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Promoting a Healthy Lifestyle among Cancer Survivors

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Abstract

In 2007, an estimated 1.6 million North Americans will be diagnosed with cancer. Given significant improvements in early detection and treatment, increasing numbers of patients can expect to be alive in five years. With improving longevity, the late-occurring adverse effects of cancer and its treatment are becoming increasingly apparent. As in other clinical populations, healthy lifestyle behaviors encompassing weight management, a healthy diet, regular exercise, and smoking cessation have the potential to significantly reduce morbidity and mortality in cancer survivors. This review will address: (1) the strength of evidence for recommendations in areas of weight management, diet, exercise and smoking cessation; and (2) the current evidence examining the efficacy of various intervention approaches to promote health behavior changes among adult cancer survivors.

Keywords

Neoplasms; Survivors; Life Style; Diet; Exercise; Smoking Cessation

Introduction

This year, roughly 1.6 million people in the United States and Canada will be diagnosed with cancer. (1,2) Given advances in early detection and treatment, two-thirds of those diagnosed with this disease can expect to be alive in 5-years. (1) These individuals will join the ever-expanding numbers of cancer survivors who now comprise 3–4% of the North American population.(3) While these statistics are encouraging, it is important to acknowledge that the impact of cancer is significant and associated with several long-term health and psychosocial sequelae.(4–18) In addition to risk for recurrence, data clearly show that compared to general age- and race-matched populations, cancer survivors are at greater risk for developing second malignancies, cardiovascular disease (CVD), diabetes, osteoporosis, and functional decline. (4–18) These comorbid conditions and competing causes of death are believed to result from cancer treatment, genetic predisposition and/or common lifestyle factors. (12,13,17)

In two recent Institute of Medicine reports entitled “From Cancer Patient to Cancer Survivor: Lost in Transition” and “Implementing Cancer Survivorship Care Planning,” the numerous health issues of cancer survivors were summarized, and the potential benefits of lifestyle

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modifications were reviewed.(19,20) Also during this period of time, the American Cancer Society (ACS) reissued its guide for Informed Choices on Nutrition and Physical Activity During and After Cancer Treatment.(21,22) Taken together, these reports serve as resources for health care providers, patient advocates, and other stakeholders to improve the health and well-being of this rapidly expanding and high risk population (see List 1 and List 2 for reproduced diet and physical activity guidelines published within the ACS report). The goal of this paper is to review these recommendations in light of more recent advances, with the following topic areas addressed: 1) strength of evidence for recommendations in areas of weight management, diet, exercise, and smoking cessation; and 2) current evidence examining the efficacy of various intervention approaches to promote health behavior changes among adult cancer survivors. To this end, an updated search of literature published on adult cancer survivors within the past two years was performed using CancerLit, PubMed, and Medline databases and employing search terms of cancer survivor(s) or neoplasms/survivor cross-referenced with MeSH terms of life style, health behavior, cardiovascular training, rehabilitation, physical fitness, physical activity, exercise, body weight, obesity, weight loss, diet, nutrition, tobacco, smoking cessation, and intervention studies. Relevant articles were then hand searched for pertinent previously published papers. Because prospective intervention studies offer the strongest evidence regarding potential benefit, we have excerpted key elements of recent lifestyle intervention trials that have health-related endpoints and have included this information in Table 1.

List 1. American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention

Maintain a healthy weight throughout life.

- Balance caloric intake with physical activity.
- Avoid excessive weight gain throughout the lifecycle.
- Achieve and maintain a healthy weight if currently overweight or obese.

Adopt a physically active lifestyle.

- Adults: engage in at least 30 minutes of moderate-to-vigorous physical activity, above usual activities, on 5 or more days of the week. Forty-five to 60 minutes of intentional physical activity are preferable.
- Children & adolescents: engage in at least 60 minutes/day of moderate-to-vigorous physical activity at least 5 days/week.

Consume a healthy diet, with an emphasis on plant sources.

- Choose foods and beverages in amounts that help achieve and maintain a healthy weight.
- Eat five or more servings of a variety of vegetables and fruits each day.
- Choose whole grains in preference to processed [refined] grains.
- Limit consumption of processed and red meats.

If you drink alcoholic beverages, limit consumption.

- Drink no more than one drink per day for women or two per day for men.

Taken from: Nutrition and Physical Activity During and After Cancer Treatment: An American Cancer Society Guide for Informed Choices. CA: A Cancer Journal for Clinicians 56: 323-353, 2006. Reproduced with Permission from the American Cancer Society

List 2. Exercise Prescription Guidelines for Cancer Survivors After Completion of Primary Treatment

Low Intensity (light effort) Endurance Exercise

- 20% – 39% of HR_{reserve} ; 40% – 50% $VO_{2\text{peak}}$; RPE of 10 to 11; 2 to 4 METs
- 45 – 60 minutes per day (total exercise minutes can be accumulated by performing short bouts of light intensity endurance exercise throughout the day)
- 5–7 days of week
- Gardening, carrying groceries, raking lawn

Moderate Intensity (moderate effort) Endurance Exercise

- 40% – 59% of HR_{reserve} ; 60% – 75% $VO_{2\text{peak}}$; RPE of 12 to 13; 4 to 6 METs
- 20 – 60 minutes per day (total exercise minutes can be accumulated by performing short bouts of moderate intensity endurance exercise throughout the day)
- 3–5 days of week
- Brisk walking, ($\geq 2.5\text{mph}$ – 4.0 mph), swimming, cycling

Vigorous Intensity (strenuous effort) Endurance Exercise

- 60% – 84% of HR_{reserve} ; $\geq 75\%$ $VO_{2\text{peak}}$; RPE of 14 to 16; 6 to 8 METs
- 20 – 45 minutes per day (total exercise minutes can be accumulated by performing short bouts of vigorous intensity endurance exercise throughout the day)
- 3–5 days of week
- Jogging ($\geq 5.0\text{mph}$), vigorous swimming, vigorous cycling

Progressive Resistance Exercise (Weight-Bearing)

- 1–2 sets (8–12 repetitions each) of 8–10 large-muscle group resistance exercises at moderate intensity
- 2–3 nonconsecutive days of week

Flexibility/Stretching Exercise (Weight-Bearing)

- Gentle reaching, bending and stretching of the large muscle groups
- Hold each stretch for 20–30 seconds; perform each stretch at least twice

Calculations: $HR_{\text{reserve}} = \text{maximal heart rate } (HR_{\text{max}}) \text{ minus resting heart rate } (HR_{\text{rest}})$.
Multiply HR_{reserve} by .20 to .84 to obtain target heart rate for desired intensity of exercise.

Abbreviations: $VO_{2\text{peak}}$, Peak Oxygen Consumption (mL.kg.min^{-1}); RPE, rate of perceived exertion; METs, metabolic equivalent *Adapted with Permission from the American Cancer Society*

Lifestyle Concerns for Cancer Survivors

Weight Management

Positive and negative energy balance are dual concerns in cancer populations. However, as noted in both the IOM and ACS reports,(19–21) as critical as anorexia and cachexia are to cancer care, for the majority of cancer survivors, obesity and overweight are problems that are

far more prevalent.(21–24) Obesity is a well-established risk factor for cancers of the breast (post-menopausal), colon, kidney (renal cell), esophagus (adenocarcinoma), and endometrium; (25) thus a high proportion of cancer survivors are overweight or obese at the time of diagnosis. Furthermore, increased pre-morbid body weight and/or body weight at the time of diagnosis has been associated with overall and cancer-specific mortality for cancers of the breast, esophagus, colon and rectum, cervix, uterus, liver, gallbladder, stomach, pancreas, prostate, kidney, non-Hodgkin's lymphoma and multiple myeloma, as well as all cancers combined. (26–32) Finally, additional weight gain is common during or after treatment for various cancers, and has been found to reduce quality of life (QOL) and exacerbate risk for functional decline, comorbidity and perhaps even cancer recurrence and cancer-related death.(20,21,33, 34) While studies exploring the relationship between post-diagnosis weight gain and disease-free survival have been somewhat inconsistent,(23,33,35,36) one of the largest studies (n=5,204) by Kroenke and colleagues,(36) found that breast cancer survivors who increased their BMI by 0.5 to 2 units post-diagnosis were found to have a relative risk (RR) of recurrence of 1.40 (95% CI: 1.02–1.92) and those who gained more than 2.0 BMI units had a RR of 1.53 (95% CI: 1.54–2.34); both groups also experienced significantly higher all-cause mortality. In addition, several studies have reported that increased body weight post-diagnosis negatively impacts QOL.(23,33,37) This accumulating evidence of adverse effects of obesity in cancer survivors, plus evidence indicating that obesity has negative consequences for overall health and physical function make the pursuit of weight management a priority for cancer survivors (23,33,38) – a priority which is substantiated through viable physiologic mechanisms,(39) as well as concern that the health issues of this population are overlaid upon the pandemic of overweight and obesity increasing worldwide.(39,40)

Despite the documented adverse effects of obesity in cancer survivors, to date only five reported studies have examined weight management in cancer populations, and all were conducted among women with breast cancer. Two of these studies were performed largely on survivors who had completed active treatment, and found that individualized dietary counseling provided by a dietitian was effective in promoting weight loss.(41,42) The more recent study by Djuric and colleagues,(42) found that counseling by a dietitian was most effective if combined with a structured Weight Watchers® program which included exercise; weight change at 12 months was $+85 \pm 6.0$ kg vs. -8.0 ± 5.5 kg or -9.4 ± 8.6 kg in the control vs. dietitian or dietitian + Weight Watchers® program, respectively. Multiple behavior interventions that utilize a comprehensive approach to energy balance, and that include both diet and exercise components have higher likelihood of being more effective than interventions relying on either component alone.(43) In their evaluation of a diet and exercise intervention among early stage breast cancer patients which was begun during the time of treatment and extended throughout the year following diagnosis, Goodwin et al.(44) found that exercise was the strongest predictor of weight loss. These findings were corroborated more recently by the observational study of Herman and colleagues.(33) Given evidence that sarcopenic obesity (gain of adipose tissue at the expense of lean body mass) is a documented side effect of both chemotherapy and hormonal therapy,(23,45–47) exercise, specifically resistance exercise, may be especially important for cancer survivors since it is considered the cornerstone of treatment for this condition.

Until more is known, guidelines established for weight management in the general population should be applied to cancer survivors, and include not only dietary and exercise components, but also behavior therapy.(48) With research indicating that 71% of cancer survivors are overweight or obese, there is a definite need to develop effective weight management interventions for this needy population.(38)

Nutrition and Diet

Energy Restriction

As noted, accumulating evidence suggests that weight management should be a priority for cancer survivors.(20,21,34) Thus, for the majority of cancer survivors who are overweight, energy restricted diets are recommended.(21,22,38) Moderate energy deficits of up to 1,000 Calories/day can be achieved by concomitantly increasing energy expenditure (via exercise) and reducing energy intake.(21) Energy restriction can be achieved by reducing the energy density of the diet by substituting low-energy density foods (e.g., water-rich vegetables, fruits, cooked whole grains, soups) for foods that are higher in Calories.(49) This "volumetric approach" enhances satiety and reduces feelings of hunger and deprivation that often serve to undermine energy-restricted diets. An additional strategy is limiting portion sizes of energy dense foods.(49) The newly issued dietary guidelines for cancer survivors emphasize energy balance and largely endorse dietary recommendations that have been established for the primary prevention of cancer and other chronic diseases.(21,40,50)

Balancing Fat, Protein, and Carbohydrate Intake

Protein, carbohydrate and fat all contribute energy (Calories) in the diet, and each of these dietary constituents is available from a wide variety of foods. Making informed choices about foods that provide these macronutrients can ensure variety and nutrient adequacy. In general, the choice of foods and their proportions within an overall diet (dietary pattern) may be more important than absolute amounts.(23,40,51) Given that cancer survivors are at high risk for other chronic diseases, the recommended amounts and type of fat, protein, and carbohydrate to reduce these disease risks also is germane.(19,21) Observational studies of breast cancer survivors (n=2,619) and colorectal cancer survivors (n=1009) within the Nurse's Health Study cohort suggest that as compared to those who reported a Western-type diet (e.g., high proportional intakes of meat, refined grains, high fat dairy products, and desserts), those who reported a prudent diet (e.g. high proportional intakes of fruits, vegetables, whole grains and low-fat dairy products) had significantly better outcomes, i.e., improved overall survival and reduced rates of colorectal recurrence and mortality, respectively (52,53) Furthermore, cross-sectional data from 714 breast cancer survivors participating in the Health, Eating, Activity and Lifestyle (HEAL) study suggest that post-diagnosis diet quality is significantly association with mental and physical functioning.(54) Recently, a feasibility study aimed at reducing functional decline among 182 elderly breast and cancer survivors by delivering a multi-component intervention to increase diet quality and physical activity found evidence of improved physical functioning;(55) this study is currently being followed up with a full scale RCT entitled Reach-Out to Enhance Wellness (RENEW – CA106919) (N=641) with results anticipated in 2009.

Fat

To date, roughly 20 reported studies have examined the relationship between fat intake and survival post-diagnosis, with almost all of these studies conducted among breast cancer survivors.(17,21,23) By-in-large results tend to be mixed; however, in the few studies that have assessed type of fat there appears to be a consistent finding that high intakes of saturated fat are associated with worse survival.(21).The recently completed Women's Intervention Nutrition Study (WINS), a randomized controlled trial (RCT) that accrued 2437 post-menopausal women within 12-months of breast cancer diagnosis and followed them for roughly 5-years found a hazards ratio (HR) for recurrence of 0.76 (95% CI 0.60, 0.98) among women assigned to the low fat diet (<15% of energy from fat) as compared to those assigned to a nutritionally-adequate diet, an effect which was even stronger among participants with estrogen-receptor negative disease.(56) While these findings may have been confounded by the six pound weight loss observed with the low fat diet over the course of the study period,

these results nonetheless provide support for the USDA recommendations to limit total fat intake to 20–35% of energy intake, saturated fat intake to <10%, and trans fatty acids to <3%), especially in view of the greater risk for CVD among survivors .(50)

Protein

Relatively few studies have examined associations between protein intake and cancer specific outcomes, though one study among early stage breast cancer survivors found that increased intakes of red meat, bacon and liver were associated with increased rates of recurrence.(57) Given these data, as well as strong evidence that red meat and processed meat are associated with increased primary risk for colorectal cancer, survivors are encouraged to limit their consumption of these foods. Protein intakes of 0.8 g/kg of body weight are recommended with 10–35% of energy coming from protein.(21,58)

Carbohydrates

Similar to protein, little research has been undertaken with regard to carbohydrates, specifically starches and sugars, and cancer survival. Although fiber is classified as a carbohydrate and its relationship to cancer has been explored extensively, such research has been limited largely to the recurrence of precancerous lesions (e.g. colorectal adenomas), more than to survivorship per se.(21) Given that glycemic control is a newly emerging area of interest in relation to cancer, more research is anticipated in this area in the next few years.(59) Given a lack of definitive data, survivors are encouraged to follow dietary guidelines established for the prevention of chronic diseases that endorse intakes of carbohydrates ranging from 45–65% of total energy intake and fiber intakes of 14 g. per 1,000 kcal. (50) Carbohydrates should come primarily from nutrient-dense food sources, such as vegetables, whole fruits, and whole grains - low-energy density foods that promote satiety, and weight control, while enhancing nutrient adequacy.(21,50) Refined carbohydrates and sugars are discouraged given their relative lack of nutritional benefit and their contribution to energy intake.(21,50)

Vegetables and Fruits (V&F)

Given high concentrations of various phytochemicals, anti-oxidants, and fiber, V&F have been promoted, not only among healthy populations for the prevention of disease, but also among cancer survivors.(21) Of a dozen observational studies examining the relationship between intakes of V&F (or nutrients indicative of those foods) and risk for cancer recurrence, the evidence has been mixed.(21,60,61) Half of the studies have observed a protective effect of V&F or specific items such as tomato sauce or cruciferae, while the remaining studies have found no associations. Results of the Women's Healthy Eating and Living (WHEL) trial, which not only promoted a low fat, high fiber diet, but also daily minimum intakes of 5 vegetable and 3 fruit servings, as well as 16 oz. of vegetable juice found no differences in recurrence among 3088 pre- and post-menopausal women followed over 7 years (62) Null findings have be attributed to high baseline V&F intakes in both study arms (mean of 7.4 servings/day) and/or an absence of weight loss, despite a low energy density diet.(63) Cancer survivors are still encouraged to consume at least 5 servings of V&F/day based on proven cardioprotective effects. (21,50)

Exercise

Increased attention has focused on the role of exercise training interventions as an adjunct supportive therapy for cancer survivors both during and following the completion of primary therapy. Up to March, 2004, 16 independent research investigations had been published examining the role of exercise training interventions in cancer survivors.(64–66) From March 2004 to March, 2006, we conducted a systematic review that identified 9 additional studies for a total of 25 studies of exercise among cancer survivors. To summarize, these studies were

conducted predominately in breast cancer survivors testing the effects of either endurance (aerobic) or combined (endurance plus resistance training) exercise training prescribed according to standard exercise prescription guidelines for healthy adults. (i.e., exercise sessions 3–5 days/week for 20–45 minutes, at a moderate-intensity for 2 to 6 months). Major outcomes of these reports included cardiorespiratory fitness, strength, psychosocial outcomes (e.g., QOL, depression, etc.), as well as various biochemical outcomes such as metabolic and sex hormones. The extant literature indicates that exercise training is safe and feasible for cancer survivors following the completion of primary therapy. Moreover, exercise training is associated with a moderately positive effect on cardiorespiratory fitness and QOL. Exercise training also is generally associated with a small positive effect on other outcomes such as fatigue, anxiety, and depression. Overall, the current literature provides sufficient evidence that exercise is a safe and well-tolerated supportive intervention that physicians can recommend to their patients following the completion of primary therapy.(17)

In the present paper, we evaluate the strength of the evidence in light of studies published within the past year (March 2006 to October 2007). A comprehensive review of the literature identified 7 new independent studies that examined the effects of an exercise training intervention among cancer survivors that had completed therapy.(67–73) Studies that examined the effects of exercise training in combination with other interventions (e.g., dietary interventions) or examined the utility of a behavioral-based intervention to promote exercise among cancer survivors were excluded.

As before, these new studies continue to focus predominantly on breast cancer, (68–72) with the remaining studies focusing on mixed cancer patients.(67,73) Four studies were randomized controlled trials,(68–71) while the other three used pre-post designs.(67,72,73) Four studies examined the effects of aerobic exercise training only,(68,71–73), two assessed the effects combined aerobic and resistance training(69,70), while one used resistance training only.(67) The intervention length ranged from 8 to 24 weeks and study endpoints were various and included exercise capacity (assessed either via a maximal cardiopulmonary exercise test or submaximal treadmill test), muscle strength, and a numerous psychosocial outcomes (e.g., fatigue, overall QOL, stress, subcomponents of QOL) (see Table 1). Findings from these more recent studies corroborate our prior conclusion that the current literature provides sufficient evidence that exercise is safe and feasible for cancer survivors following the completion of primary therapy and such interventions may be associated with potentially clinically meaningful improvements in exercise capacity and overall QOL. Although not a primary focus of this review, these results also are consistent with the findings of exercise intervention studies conducted *during* cancer therapy.(74) For example, in the largest study to date, Courneya et al. (75) examined the effects of aerobic exercise alone, resistance exercise alone, or usual care on physical fitness, muscle strength, body composition, and indices of QOL and other psychosocial outcomes among 242 operable breast cancer patients initiating adjuvant chemotherapy. Results indicated significant favorable effects of aerobic and resistance exercise training on multiple outcomes (including increased chemotherapy completion rates) in comparison to usual care without any significant adverse events.

Further strong evidence for the role of exercise for cancer survivors is provided by four landmark studies that examined the association between physical activity and cancer recurrence and overall survival in persons diagnosed with breast (76,77) and colon cancer.(78,79) Results of these studies suggest that survivors who engaged in routine physical activity had a significant disease-free and mortality risk reduction compared with those who were physically inactive. Of note, these findings also include data obtained from women participating in the control arm of the WHEL study, and show that increased physical activity (equivalent of brisk walking for 30 minutes 6 days/week) was associated with a significant reduction in the risk of death among

1,490 women with breast cancer, an effect independent of either weight status or V&F consumption (77)

Findings from these observational studies have important implications for future exercise interventions focused on cancer survivors. At present the exercise training studies included in the current paper, as well as those reviewed in our prior paper, have predominantly focused on the effects of exercise training on exercise capacity and overall QOL.(17) These interventions have included relatively small sample sizes (≤ 100) with short-term intervention periods (≤ 6 months) that are prescribed 2 to 3 times a week. If exercise training or cancer exercise rehabilitation programs are to become an integral component of multidisciplinary management of cancer survivors, large-scale randomized controlled trials will be required that go beyond simply including exercise capacity and QOL outcomes; examine long-term interventions (≥ 6 months), and prescribe exercise training 3 to 5 days a week which is consistent with the results of the observational studies and current recommendations of the American Cancer Society, the Centers for Disease Control, the American College of Sports Medicine and the World Health Organization (see List 2).(40) Thus, well-designed trials that examine the efficacy of exercise training on biologic mechanisms, derived from preclinical studies, or clinically-meaningful intermediate surrogate endpoints of cancer recurrence and/or overall survival are urgently required. Findings from studies of this nature will provide the necessary evidence to convince policy makers for the inclusion of exercise rehabilitation in cancer management.

Smoking Cessation

As noted in the IOM report,(19) nearly one-third of all cancers are caused by smoking, thus there is a high likelihood of tobacco-use among survivors, especially those who have been diagnosed with smoking-related malignancies, i.e., lung, head and neck, cervix, bladder, kidney, pancreas and myeloid leukemia.(80,81) Persistent tobacco-use post-diagnosis also is associated with poorer outcomes, including increased complications of treatment, progressive disease, second primaries and increased comorbidity.(82,83) Thus, while smoking cessation plays a substantial role in prevention and primary care, it is perhaps even more critical for cancer survivors to quit smoking.(84) Fortunately, many survivors respond to the “teachable moment that a cancer diagnosis provides,(85) and quit of approximately 50% are noted among survivors with smoking-related tumors.(86,87) Unfortunately, data from a recent study suggest that most institutions fail to offer smoking prevention (61%) or cessation (75%) programs to individuals diagnosed with cancer, and many even lack a referral system (42%).(88) Furthermore, even among survivors who are able to quit, high percentages are unable to remain smoke-free with approximately one-third of smokers continuing to smoke after their cancer diagnosis.(87) Recent data from the National Health Interview Survey also suggest that current smoking rates may be especially high in younger cancer survivors (ages 18–40) than in the general population,(89) though subsequent controlled analyses on data with longer follow-up suggest that these differences may not be as discrepant as previously thought.(90)

Given evidence that combined interventions that utilize behavioral counseling along with pharmacotherapy are effective, definitive guidelines exist for providing care as it relates to smoking cessation.(19) The 5-A approach endorsed by the US Preventive Services Task Force provides a concrete framework for health care providers to deliver appropriate care regarding smoking cessation and is a featured element within the IOM report.(19,91) Despite this extant framework, the barriers to longstanding smoking cessation success are substantial and findings from intervention trials have been mixed; the IOM report provides a solid overview of studies conducted up until 2005 and notes the significance of smoking cessation within the survivor population and the numerous barriers that exist.(19) Fortunately, the early trials of Gritz et al. (92) as well as the most recent trial of Emmons et al.(93) provide success stories that can guide future treatment, research and practice. The randomized controlled trial by Emmons et al.

(93) tested a peer telephone counseling intervention with tailored materials against standardized self-help materials (both with optional nicotine replacement) among 796 currently smoking adult childhood cancer survivors. They found that quit rates were significantly higher in the counseling group compared to the self-help group at both the 8-month (16.8% v 8.5%; $P < .01$) and 12-month follow-up (15% v 9%; $P < .01$).⁽⁹³⁾ This home-based intervention also was found to be cost-effective. This recent positive trial not only is important for its contribution to smoking cessation research, but it also paves the way more generally for future health promotion programs by testing innovative strategies that are well-accepted and more readily disseminable to survivor populations who often are hard to reach. As noted in the IOM report,⁽¹⁹⁾ opportunities also exist for interventions that incorporate social or familial support as a key element. An ongoing trial which is currently testing the efficacy of such a family-based intervention is entitled “Family-Ties” (CA92622) and results are imminent. As in areas of diet and exercise, more research is necessary to determine interventions that are optimally effective and promote permanent smoking cessation – acknowledging that continued tobacco-use may be particularly resistant in cancer survivors. It is also worth noting that smokers may represent a prime population not only for smoking cessation efforts, but also for multiple risk factor interventions since findings of Butterfield et al.⁽⁹⁴⁾ suggest that the majority (63%) of cancer survivors who smoke also are likely to engage in at least two to three other unhealthy lifestyle behaviors, such as sedentary behavior, high red meat consumption and excessive alcohol-use.

Health Behavior Change and Preferences for Delivery among Cancer Survivors

Behavior Change Post-Diagnosis

Most earlier research suggested that the practice of healthy lifestyle behaviors was higher among cancer survivors than in the general population; however, recent large-scale studies now indicate that few health behavior differences exist between cancer survivors and healthy populations or non-cancer controls.^(35,89,90) Two of these studies relied on data collected from survivors of several different cancers and who were nested within a U.S. sample which included both cancer cases and controls, thus yielding data that are less likely to be influenced by responder bias. Analyses by Coups and Ostroff⁽⁸⁹⁾ and Bellizzi et al.⁽⁹⁰⁾ on health behaviors of cancer cases compared to age- and race-matched controls participating in the National Health Initiative Survey-2000 indicate that while cancer survivors are slightly more likely to adhere to physical activity guidelines, for the most part their health behaviors parallel those of the general population – a population marked by inactivity, overweight or obesity, suboptimal fruit, vegetable and fiber consumption, and high intakes of fat.⁽⁹⁰⁾ Similar results were found in another study that exclusively tracked lifestyle behaviors in a cohort of women ($n = 2,321$) with early stage breast cancer.⁽³⁵⁾ These studies suggest that although many cancer patients report healthful lifestyle changes after diagnosis, these changes may not generalize to all populations of cancer survivors or may be temporary. Given higher rates of comorbidity within this population and evidence that diet, exercise, and tobacco-use affect risk for other cancers and other chronic diseases, these recent data support a terrific need for lifestyle interventions that target this vulnerable population.

When is the best time to intervene?

Little data exist as to when cancer survivors may be most receptive to health behavior interventions. An early study of 978 breast and prostate cancer survivors,⁽⁹⁵⁾ suggests that most (57%) reported a preference for diet, exercise and/or smoking cessation information “at diagnosis or soon thereafter” and that a significant decrease ($p = .003$) was noted as time elapsed from diagnosis. Factors such as age and gender also may affect interest and uptake of lifestyle interventions. For example, McBride et al.⁽⁹⁶⁾ found that interest levels for lifestyle

interventions may be sustained over time among women, but not in men since the psychological impact of disease diminishes significantly with time from diagnosis among males, but not in female survivors.

Timing of interventions also is dependent upon the targeted behavior (e.g., diet, exercise, etc); the channel of delivery (clinic or home-based), treatments received (e.g., surgery, radiation, chemotherapy), side effects (fatigue, pain, nausea, etc.), and desired outcomes (short-term symptom management or overall long term health). For example, observations from recent studies suggest that interventions involving physical activity may receive better uptake and continued adherence if introduced after primary therapy is complete rather than during active treatment.(75,97–99) Furthermore, issues such as time, transportation, child-care and patients' willingness to undertake new lifestyle behaviors may undermine the success of health promotion efforts and require careful consideration regarding timing, content, delivery channel and patient selection. Also important is the realization that several strategic iterations may be necessary in order to create an intervention that not only has proven efficacy, but that also is well-accepted and generalizable to the patient population at large.

Preferred Channels for Delivery

As with intervention timing, there are relatively few studies that have explored patient preferences regarding intervention delivery channel and even fewer that have compared the relative efficacy of different methods. In one study of 307 cancer survivors, Jones et al.(100) found that 85% of cancer survivors preferred face-to-face exercise counseling for a one session class. Other researchers have found that distance and accompanying issues of time and transportation pose significant barriers for in-person programs, especially among older cancer survivors (61% of cancer survivors are comprised of those 65 years of age or older).(95,101–103) Such barriers also are present among survivors of more rarely occurring cancers who often have to travel great distances to receive specialized care in appropriate clinical settings, i.e., childhood survivors.(104) In two separate survey studies among breast and prostate cancer survivors(95) and childhood cancer survivors,(104) Demark-Wahnefried and colleagues found that distance medicine-based or home-based programs were significantly favored over clinic-based venues. Surprisingly, mailed interventions garnered higher preference scores than computer-based formats among younger cancer survivors. Similarly, Rutten et al.(105) reported that cancer survivors were twice as likely to report reliance on print materials as sources of health information rather than the internet or other media sources. It is currently unknown whether these results are apt to change over time or whether there is a definite hard-set preference for print materials over computer-based venues. Given that cancer is a disease associated with aging and that receptivity for computer-based formats is even lower in older populations, it is safe to say that although web-based programs offer future promise, full penetrance of such programs, especially among the most underserved populations of cancer survivors, is currently questionable.(38)

As recently reviewed by Stull and colleagues,(106) the preponderance of reported health promotion efforts among cancer survivors have utilized clinic-based interventions, though increasing numbers of interventions have employed hybrid programs that rely on both clinic-based sessions with follow-up telephone counseling.(38,43) Although the potential acceptability and reach for home-based interventions is notably greater than for clinic-based programs, to date only five studies have employed this approach (55,93,107–109) By-in-large most health promotion interventions among cancer survivors have reported favorable findings although more research is needed to determine optimal approaches, not only with regard to delivery channel, but also to the aforementioned areas, i.e., timing, pairing of behavioral components, etc.(38,106)

Summary

Currently, there is scant evidence regarding the direct impact of post-diagnosis behavioral change on cancer-related progression, recurrence or survival. Indeed, much more research is necessary, not only to determine proof of concept (i.e., that behavior change can make an impact on cancer-specific outcomes and overall health), but also to arrive at interventions that are well-accepted and that reach cancer survivors who are most vulnerable. Research is ongoing and data are beginning to accumulate. In the interim, oncologists should not lose sight of the fact that there exists a significant body of research that shows the benefit of a healthful diet, regular exercise and smoking cessation for reducing risk for many of the comorbid conditions (i.e., other cancers, CVD, diabetes and osteoporosis) and side effects (i.e., fatigue and depression) for which cancer survivors are especially prone. Thus, oncology care providers can assist their patients by endorsing existing health guidelines and encouraging their patients to take active roles in pursuing general preventive health strategies.

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Table 1
Diet and Exercise Intervention Trials Employing Cancer-Specific or General Health Outcomes (March 2006 – October 2007)

Authors	Site	Sample	Age	Design	Intervention	Frequency/Intensity/ Duration	Results
Dietary Interventions							
Chlebowski et al. [56]	Breast	2437 post-menopausal patients diagnosed with localized disease within 12 months	48-79 years Mean = 58.5 years	RCT	Low fat, nutrient adequate diet (<15% of total energy) vs. a nutrient adequate diet	5 year median follow-up	Overall, patients assigned to the low fat diet had significant reductions in recurrence (HR=0.76; 95% CI: 0.6-0.98); though this effect was limited to patients who had ER- receptor disease (HR=0.58; 95% CI: 0.37-0.91); and not patients with ER+ disease (HR=0.85; 95% CI: 0.63-1.14).
Pierce et al. [62]	Breast	3088 pre- & post-menopausal patients diagnosed with stage I-IIIa disease within 4 years	18-70 years Mean = 53 years	RCT	Very high V&F (5+ daily servings of vegetables, 3+ daily servings of fruit + 16 oz. of vegetable juice/day), low fat (15-20% of energy) and high fiber (30 g/day) diet vs. standard instruction on 5+ daily servings of V&F	7.3 year mean follow-up	No significant differences in rates of breast cancer recurrence found between study arms (HR=0.96 95% CI: 0.8-1.14).
Exercise Interventions							
De Backer et al. [67]	Mixed	57 patients who had received chemotherapy for lymphoma, breast, gynecologic, testicular, or colorectal cancer	24 to 73	Pre-Post	Supervised high-intensity resistance training program	1 to 2 times/wk of 6 exercises at 65% to 80% of one-repetition maximum for 18 weeks	Statistically significant ↑ in muscle strength, exercise capacity (VO_{2peak}), and QOL
Daley et al. [68]	Breast cancer	108 operable breast cancer patients who had received adjuvant therapy who were 12-36 mths post treatment	Mean age ~ 50	RCT	Participants were randomized to 1 of 3 groups: (1) Supervised aerobic exercise training (2) Supervised placebo-Exercise (3) Usual Care	A Aerobic Exercise Group: 3x/wk @ 65% to 85% of heart rate max Placebo-Exercise Group: Light-intensity stretching/conditioning 3x/wk for 18 weeks	Statistically significant ↑ QOL & aerobic fitness favoring aerobic exercise versus usual care. Indices of psychosocial health improved for both intervention groups
Herrero et al. [69]	Breast cancer	16 operable breast cancer survivors who had completed primary adjuvant therapy	Mean age ~ 50	RCT	Supervised combined aerobic and resistance training program	3x, 90 minute sessions/wk at a moderate intensity for 8 weeks	Statistically significant ↑ QOL, VO_{2peak} , and muscle strength
Milne et al. [70]	Breast cancer	58 operable breast cancer patients within 2 years of completing primary therapy	Mean age ~ 50	RCT	Supervised combined aerobic and resistance training program	Aerobic training (20 mins in duration) & resistance training (12 different exercises) performed 3x/wk for 12 weeks. No intensity was provided	Statistically significant ↑ overall QOL, subcomponents of QOL that favored the exercise group. No significant between group ↑ in aerobic fitness and muscle strength
Nikander et al. [71]	Breast cancer	30 operable breast cancer patients within 6 months of chemotherapy completion	41 to 65	RCT	Supervised and home-based aerobic exercise training	1x/wk & home-based exercise 2x/wk at a moderate intensity for 12 weeks	Significant between-group differences in several physical performance outcomes.
Schneider et al. [72]	Breast cancer	96 operable breast cancer patients who	Mean age ~ 50	Pre-Post	Supervised aerobic-based exercise sessions	Exercise sessions performed 2 to 3x/wk at 40% to 70% of heart	Significant within group improvements in blood pressure, heart rate, cardiopulmonary

Authors	Site	Sample	Age	Design	Intervention	Frequency/Intensity/ Duration	Results
Schneider et al. [73]	Mixed	had completed adjuvant therapy 37 male cancer survivors who had received treatment for prostate, colon, Hodgkin's, lung cancer	Mean age ~ 64	Pre-Post	Supervised aerobic-based exercise sessions	Exercise sessions performed 2 to 3x/wk at 40% to 70% of heart rate reserve for 12 weeks	fitness (predicted VO_{2max}), pulmonary function. Improvements were also observed for several psychosocial outcomes Significant within group improvements in heart rate and cardiopulmonary fitness (predicted VO_{2max}). Improvements were also observed for several psychosocial outcomes
Multi-component Interventions (Diet and Exercise)							
Demark-Wahnefried et al. [55]	Breast & Prostate	182 elderly breast and prostate cancer survivors diagnosed within the 18 months	Age 65+, Mean age 72 years	RCT	Home-based, telephone counseling – mailed material intervention on diet and exercise vs. telephone counseling and mailed materials on general health topics	Telephone counseling delivered every two weeks for 24 weeks	As compared to attention controls, Intervention participants significant improved diet quality (-2.9 vs. +2.2; p = .003); trends were observed in physical activity energy expenditure (-400 vs. +111 kcal/week) and physical functioning (-0.5 vs. +3.1)