from a weight watchers intervention v. control but again no difference in energy intake was demonstrated, albeit this was a small study including only eighteen survivors of breast cancer.

Fruit and vegetables were reported in three of these studies. The participants increasing consumption of fruit and vegetables in both the intervention arm and the control group were very similar in one study⁽⁶⁶⁾. Fruit and vegetable consumption was reported by one study⁽⁴⁷⁾ at 6 and 12 months, with no difference

demonstrated between groups⁽⁴⁷⁾ and these results were mirrored again with women after breast cancer⁽⁶⁵⁾.

Fibre was reported by two studies where group sessions were evaluated. One study⁽⁵⁵⁾ reported at 3 months in eighteen survivors of colorectal cancer and there was a difference between groups although another study⁽⁴⁷⁾ after 6 and 12 months showed a null results.

Overall group sessions as a mode for providing a dietary intervention did not positively affect dietary intake for energy or fruit and vegetables. One small study showed a difference in dietary fibre⁽⁵⁵⁾. However, the studies discussed had small sample sizes and one was a pilot study⁽⁵⁰⁾, two studies recruited Hispanic women after breast cancer so were focusing on minority groups^(47,65) and one study using groups sessions targeted young breast cancer survivors⁽⁶⁶⁾. It can therefore justifiably be concluded that there is a paucity of evidence evaluating group sessions in all cancer types with large representative samples.

Mailed information

In three studies information was provided by mail. One study⁽⁴⁹⁾ reported on energy intake at 6 and 12 months in forty participants and found no difference between groups at either time point.

Two studies reported on fruit and vegetable servings. One study reported data at 12 months in 519 survivors showing an increased intake of fruit and vegetables in the intervention group compared with the control group in breast and prostate survivors⁽⁴⁶⁾. However another study reporting fruit and vegetable intake graphically, showed the opposite after 12 months⁽⁴³⁾. Two studies reported on diet quality and there was an improvement in diet quality in both studies favouring the dietary intervention group^(46,49). Diet quality was assessed using DQI⁽⁶³⁾.

Mailed dietary intervention did not affect energy intake although in some studies benefits were seen for fruit and vegetable intake and diet quality^(46,49). For a relatively cost-effective means of providing a dietary intervention the results are encouraging especially for an intervention where resources would be relatively low in relation to staffing and administration. It is noteworthy that the information packs provided to participants for the mailed intervention incorporated behavioural change theory and were designed encompassing participants feedback with extensive piloting and evaluation⁽⁶⁷⁾.

Individual face-to-face intervention

Four studies provided dietary intervention via individualised face-to-face consultations^(50-52,68). Energy intake was reported by one study in women after uterine cancer at 3 months⁽⁵¹⁾ and 12 months and there was no difference seen after each time point. Another study also reported there was no difference between groups for energy intake but no data were presented⁽⁶⁸⁾. Energy intake was reported in a small sample and again there

was no real difference between the individualised groups *v.* control⁽⁵⁰⁾. Fruit and vegetable servings were reported by one study⁽⁵¹⁾ after 12 months and no difference was shown, although in another study that reported change scores there was a difference between groups favouring the intervention group⁽⁵²⁾. In this same study a difference in dietary fibre intake was seen after 6 months. In summary face-to-face dietary intervention improved fruit and vegetable intake in one study⁽⁵²⁾ but not in another⁽⁵¹⁾ and dietary fibre⁽⁵²⁾ but none of the studies affected energy intake.

Web based

One study⁽⁶⁹⁾ provided dietary intervention via the internet and recorded vegetable consumption as an outcome at 6 and 12 months and no differences were demonstrated at either time point. In summary there is no evidence that a web-based intervention can improve fruit and vegetable intake.

Discussion

There is clear evidence supporting the link between cancer and dietary intake from a substantial amount of epidemiological evidence^(16,20). People living after cancer have an increased level of motivation for change⁽¹¹⁾, which is well documented with some people actively engaging in eating a healthier diet and following a healthier lifestyle after a diagnosis⁽³⁶⁾. This is supported within psychosocial research investigating motivation levels, intention and willingness to change, after a major life event where people reprioritise the importance of healthy behaviours in their lives⁽⁹⁾. People's lived experiences from qualitative interviews have supported these findings not only in colorectal cancer but in other cancer types^(36,37). It is therefore a logical next step from the evidence base to investigate ways to capitalise on increased awareness of healthier lifestyle initiatives after a diagnosis of cancer. There is evidence that cancer survivors use health care services more than their age matched peers⁽²⁶⁾. However, there is no evidence that dietary interventions can reduce morbidity and mortality over a period of 10 years in people after cancer^(22,26), although a decade may not be long enough for a dietary intervention to effect these outcomes. Albeit, in women who were given the intervention whilst still receiving treatment for breast cancer benefits of dietary intervention were demonstrated in a large trial in the USA in relation to recurrence free survival and disease free survival⁽⁷⁰⁾. It is difficult to conduct studies for long periods of time over a life course due to the difficulties of obtaining funding for long-term follow-up. Participants, who are lost to follow-up in RCT may be those that have higher rates of comorbidities and who are less committed to the intervention, introducing some degree of bias.

From studies reviewed the most favoured method of providing dietary interventions was via the telephone^(58,59,60,62,71), and this was often combined with

written materials⁽⁴⁶⁾ or lifestyle coaching⁽²²⁾. Overall there was evidence that telephone-based dietary interventions increased fruit and vegetables intake primarily in breast cancer⁽²²⁾ and at some time points in colorectal cancer and mixed cancer groups⁽⁵⁹⁾, although the benefits were not consistent across all the studies^(56,61). Dietary interventions were also shown to increase dietary fibre intake in women after breast cancer⁽²²⁾, although again this increase was not seen consistently⁽⁵⁹⁾. Diet quality also improved with telephone dietary intervention in one study with a mixed cancer cohort at 6 months but not 12 months⁽⁵⁸⁾ although this was not repeated in a study with breast cancer survivors using a different scale⁽⁶²⁾.

Dietary intervention provided in groups did not change energy intake^(47,50,55,65), nor fruit and vegetable intake overall as most studies did not report any increase^(47,65). Studies evaluating dietary interventions provided by mail only reported on a few dietary outcomes and for fruit and vegetable intake there were contradictory results between two studies^(43,46); however, diet quality in two mixed cancer cohorts was shown to improve^(46,49).

Dietary intervention provided by face-to-face consultations demonstrated a difference for fruit and vegetables and dietary fibre in women after breast cancer⁽⁵²⁾ but not after uterine cancer⁽⁵¹⁾. Again there was no change in energy intake⁽⁵⁰⁻⁵²⁾. The evaluation of web-based dietary intervention was limited and did not lead to any positive dietary modifications⁽⁶⁹⁾. The development of dietary interventions designed to be delivered via the internet is limited in cancer survivorship so this may be an area for future developments with the advent of advancing technologies leading to more interactive, user friendly packages.

There was limited success across all studies to modify energy intake. This is not really surprising as the dietary interventions were not necessarily focusing on reducing energy and predominantly were providing healthy eating dietary advice.

We present an overview of current RCT evaluating dietary interventions in people who have survived cancer. A limiting factor in the discussion is the absence of quality assessment using a recognised tool to determine the robustness of the evidence base. Some studies were subject to type two error due to small sample sizes and thus imprecision, whilst other studies had high risks to bias due to absence of blinding, lack of objective outcomes and high levels of attrition. The dietary outcomes reported were also limited in studies and all used a wide variety of dietary assessment methods to measure nutrients or food intake.

In conclusion, there is a lack of robust evidence that energy, fruit and vegetable intake, dietary fibre or overall diet quality can be improved in people who have survived cancer despite ample evidence linking a poor diet to cancer occurrence from population based studies⁽¹⁶⁾. None of the approaches to change diet, be they individual face-to-face, group, telephone, mail or internet based showed strong long-term effects on dietary variables other than the large studies with women with breast cancer⁽²²⁾. Whilst this is disappointing it is not surprising



given the difficulty of assessing habitual dietary intake and embedding the principles of behaviour change theory⁽⁷²⁾ into a long-term dietary intervention.

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Conflict of Interest

None.

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