HEALTH BEHAVIOR CHANGES AFTER A CANCER DIAGNOSIS: WHAT DO WE KNOW AND WHERE DO WE GO FROM HERE?[1,2]

Bernardine M. Pinto, Ph.D.
The Miriam Hospital and Brown University School of Medicine

Elizabeth Eakin, Ph.D.
AMC Cancer Research Center

Nancy C. Maruyama, M.D.
Roger Williams Cancer Center

ABSTRACT

Survival rates for certain types of cancer have improved over the past few decades. Changing unhealthy behaviors such as smoking, poor diet, and sedentary life-style among individuals who have been diagnosed with cancer may help to reduce cancer treatment sequelae, possibly reduce risk of recurrence for specific types of cancer, and reduce risk for other common diseases such as cardiovascular disease, obesity, and hypertension. This article reports the prevalence of each of these behaviors among those diagnosed with cancer and reviews interventions that have targeted these risk behaviors. There is considerable variation in the type of research questions asked, the methodologic quality of the research, sample sizes, and the outcomes observed across studies focusing on changing the three health risk behaviors. In the final section, we provide guidelines for researchers in developing health behavior interventions for individuals diagnosed with cancer and highlight challenges that should be addressed.

(**Ann Behav Med** 2000, *22*(1):38–52)

INTRODUCTION

Due to improved detection rates and treatments for some forms of cancer, cancer survival rates have significantly improved over the past half century. Five-year survival rates have risen from 1 in 5 in the 1930s to 4 of 10 patients diagnosed with cancer in recent years (1). For example, 85% of women diagnosed with early stage breast cancer will survive beyond 5 years (2). These improvements in survival have been accompanied by efforts to improve quality of life and overall functioning of survivors. There have been several reviews of the effectiveness of psychological interventions on mood, quality of life, and sexual functioning among cancer survivors (3–7). Andersen (7) suggested in her review that greater gains in psychological and behavioral outcomes could be achieved if health behavior components were added to psychological interventions for people diagnosed with cancer. However, there have been no reviews of the effects of life-style change following a cancer diagnosis. This is important because cancer treatments can directly impact healthy behaviors; for example, chemotherapy may alter a person's taste sensitivity, thereby affecting diet and nutrition, or treatment-induced fatigue may interfere with exercise (8,9). Additionally, the diagnosis and treatment of cancer is a significant stressor in itself that could contribute to changes in appetite and sleep and may disrupt the practice of healthy behaviors. Andersen (7) speculated that there may also be survival benefits associated with health-protective behaviors (e.g. adherence to follow-up tests and visits) and health-promoting behaviors (e.g. stopping smoking, healthy diet, exercise). Hence, investigating the interaction of behavioral and psychological factors with physiological factors in affecting the course of disease/recovery and quality of life offers many opportunities for behavioral medicine professionals.

With improvement in cancer treatments and the growing number of cancer survivors, health behaviors may become relevant not only to prevention of cancer recurrence and improved survival, but also to quality of life and the reduction of risk for other chronic diseases such as cardiovascular and lung disease, hypertension, and obesity. No one has examined whether long-term cancer survivors face greater health risks from cancer and its treatment or from the diseases that are the causes of morbidity and mortality in the general population, such as cardiovascular disease. The diagnosis and treatment of cancer offers potential opportunities for intervening to modify unhealthy behaviors. This article reviews studies conducted among cancer patients and survivors that focus on altering one or more of three unhealthy behaviors (i.e. smoking, high-fat/low-fiber diet, and sedentary behavior).

METHODS

We searched MEDLINE and PsychLit computerized data bases for studies reporting both prevalence and interventions targeting smoking, diet, and exercise published in English since 1980. Key words included "cancer" and "cancer survivors," "smoking" and "smoking cessation," "diet," "nutrition," and "exercise" and "physical activity." There is some confusion about the use of the terms "cancer patient" versus "cancer survivor." The National Coalition for Cancer Survivorship defines a cancer survivor as "from the time of discovery and for the balance of life, an individual diagnosed with cancer is a survivor," whereas the term "patient" is preferred by the medical community. Yet, others consider a cancer survivor as someone who has lived at least 5 years past diagnosis. To date, there is no consensus on the

[1] Preparation of this manuscript was supported in part by the National Cancer Institute Grant CA 75452.

[2] We thank Judith DePue, Ed.D., M.P.H. and Christopher Sciamanna, M.D., M.P.H. for their valuable comments on an earlier version of the manuscript. We thank Barbara Doll and Barbara McCray for assistance with manuscript preparation.

Reprint Address: B. M. Pinto, Ph.D., The Miriam Hospital and Brown University School of Medicine, 164 Summit Avenue, Providence, RI 02906.

appropriate usage of the term "survivor." For purposes of this review, we use the term "patient" to refer to those individuals who are in treatment for cancer and "survivors" to refer to those who have completed medical treatment. We did not find any intervention studies examining health behavior changes among people who had been diagnosed with cancer more than 5 years previously. In an attempt to be broadly inclusive, intervention studies were deemed acceptable for review if they included, at a minimum, a pre–post design. We also sought to include studies of children and adolescents; however, no such studies were found. Experts in each area were contacted regarding unpublished or studies in press. The reviews for each behavior include data on the prevalence of the risk behavior and intervention studies that, at a minimum, used a pre–post design.

Regarding smoking cessation, only four intervention studies were identified and all were retained for review. For dietary interventions, we selected studies that aimed to alter overall dietary patterns, rather than simply adding single nutrients or dietary supplements. Regarding exercise, we excluded cross-sectional studies such as those examining changes in exercise tolerance among pediatric cancer cases versus healthy controls, as well as studies that offered physical therapy to cancer patients.

In this paper, we attempt to answer the following questions: (a) What is the prevalence of each unhealthy behavior among those who have been diagnosed with cancer? and (b) What do we know about the efficacy of intervening on one or more of these behaviors in these two groups (patients and survivors)? To address the second question, we pose additional questions to guide the reader. The review is followed by a final section summarizing recommendations and directions for future research across the three risk behaviors.

SMOKING

Prevalence

In a paper reviewing the literature on smoking and smoking cessation in cancer patients prior to 1980, Gritz (10) described the results of a number of studies which evaluated smoking rates in various cancer populations. Spitz and colleagues (11) assessed smoking prevalence (including those who had quit smoking within the past year) among a sample of 5,998 general cancer patients admitted to a cancer treatment facility from 1986 to 1988. Smoking prevalence was 30% among male and 29% among female cancer patients. Patients with smoking-related cancers were not analyzed separately. Gritz (10) noted that while the prevalence figures in the study were quite similar to smoking rates reported in general population surveys at that time, the level of consumption among the cancer patient sample was significantly higher (>50% of the smoking male smokers and 25% of the women smoked ≥25 cigarettes per day) versus the daily smoking rate in the general population (33% of men and 21% of women smokers smoked ≥25 cigarettes per day). In the second study, smoking prevalence was 18% among 688 patients with a variety of cancers across six cancer clinics as surveyed from 1989 to 1990 (12). Smoking rates among those with smoking-related cancers have been found to be much higher than among cancer patients in general. Data from two lung cancer clinical trial populations indicated that 95% and 99% of lung cancer patients had a history of ever smoking (13,14). Just over half of the patients from each of these studies were current smokers at the time of diagnosis, but as Gritz (10) pointed out, this figure excluded the large numbers of patients who quit smoking at diagnosis. On a more positive note, self-reported smoking cessation rates among cancer patients were found to be fairly high and ranged from 40% to 70% across a number of early studies in this area (11,15–19).

A number of retrospective studies have assessed smoking rates among adult survivors of childhood and adolescent cancer (20–24). Survivors of childhood cancer are vulnerable to tobacco-related health problems because they may have reduced pulmonary function (25) and are at risk for congestive heart failure resulting from specific chemotherapy drugs (26). The majority of these studies have found few differences between smoking rates among adult survivors and those of the study comparison groups (usually siblings or age- and gender-matched national survey data). In the largest of these retrospective studies, Haupt and colleagues (21) compared smoking rates among 1,289 childhood and adolescent cancer survivors with those of 1,930 of their siblings using matched analyses that controlled for the influence of family factors. While the differences were not statistically significant, survivors were 8% less likely than sibling controls to be current smokers, 13% less likely to be ever-smokers, but 12% less likely to have quit smoking. Tao and colleagues (24) surveyed 592 young-adult survivors of acute lymphoblastic leukemia and 409 sibling controls. They found that survivors were significantly less likely to have ever smoked (23% versus 36%) but were less likely to have quit smoking (27% versus 35%), although the latter comparison was nonsignificant.

Design Issues

Only four studies were found which described the outcomes of smoking cessation interventions targeting cancer patients (27–30) (Table 1). All studies used randomized, controlled designs comparing an intervention group to a usual care control group. Follow-ups ranged from 5 weeks (28–30) to 12 months (27), and all studies included cotinine confirmation of self-reported abstinence from tobacco. In addition, all studies used regular hospital staff (i.e. not research staff) to deliver the interventions.

Sample Characteristics

In all four smoking cessation intervention studies, the study samples were comprised of adult patients (mean age = 55) hospitalized for cancer surgery. The types of cancer included head and neck (27) and patients with a variety of tumor sites (e.g. breast, gynecologic, urologic, gastrointestinal, thoracic, and head and neck) (28–30). Sample sizes were generally small: $N = 26$ (30), $N = 28$ (28), $N = 30$ (29), and $N = 186$ (27). The majority of patients in all four studies were Caucasian; and primarily female in three studies (28–30) and primarily male in one study (27).

Types of Interventions

The interventions were similar across all four smoking cessation studies. They included an initial counseling session (or sessions) in the hospital, followed by postdischarge supportive phone contact (28–30) or booster sessions at postoperative outpatient visits (27). The specific content of the smoking interventions was also similar across studies and involved components consistent with nationally established smoking cessation programs (i.e. the FreshStart program of the American Cancer Society), including advice to quit from the provider, a review of the benefits of quitting, setting a quit date, developing a plan to overcome barriers to quitting/relapse prevention, and follow-up support. The interventions did not appear to be particularly theoretically driven, although "stage of change" was assessed and evaluated as a predictor of abstinence in one study (27). The smoking intervention was delivered by nurses in three studies (28–30) and by

TABLE 1
Intervention Studies

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
Smoking						
Griebel, Wewers, and Baker (28)	$N = 28$ Hospitalized for cancer surgery Tumor sites included gynecologic, breast, gastrointestinal, thoracic, urologic, neurologic, & head & neck Intervention Group $N = 14$ Mean age = 50.2 % female = 50 Usual Care Group $N = 14$ Mean age = 51.9 % female = 64	Randomized controlled trial	6 weeks post-intervention Self-reported 7-day abstinence Cotinine confirmation	Nurse-delivered 20-minute smoking cessation counseling postsurgery plus 5 weekly 10-minute supportive phone calls Usual care not specified	21% of Intervention Group & 14% of Usual Care Group abstinent at 6-week follow-up, n.s. Cotinine confirmed	Small sample and inadequate power to detect treatment effect. No long-term follow-up.
Gritz et al. (27)	$N = 186$ Hospitalized for cancer surgery Tumor sites were head & neck Study Completers $N = 114$ Mean age = 57.8 % female = 31 Study Noncompleters $N = 72$ Mean age = 59.5 % female = 19	Randomized controlled trial	1, 6, & 12 months postintervention Self-reported ever quit, point prevalence, & continuous abstinence Cotinine confirmation	Surgeon-delivered Smoking cessation counseling session postsurgery plus booster sessions at first 6 monthly medical visits post-treatment Usual Care Group received standardized advice to quit	74% of Intervention and 77% of Usual Care reported continuous abstinence at 12-month follow-up, n.s. Cotinine confirmed	Inclusion of recent ex-smokers may have attenuated treatment effect. Possible that control condition incorporated too many elements of treatment condition.
Stanislaw and Wewers (30)	$N = 26$ Hospitalized for cancer surgery Tumor sites included head & neck, breast, prostate, & cervical Intervention Group $N = 12$ Mean age = 58.3 % female = 75 Usual Care Group $N = 14$ Mean age = 53.4 % female = 71	Randomized controlled trial	5 weeks post-intervention Self-reported abstinence Cotinine confirmed	Nurse-delivered Three 20- to 30-minute smoking cessation counseling sessions postsurgery plus 5 weekly supportive phone calls Usual care unspecified	75% of Intervention and 43% of Usual Care Group abstinent at 5-week follow-up, n.s. Cotinine confirmed	Small sample and inadequate power to detect treatment effect. No long-term follow-up.
Wewers, Bowen, Stanislaw, and Desimone (29)	$N = 30$ with cancer Hospitalized for cancer surgery (Part of larger study of 80 total patients hospitalized for various types of surgery) Tumor sites included head & neck, breast, prostate, & cervical Intervention Group $N = 14$ Mean age = 56.4 % female = 64 Usual Care Group $N = 16$ Mean age = 53.3 % female = 69	Randomized controlled trial	5 to 6 weeks postintervention Self-reported abstinence Cotinine confirmation	Nurse-delivered Three 20- to 30-minute smoking cessation counseling sessions postsurgery plus 5 weekly supportive phone calls Usual care unspecified	64% of Intervention Group abstinent at 5- to 6-week follow-up, n.s. Cotinine confirmed	Small sample & inadequate power to detect treatment effect. No long-term follow-up.

TABLE 1
Continued

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
Diet						
Nordevang, Callmer, Marmur, and Holm (33)	240 women with breast cancer within 4 months of diagnosis (Stages I and II) Ages: 50–65	Randomized controlled trial	Baseline, 1- and 2-year follow-up interviews	Individualized dietary counseling by a trained dietitian	Intervention Group reduced dietary fat significantly from 36% to 23% of energy vs. 37% to 34% of energy in Control Group Significant changes in daily consumption in Intervention Group vs. Control Group: Vegetable consumption increased 66 gm/10 MJ vs. 35 gm/10 MJ Fruit consumption increased 86 gm/10 MJ vs. 56 gm/10 MJ Potato intake increased 43 gm/10 MJ vs. an increase of 8 gm/10 MJ Bread intake increased 31 gm/10 MJ vs. no change Cereal intake increased 11 gm/10 MJ vs. 4 gm/10 MJ	Small sample size, possibility of bias because dietary assessments were made by the dietitians who delivered the intervention. 2% of Intervention Group completed 2-year follow-up compared with 89% of the Control Group.
Women's Intervention Nutrition Study (WINS) (32)	290 breast cancer patients (Stages I–IIIa in active treatment) Mean Age: Intervention Group = 61.1 (7.1) Control Group = 60.3 (6.2)	Randomized controlled trial	Baseline, 3, 6 months, and every 6 months up to 2 years: Dietary assessments, serum lipid analyses, anthropometric data	Individualized dietary instruction program administered by dietitians	Fat intake reduced significantly to 20.3% (2.4) in Intervention Group vs. 31.5% (2.6) in Control Group Significant weight loss of 1.46 (5.01) kg vs. weight gain of 1.8 (6.34) in Control Group at 18 months	50% attrition in both groups.
Pierce et al. (34)	93 women with breast cancer (Stages I, II, IIIa) posttreatment within 4 years of diagnosis Pre- and postmenopausal No tamoxifen Intervention Group Mean age = 70 Control Group Mean age = 64	Randomized, controlled, after stratification by age and stage	Baseline, 6 and 12-month follow-up dietary assessments, serum lipids and cartenoids, anthropometric data	Individualized dietary counseling delivered via telephone	Significant changes in daily consumption in Intervention Group vs. Control Group Vegetable intake increased 6.7 gm/10 MJ (0.5) servings/day vs. 3 gm/10 MJ (0.3) Fruit intake 4.0 gm/10 MJ (0.3) vs. 2.5 gm/10 MJ (0.3) Fiber intake 21.0 gm/10 MJ (1.2) vs. 14.3 gm/10 MJ (1.0) Beta–Carotene intake at 1.284 gm/10 MJ (0.172) vs. 0.994 gm/10 MJ (0.199) Alpha–Carotene intake 0.587 gm/10 MJ (0.079) vs. 0.224 gm/10 MJ (0.050) Lycopene intake 0.705 gm/10 MJ (0.061) vs. 0.649 gm/10 MJ (0.049)	4 dropouts in Intervention Group (14%) and 6 in Control Group (15%). 7 women with relapse prior to 12 months.

TABLE 1
Continued

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
Kristal, Shattuck, Bowen, Sponzo, and Nixon (31)	144 postmenopausal women with Stages I and II breast cancer, up to 18 months post-diagnosis, at or above 10% of ideal weight Age ≥ 50: 86%	Randomized controlled trial	Baseline, 3, 6, and 12 months dietary assessments, body weight	Trained volunteer staff (40% were dietitians) administered individualized sessions and structured group sessions Emphasized exercise	Intervention Group significantly decreased fat intake to 20% (6.9) of total energy and increased carbohydrate to 62.6% (9.1) of total energy vs. 28.8% (7.7) and 55.7% (8.7) respectively in the Control Group. Intervention effect on weight at 12 months was 3.5 (0.7) kg	No comparison group with professional staff administering the intervention. Did not control for the effect of exercise on weight. Retained 77% of Intervention Group 12 months and 74.6% of Control Group.
Physical Activity						
Berglund, Bolund, Gustafsson, and Sjoden (49)	$N = 199$ Majority diagnosed with breast cancer Postmedical treatment Intervention Group $n = 98$ Mean age = 52.5 years Control Group $n = 101$ Mean age = 53.9	Randomized controlled trial	Pre, post, 3, 6, & 12-month follow-ups Appraisal of having received sufficient information Physical and Social Activities Scale Self-report of physical strength & activity Symptoms Frequency & burden of physical symptoms Mood Modified Hospital Anxiety and Depression (HAD) Scale Coping Mental Adjustment to Cancer Quality of Life 2 items Communication with staff Cancer Inventory of Problem Situations	Facilitators Oncology nurse, experts Duration 7 weeks 11 2-hour sessions Program Physical training × 4 weeks Information × 4 weeks Coping × 3 weeks	Intervention Group Significant improvements in physical training, and strength at post and 3-month follow-up Decrease in body avoidance, higher appraisal of receiving sufficient information, decrease in frequency of sleeping problems, increased fighting spirit in Intervention vs. Control Group at post Both groups showed a decrease in fatigue and activity problems 1-Year Folow-up Intervention Group Significant increase in gains in fighting spirit, appraisal of receiving sufficient information, physical strength and training vs. Control Group Both groups Significant increase in employment; decrease in tiredness, body image problems, health problems, anxiety, depression, anxious preoccupation, fatalism, and hopelessness	Physical training included relaxation training. Self-report of physical strength and physical training with no objective measures. Multicomponent program: Role of exercise alone cannot be determined. No data on exercise adherence during follow-ups.
Berglund, Bolund, Gustafsson, and Sjoden (48)	$N = 60$ Majority diagnosed with breast cancer Posttreatment Intervention Group $n = 30$ Mean age = 53.2 Control Group $n = 30$ Mean age = 54.2	Matched (age, cancer diagnosis, sex, and satisfaction with information) comparison group	Pre, post, 3, 6, & 12-month follow-ups Appraisal of having received sufficient information Physical and Social Activities Scale Self-report of physical strength and activities Mood Modified HAD Quality of life Two items	Facilitators Oncology nurse, experts Duration 7 weeks 11 2-hour sessions Program Physical training × 4 weeks Information × 4 weeks Coping × 3 weeks	Intervention group Significant increase in satisfaction with information received, increase in social activities and increase in physical strength vs. Control Group Significantly higher anxiety and depression and lower quality of life than Control Group Both Groups Significant decreases in tiredness, increases in physical strength, training, and global health	Nonrandom group assignment. Baseline group differences: Control subjects had fewer physical symptoms and less distress. Intervention Group reported significant increase in participation in patient organizations. Self-report of physical strength and physical training, no objective measures.

TABLE 1
Continued

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
Decker, Turner–McGlade, and Fehir (40)	$N = 12$ (9 men) Mean age = 43 Patients with acute leukemia awaiting bone marrow transplant	Single group	Pre, post bone marrow transplant, 6½ & 12-month follow-ups Physical Exercise bike stress test Mood Beck Depression Inventory	30 minutes 3×/week ≤85% maximum heart rate	Maximum aerobic capacity and basal metabolic rate decreased from pre to post bone marrow transplant	No data on adherence to exercise, supervision, and duration of exercise program. No statistical analyses.
Dimeo et al. (41)	$N = 20$ (11 men) Various cancers Mean age = 36 Post stem cell transplant (30 ± 6 days)	Single group	Pre & post Physical Treadmill stress test	Physician supervised Duration 6 weeks 5×/week Program Interval training on treadmill 75%–85% of maximum heart rate Exercise gradually increased from 3 minutes to 30 minutes/day	4 patients completed study Significant increase in maximum performance on stress stest, decrease in heart rate and lactate concentration	No control group Small sample
Dimeo, Fetscher, Lange, Mertelsmann, and Keul (47)	$N = 72$ Patients with various solid tumors, majority with breast cancer Prior to high dose chemotherapy and stem cell transplant Intervention Group $n = 33$ Mean age = 39 ± 10 Control Group $n = 35$ Mean age = 40 ± 11	Randomized controlled trial	Prehospitalization and at discharge Physical Treadmill stress test Hemoglobin concentration Serum chemistry	Supervised Daily biking with bed ergometer Interval training ≤50% of maximum heart rate	Intervention Group exercised on 82% of hospitalized days Intervention Group Significantly greater maximum performance on the stress test at discharge vs. Control Group Significantly less loss of physical performance during hospitalization, shorter hospital stay, shorter duration of neutropenia, less severe diarrhea and pain vs. Control Group	Assessment of diarrhea and pain not described. Dose of exercise difficult to quantify since days to hospital discharge varied.
Dimeo, Rumberger, and Keul (42)	$N = 5$ Individuals with various cancers reporting severe fatigue over 5 weeks–18 months Postchemotherapy	Single group	Pre & post Physical Treadmill stress test	Physician supervised Duration 6 weeks 5 ×/week Program Interval training on treadmill 75%–85% of maximum heart rate Exercise gradually increased from 3 minutes to 30 minutes/day	Significantly higher maximum performance on stress test at post No reports of fatigue at post	No control group. Small sample. Measure of fatigue not described.
Dimeo et al. (44)	$N = 32$ Individuals with various solid tumors and Non-Hodgkins lymphoma Post chemotherapy and stem cell transplant Exercise Group: $n = 16$ Mean age = 42 Control Group $n = 16$ Mean age = 39	Nonrandomized, two group	Pre & Post Physical Treadmill stress test Cardiac function Hemoglobin concentration	Physician supervised Duration 6 weeks 5 ×/week Program Interval training on treadmill 75%–85% of maximum heart rate Exercise gradually increased from 3 minutes to 30 minutes/day	Intervention Group Significantly higher maximum physical performance and hemoglobin concentration vs. Control Group at post 25% of control subjects reported fatigue at post vs. 0% in exercise group	Nonrandom group assignment. Small sample size. Measure of fatigue not described.

TABLE 1
Continued

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
MacVicar and Winningham (45)	$N = 10$ Patients with breast cancer undergoing chemotherapy Exercise Group $n = 6$ Patient Control $n = 4$ Healthy Exercise Control $n = 6$	Three group, nonrandomized, age-matched	Pre & post Physical Exercise bike stress test Mood Profile of Mood States	Duration 10 weeks 3×/week Program Interval training cycle ergometry 60%–85% of maximum heart rate	21% increase in oxygen uptake (functional capacity) in the Exercise Group vs. 17% in Healthy Exercise Controls vs. 2% decrease in Patient Controls	Nonrandom group assignment. Stage of disease and subject characteristics not described. Small sample. No statistical analyses.
MacVicar, Winningham, and Nickel (50)	$N = 45$ women with Stage II breast cancer on chemotherapy Exercise Group $n = 18$ Mean age = 45 ± 10.2 Placebo Group $n = 11$ Mean age = 46.1 ± 10.3 Control Group $n = 16$ Mean age = 43.8 ± 9.3	Three groups Stratified on baseline functional capacity and randomized	Pre & post Physical Exercise bike stress test	Duration 10 weeks 3×/week Program Interval training cycle ergometry 60%–85% of maximum heart rate Placebo program 10 weeks 3×/week Stretching and flexibility exercises	40% increase in maximum oxygen uptake and performance on stress test in the Exercise Group vs. both comparison groups (differences are significant)	Small sample size.
Mock et al. (46)	$N = 14$ Mean age = 44 Stage I and II breast cancer patients undergoing chemotherapy Majority were Caucasian Intervention Group $n = 9$ Control Group $n = 5$	Two groups Random assignment in clusters	Pre, mid, & post chemotherapy Physical Karnofsky Scale 12-Minute Walking Test Symptoms Symptom Assessment Scales Distress Brief Symptom Inventory Psychosocial Psychosocial Adjustment to Illness Scale Tennessee Self-Concept Scale Body Image Visual Analog Scale	Facilitators Oncology clinical nurse specialist Duration 4–6 months Exercise Sessions 4–5×/week Individual outdoor walking with Support Group sessions 1½ hour every 2 weeks	Exercise Group exercised ≥30 minutes ≥3×/week Midtreatment Significantly less adjustment difficulties, lower distress scores, fatigue, nausea, and depression in Intervention vs. Control Group At post, significant improvement on walk test and less sleep difficulties in Exercise Group vs. Control Group	Small sample size. Role of exercise alone cannot be determined. No follow-up.
Mock et al. (53)	$N = 46$ Mean age = 49 years Stage I–II breast cancer Postsurgery Receiving radiation Majority were Caucasian Exercise Group $n = 22$ Control Group $n = 24$	Two group Nonrandomized	Pre, mid, & post radiation treatment Physical 12-Minute Walk Test Symptoms Symptom Assessment Scales Piper Fatigue Scale	Facilitator Oncology nurse specialist Duration 6 weeks 4–5×/week Individual outdoor walking for 20–30 minutes Phone calls and clinic visits for adherence Control Group: Phone contact	86% of Intervention Group participants reported exercising ≥3 times/week Intervention Group Significant improvement on walk test, significant decrease in fatigue intensity, sleeping difficulties and anxiety vs. Control Group	Regular walking also reported among Control Group.
Peters et al. (43)	$N = 24$ Mean age = 49.3 Stage I–II breast cancer Postsurgery	Single group	Pre, post, 6 months follow-up Physical Exercise bike stress test Biochemical Amount & cytotoxic activity of natural killer cells Personality Freiburger Personality Inventory FPI-R	Duration 29 weeks 5×/week for 6 weeks in hospital + 2–3×/week for 6 months Supervised for 6 weeks	Mean frequency of training 2.2/week Cytotoxic activity of natural killer cells increased significantly at follow-up Life satisfaction significantly higher at 5 weeks vs. pretest	No control group. Frequency of exercise fairly low.

TABLE 1
Continued

Authors	Subjects	Design	Assessments of Outcomes	Intervention	Outcomes	Comments
Segar et al. (54)	$N = 24$ Mean age = 48.9 Individuals with breast cancer Mean 41.8 months post-surgery 75% Caucasian Exercise Group $n = 10$ Exercise + Behavior Modification $n = 10$ Control Group $n = 10$	Sequential assignment to groups, crossover design at 12 weeks	Pre-, 10 weeks, & after 12 week crossover Mood Beck Depression Inventory Strait Anxiety Inventory Self-esteem Rosenberg Self-Esteem Inventory	Exercise Group Unsupervised aerobic exercise 30 minutes, 4 ×/week ≥60% of age predicted maximum heart rate Exercise + Behavior Modification Same as above + self-reward after each exercise session and at end of each week	Both exercise groups combined for analyses Those exercising ≥1,068 minutes included in analysis (≥89% compliance) Pre–post comparisons show significant time and interaction effects for depression, interaction effects for state anxiety and trait anxiety, and time effects on self-esteem	Analyses on cross-over phase limited by sample size. No corroboration for exercise self-reports.
Winningham and MacVicar (52)	$N = 42$ Stage II–IV breast cancer patients receiving chemotherapy Exercise Group $n = 16$ Mean age = 46.1 Placebo Group $n = 14$ Mean age = 48.2 Control Group $n = 12$ Mean age = 45.3	Randomized controlled trial Stratified on age and functional capacity and randomized	Pre & post Physical Exercise stress test Symptoms SCL-90-R Somatization Scale to assess nausea	Supervised Duration 10 weeks 20–30 minutes 3×/week Program Interval training cycle ergometry 60%–85% of maximum heart rate Placebo Group Stretching and flexibility exercises	Exercise Group Significant decrease on somatization scores vs. other groups	One item assessing nausea on the Somatization scale.
Winningham, MacVicar, Bondoc, Anderson, and Minton (51)	$N = 24$ Mean age = 45.6 Stage II breast cancer patients on chemotherapy Exercise Group $n = 12$ Control Group $n = 12$ Placebo Control Sample size not described	Randomized controlled trial Stratified according to functional capacity and randomized	Pre & post Physical Exercise bike stress test Anthropometrics and skin fold	Supervised Duration 10–12 weeks 20–30 minutes 3×/week Exercise Group Interval training cycle ergometry 60%–85% of maximum heart rate Placebo Group Stretching and flexibility exercises	Placebo Group not included in the analyses Exercise Group Significant decrease in subcutaneous fat vs. controls, percentage of body fat decreased significantly in Exercise Group, and increased in Control Group	Small sample size. Information on diet not obtained. Some subjects on Prednisone previously.

Note: n.s. = not statistically significant. Table adapted from "Exercise in the Rehabilitation of Breast Cancer Survivors," by B.M. Pinto and N.C. Maruyama, 1999, *PsychoOncology, 8,* pp. 191–206. © Copyright John Wiley & Sons Limited. Reproduced with permission.

surgeons in one study (27). Training in delivering the smoking cessation intervention was given to providers in all four studies. In all four studies, patients in the control group received usual care. However, attempts to track the implementation of usual care or to standardize the delivery of usual care intervention were described in only one study (27) and involved having the provider deliver advice to quit to usual care subjects.

Intervention Efficacy

The efficacy of smoking cessation interventions for patients with cancer is difficult to evaluate based upon the studies reviewed. Only one of three studies included a follow-up of 6 months or more (27). None of the four studies demonstrated a significant intervention effect; although as seen in Table 1, in three of the studies, abstinence was greater among subjects in the intervention conditions than in the usual care control conditions at immediate postintervention follow-up, 21% versus 14% (28), 64% versus 50% (29), and 75% versus 43%, respectively (30). Cotinine confirmation of self-reported abstinence ranged from 75% to 100%. A primary issue in understanding the lack of significant treatment effects is whether there was adequate power to detect an intervention effect, which was not addressed in any of the studies. The lack of statistically significant effects is likely due to inadequate sample size in the three studies mentioned above, none of which had a sample greater than 30 patients.

In the study by Gritz and colleagues (27), continuous abstinence at 12 months was greater among usual care than experimental subjects (77% versus 64%, respectively). The authors discuss four possible explanations for the lack of intervention effect: (a) Contamination of the control condition may have occurred since the same group of providers delivered the intervention to experimental and control group patients; (b) Some providers may have delivered usual care that was more extensive than called for in the study; (c) Inclusion of recent ex-smokers in the sample may have diluted the intervention effect, since results showed that all ex-smokers remained abstinent throughout the trial; and (d) The

most important elements of advice to quit smoking were incorporated into the control protocol and were delivered at a time when the majority of cessation took place, at the time of initial diagnosis and treatment. While there was not an effect of the enhanced intervention over and above the standardized advice given to the control group, the systematic, brief advice to quit received by all patients in the study may have played a role in the 70% continuous abstinence rates at 12 months seen across all patients in the study. However, this was not experimentally evaluated given the absence of a true no-treatment control group. Gritz notes that the cessation rates in her study were at the high end of studies reporting on the natural history of 12-month quit rates among oncologic and cardiac populations, which range from 25% to 70% (27).

Summary

The prevalence of smoking among cancer patients ranges from 18% to 99%, depending upon the type of cancer. Data on the prevalence of smoking among cancer survivors were notably absent from the literature, with the exception of data on smoking among adult survivors of childhood cancer. Similarly, the smoking cessation literature has focused solely on cancer patients and not on cancer survivors. The methodologic limitations of the four smoking cessation intervention studies reviewed make their efficacy difficult to evaluate. The small sample sizes and attendant lack of statistical power across studies are a major weakness, as is the lack of long-term follow-up in three of the four studies. Other limitations include the lack of more racially diverse samples and inadequate attention to whether study participants were representative of the larger population of smokers with cancer from which the study samples were drawn. Strengths of the studies include the use of regular hospital providers (and not research staff) to deliver the interventions and the inclusion of patients with a variety of tumor sites. While brief hospital-based, nurse-delivered smoking interventions with phone call follow-up appear promising, future studies with adequate power to detect intervention effects and longer term follow-ups are needed to determine their efficacy. The studies reviewed were offered to patients in a hospital setting, and hence, it is not known whether smoking cessation interventions would help in encouraging those who have completed medical treatment to stop smoking (i.e. the most effective "timing" of the intervention). Also needed are data on the prevalence of smoking among cancer survivors as well as smoking cessation studies involving this population.

DIETARY INTAKE

Prevalence

Though much has been written on dietary risk factors for cancer, the dietary intake patterns of cancer patients and survivors has not been widely explored. Baseline dietary intake data from two intervention studies for women with breast cancer (31,32) indicate that, in one study, women reported dietary intakes of total energy, fat, protein, and carbohydrates that were comparable to the dietary patterns described in the U.S. population survey (National Health and Nutrition Examination Survey [NHANES] III) (31), while in the other study, the women had higher percentage of calories from fat (32).

Design Issues

The literature search yielded four studies of dietary interventions in individuals diagnosed with cancer, all of which were conducted among women with breast cancer (Table 1). The studies investigated whether women with breast cancer could modify their dietary behavior following cancer diagnosis (31–34), both during active treatment (32) and after (31,33,34), and began to explore, in a preliminary way, whether dietary changes have an effect on recurrence and survival (32,34). All used randomized, controlled designs, although one stratified participants by age and stage of disease prior to randomization (34). One study specifically stressed the importance of physical activity so that the effects of diet on weight and cancer outcomes cannot be isolated from those of diet alone (31). Two studies assessed baseline and follow-up measures of the study outcomes for up to 2 years (32,33), while the other two followed subjects for a year (31,34). Thus, dietary behavior changes for up to 2 years have been examined. Biological measures of dietary adherence to corroborate the participant's self-report were included in three studies (31,32,34). The biological measures included serum lipids (32,34), carotenoids (a marker for fruit and vegetable intake) (34), and anthropometric data such as weight (31,32,34). One difficulty with the use of weight as an outcome is that the effects of diet on weight can be confounded by the effects of exercise. Three of the four studies do not mention whether they controlled for exercise, and one intervention specifically encouraged exercise (31).

Sample Characteristics

The dietary studies included women with Stages I and II breast cancer (31,33) and women with Stages I through IIIa disease (32,34). Three of the four studies included women who were postmenopausal (31–33), while one study included those who were premenopausal, stratified women by age and stage prior to randomization, and also excluded those taking Tamoxifen (34). Age, menopausal status, disease stage, and use of Tamoxifen might affect biological outcomes such as weight, lipid profiles, and ultimately, recurrence and survival. All the studies excluded women with diseases that required dietary restrictions, so that dietary changes due to other diseases such as diabetes were controlled for. Sample sizes ranged from 93 to 290 with a mean of 192 and, in general, have been larger than the sample sizes of studies of smoking cessation or exercise adoption after a cancer diagnosis. Participants were mostly middle-aged, and only one study mentions race where 97% of the women were Caucasian (31). Thus, the homogeneity of the samples limits the generalizability of the findings.

Types of Interventions

The overall goals of the dietary interventions were to reduce fat intake to 15% of total energy (31,32) and, in the third study, to 20%–25% of total energy (33). The timing of interventions ranged from occurring during active medical treatment (32), to within 4 months of treatment (33), and up to several years posttreatment (31,34). Interventions were intensive and in three of the four studies, were delivered by professional staff. The format was typically individualized dietary counseling (31–34) and involved teaching the participants low-fat and high-fiber food preparation skills (31–33). The interventions were based on behavioral and social learning theory (31,32) and social cognitive theory (34). One study used a group format in addition to the individual sessions (31). Trained dietitians administered the interventions in three studies (32–34). In an attempt to widen the delivery of dietary interventions, one study explored the feasibility of a telephone-based intervention to introduce a high-vegetable, reduced-fat, increased-fiber diet (34). Control groups received minimal intervention. In three of the four studies, participants randomized to the control group were given pamphlets with recommended diets for

cancer patients (31,32,34), and in the fourth study, the controls received no intervention (33).

The same dietitians who provided the intervention to the participants in one study also assessed adherence to the dietary changes, thereby adding potential for bias in the measurement of dietary adherence (33). Three other studies used independent raters to collect the dietary information from participants (31–33), and one attempted to quantify adherence by calculating an adherence score (34).

Intervention Efficacy

In the studies reviewed for this paper, women with breast cancer were able to adopt dietary changes and maintain the changes for up to 24 months (32,33). In all the studies, participants in the interventions were able to significantly reduce total fat intake when compared with controls (31–34) and increase consumption of fruit (33,34), carbohydrates (31,33), and vegetables (33,34). There is less concern about the bias in self-reports of dietary intake because of the addition of biological measures of adherence in two of the studies reviewed (32,34). Intervention participants showed significant increases in serum carotenoids (which are a measure of fruit and vegetable intake) when compared with controls (34) but there were no group differences in serum lipid profiles (32,34). Two of the studies reported that participants in the intervention group experienced significant weight loss when compared with controls (31,32). One of these studies stressed the importance of physical activity, thereby confounding the effects of diet alone on weight (31), and the other did not document patients' physical activity (32).

Limited work has been done to broaden the delivery of dietary interventions. Data suggest that intervention via telephone may be as effective as person-to-person interventions (34). Attempts have been made to reduce the burden and expense of using professional staff to deliver the interventions by using volunteer staff (31). Participants in this study (31) were able to achieve a mean fat intake below 20% of total energy which is comparable to the goals of the other studies. Unfortunately, the study utilizing the volunteer staff (40% were dietitians) did not include a comparison group of paid staff. Also, the participants in the study with the volunteer staff were selected to be 105% of their ideal weight at baseline and may not have been comparable to the women participating in the other studies.

The timing of dietary interventions may be an important factor in the individual's ability to adhere to dietary changes. For example, when dietary interventions included women either during treatment or within 4 months of diagnosis, there was approximately 50% attrition in the intervention group (32,33), and there was also 50% attrition in the control group when the intervention was offered during active treatment (32). In the studies for women up to 18 months (31) and 4 years postdiagnosis (34), there was high retention (75%–80%) in both groups. These results suggest that intervening too soon after diagnosis may lead to higher dropout rates.

Summary

As we review the progress made in promoting life-style changes after a cancer diagnosis, it is clear that dietary interventions among cancer patients and survivors represent more sophisticated research designs with larger samples. These studies yielded promising results of dietary change after cancer diagnosis, both during active treatment and after treatment has been completed, and have begun addressing questions about the effects of such changes on cancer recurrence. Evidence of dietary changes have been found not only via self-report, but also corroborated with biochemical or physiological indices (32,34). Strengths of the dietary studies include steps that minimize assessment bias by having assessments done by individuals who did not deliver the intervention (31), longer follow-up to determine maintenance of behavior changes (32), and data on study attrition (31,33,34). A limitation of the studies was the homogeneity of samples which limit generalizability.

SEDENTARY BEHAVIOR

Prevalence

Few studies have reported on the prevalence of sedentary behavior after a cancer diagnosis. Sedentary behavior (defined as no exercise participation in one study [35] and as exercising less than two to four times per week in another study [36]) was reported among 28% to 41% of women who had been diagnosed with breast cancer over the previous 1 to 2 years (35,36). However, these results were obtained from small samples of volunteers ($n < 100$) and are not likely to be representative samples. There have also been reports of reductions in exercise participation during cancer treatment (37,38). Thus, at best, the prevalence of sedentary behavior among patients and survivors is likely to be similar to that among U.S. adults (i.e. 28% of U.S. adults report no participation in leisure-time physical activity, Behavioral Risk Factor Surveillance System, 1992 [39]).

Design Issues

Studies investigating the effects of exercise alone among patients or survivors of cancer have used designs ranging from pre–post studies with no control group (40–43), nonrandomized studies with control groups (44,45), randomized controlled trials (46–49), and randomization to intervention and control groups after matching for age and metabolic capacity (50–52) (Table 1). Placebo groups (stretching and flexibility exercises) to control for the effects of social contact were used in a few studies (50–52). In three of the studies reviewed, exercise was offered as a component of the intervention program (46,48,49), making it difficult to isolate the effects of exercise alone. The studies reviewed largely focused on short-term adoption of exercise (and associated outcomes), with the norm being no follow-up assessments (42,44,46,47,50,51,53) or follow-ups at less than 6 months (40,54). Only two studies reported follow-ups at 6 months or longer (43,55). A majority of the on-site supervised programs report significant pre–post improvements in maximal oxygen uptake (40–42,44,45,47,50) to demonstrate fitness benefits and provide indirect corroboration for exercise adherence. Two of the unsupervised exercise studies (46,53) demonstrated improvements on the 12-minute walk test, and the third study (54) did not obtain corroboration of self-reports of exercise (54).

Sample Characteristics

A majority of the exercise studies have been conducted among middle-aged patients with early-stage breast cancer, receiving chemotherapy (45,52) or radiation therapy (53). In almost all instances, the sample sizes have been small, ranging from 10 (45) to 62 patients (50). A similar pattern is seen for studies offering exercise interventions for those who had completed medical treatment, with the largest sample of 199 for a multicomponent intervention that included exercise (49). Women (with breast cancer) have largely been participants in these trials. Ethnicity/race has seldom been mentioned in the papers reviewed (45,50,41–

44,47), and it seems likely that few minority individuals have been participants. The restricted sample characteristics limit the generalizability of results to patients or survivors of other cancers (or stage of cancer), older individuals, and minorities. No information has been provided on participants' exercise behavior prior to their study participation and, hence, it is not clear whether individuals who exercised prior to their cancer diagnosis or thereafter were overrepresented in the samples.

Types of Interventions

As a rule, the exercise programs offered to individuals with a diagnosis of cancer have not been based on a theoretical approach. With the exception of studies by Mock and colleagues (46,53) based on the Roy Adaptation Model for Psychosocial Adjustment that views adaptation as a physiological and psychological mode (56), there is no mention of a theoretical conceptualization for the intervention. Exercise programs offered to patients receiving chemotherapy, as well as those offered to individuals following high-dose chemotherapy and bone marrow transplants, have been conducted in a hospital setting (41,42,44,47) and supervised by physicians (41,42,44,47) or research staff (45,50–52). Control groups as a rule received no intervention and participated only in the assessments (exception: see [53] and Table 1). For the most part, at pretreatment, exercise stress tests were used to identify cardiac disease and to estimate appropriate exercise training intensity, and they were repeated at posttreatment to document improvement in aerobic capacity (41,42,44,45,47,50–52). The length of training varied from 4 weeks (48,49) to 10 weeks (45,51,52) with three or more sessions per week (41,42,44,45,47,50–52). It is unlikely that improvements in exercise capacity could be accrued from short training programs such as those for 4 weeks (one session per week) (48,49). Training intensities were generally moderate at 60%–85% of maximum heart rate (41,42,44,45,47,50–52). All programs offered aerobic training using bicycles (45,50–52) or treadmills (41,42,44,47). Strength training was generally not offered with two exceptions (48,49).

Estimating the exercise "dose" (intensity, duration, and frequency) in the three unsupervised exercise programs conducted off-site presents more of a challenge. Mock and colleagues offered walking programs ranging from 7 weeks (53) to 6 months (46) using Winninghams' Rhythmic Walking Protocol (57), and in the third study, individuals (mean 42 months postsurgery) participated in unsupervised exercise at 60% of predicted maximum heart rate (54).

Intervention Efficacy

Our review shows that there has been adequate demonstration of the feasibility of on-site supervised (45,50,51) and home-based walking programs (46,53) in relatively small samples of women receiving chemotherapy or radiation. Individuals who have completed bone marrow transplantation have been able to participate in supervised on-site programs (41,47). Overall, significant improvements in functional capacity were demonstrated in performance on exercise stress tests or walk tests among patients being treated for cancer (50) or those who had completed treatment (47). Self-reports of exercise participation in some of these studies have been limited by the absence of fitness measures or the use of objective activity monitors (48,49,54). At this time, there are no data to support conclusions about effective timing of an exercise intervention (i.e. during treatment versus after treatment). While it is clear that exercise adoption is indeed possible among the patient samples studied (largely those with breast cancer), little is known about the maintenance of this behavior, since most follow-ups were less than 6 months.

Among exercise programs offered to patients receiving cancer treatment, there appear to be added benefits in that there is limited evidence in support of prevention of weight gain (51), attenuation of cancer treatment sequelae such as neutropenia (low white blood cell count) (47), pain (47), fatigue (52,53), and sleep problems (53). There are little data on immune changes associated with exercise participation among cancer patients and survivors. When psychological outcomes are considered, data suggest that women who exercise during cancer treatments or after treatments have been completed report reductions in anxiety (53,54) and reductions in depression (54).

Summary

Intervention efforts for exercise, as for smoking, on the whole represent weaker research designs and conclusions have been limited by small, convenience samples of women with breast cancer. Studies have demonstrated the feasibility of on-site supervised (45,50,51) and home-based walking programs (46,53) for women receiving chemotherapy or radiation. Individuals who have completed bone marrow transplantation have also been able to participate in supervised on-site programs (41,47). Results suggest that exercise can contribute to improved fitness, improved mood, and body image, and attenuation of treatment sequelae such as fatigue. However, problems in the design and small sample sizes in these studies limit the ability to draw strong conclusions on the benefits of exercise (58). Self-reports of exercise participation in some of these studies have been limited by the absence of fitness measures or the use of objective activity monitors. It is also not clear whether individuals who exercised prior to their diagnosis were overrepresented in the samples studied. Finally, since follow-up assessments have not been conducted, little is known about exercise maintenance. It is encouraging to note that becoming physically active can offer improvements in several domains: physical fitness, mood, treatment-related side effects, and body image. Hence, researchers interested in helping cancer patients and survivors adopt exercise would do well to attend to the strengths in the dietary change literature in developing appropriate intervention programs.

FUTURE DIRECTIONS: WHERE NEXT?

Given the improved rates of survival from many types of cancers, there is increasing interest in examining the type and prevalence of cancer-related health problems faced by these individuals (e.g. secondary cancers, cataracts, sexual dysfunctions, neuropsychological problems) and in reducing cancer-related morbidity. There are several issues to be considered by investigators in further exploring the relevance, feasibility, and effects of interventions targeting health behaviors in this population. Questions that should be addressed in designing interventions for individuals who have been diagnosed with cancer are summarized below.

Selection of Target Behavior(s)

Our review indicates that the goals of health behavior change varied across the illness continuum with interventions (e.g. exercise programs) offered to individuals in treatment, chiefly focusing on reduction of treatment sequelae (e.g. fatigue, nausea) and those offered to individuals who had completed treatment aimed at reducing morbidity, improving mood and quality of life, and perhaps reducing risk of recurrence. Hence, it is important to select

a behavior which, if changed, can improve affect and quality of life after medical treatment (e.g. exercise adoption to reduce weight, improve body image, etc.) or reduce risk for cancer recurrence or metastases (e.g. smoking cessation for head and neck cancer patients) (12,59). However, there is a cautionary note in that, in some instances, a poor prognosis may not make health behavior change a worthwhile endeavor and, in fact, may overburden the terminally ill.

Another question to consider: If an individual displays several unhealthy behaviors, should each behavior receive attention? Intervention programs among healthy adults have generally shown that requiring changes in more than one behavior concurrently (e.g. smoking cessation and weight management) often results in neither behavior change being successfully accomplished (60,61). However, there are suggestions that changing one life-style behavior (e.g. dietary fat) may function as a "gateway" to making changes in other life-style behaviors (e.g. 62). Hence, future studies should capitalize on the lessons learned in promoting life-style changes in one or more behaviors among healthy individuals.

Target Populations

There are three issues that merit attention: First, our review has revealed scant data on the prevalence of smoking, poor diet, and sedentary behaviors among cancer patients and survivors. A primary issue would therefore involve study of the prevalence of these behaviors among patients and survivors of various cancers. Second, it is clear that the dietary and exercise interventions have largely been offered only to women with breast cancer. There are many opportunities to identify the most appropriate and effective interventions for the large and heterogenous populations of cancer patients and cancer survivors. Future intervention efforts should be directed toward individuals with other types of cancer for whom life-style risk factor changes offer potential benefits in mood or reduce side effects of cancer treatment (e.g. prostate cancer, colon cancer) or improve quality of life or possibly reduce risk of recurrence. To increase generalizability, studies should also strive to include members of both genders, minority groups, and survivors of childhood cancers. Third, risk behaviors and interventions among pediatric cancer patients is an area which has received little research attention. This literature review revealed no published studies on the prevalence of tobacco use, dietary patterns, or physical activity or health behavior interventions among pediatric cancer patients. In addition to assessing the prevalence of health risk behaviors among pediatric cancer patients and their families, we need to know if and how these issues are currently being addressed in health care settings.

Theoretical Bases for Interventions

As pointed out earlier, there is a paucity of theory-driven research on health behavior change among individuals diagnosed with cancer. Concepts from social learning and social cognitive theory have been used in some of the dietary interventions, and the Roy Adaptation Model (56) has been used in two exercise studies (46,53). Restrictions on sample size have also limited the ability to detect the contributions of a theory-driven intervention in predicting behavior change. Investigators should pay heed to lessons learned and promising theories (63–69) in changing each of these behaviors in healthy individuals or those with other chronic diseases such as cardiovascular disease, human immunodeficiency virus (HIV), and diabetes. Other models, such as the Biobehavioral Model of Coping proposed by Andersen and colleagues (7), can also form a framework to approach health behavior change. Working from a theoretical basis will not only help to test the efficacy of the theory for individuals with cancer, but help to identify appropriate behavior change techniques for cancer patients or those who have survived the disease(s).

As with noncancer groups, the cancer patient's or survivor's readiness to make behavior changes and ability to maintain behavior change cannot be assumed. The readiness to make behavior change may be affected by a variety of disease factors such as the stage and type of disease, previous history of behavior change, and psychological variables such as coping, locus of control, perceived benefits and costs of behavior change, and anxiety and depression which may accompany diagnosis and treatment. For example, in a survey of women who had been treated for breast cancer, positive appraisal as a coping strategy was a significant predictor of changes in self-reports of stress level and diet (70). Of note, patients' "responsibility for recovery" (as measured by a single item) correlated with positive changes in exercise. In another survey of survivors of colorectal cancer, intention and perceived behavioral control (concepts in Ajzen's Theory of Planned Behavior [65]) predicted exercise participation during cancer treatment (37). Finally, history of behavior change (e.g. exercise history, quitting smoking attempts) may predict subsequent behavior change; for example, resuming regular exercise after cancer treatment may be important to those who have exercised prior to their cancer diagnosis. Unfortunately, in the exercise studies reviewed, it is not known whether participants exercised regularly prior to their cancer diagnosis. In sum, it is clear that there are many opportunities for educators and researchers to develop theoretically-based programs that capitalize on effective behavioral change approaches for healthy individuals and carefully incorporate variables relevant to the disease(s) (e.g. time since diagnosis, type of medical treatment for cancer, and disease stage) and variables that predict success in changing the specific behavior(s).

Outcome Variables

Our review indicates that quitting smoking, dietary changes, and exercise adoption are achievable among individuals with certain types of cancer; however, less is known about the maintenance of behavior changes, particularly smoking cessation and exercise maintenance, and the effects on outcomes such as fitness and mood. Second, apart from assessment of behavior change and obtaining corroboration for self-reports (e.g. saliva cotinine for smoking cessation interventions, fitness changes for exercise adherence, biochemical markers for dietary changes), the inclusion of psychological measures and quality of life measures might add a further dimension to what is known about who adopts such changes and what impact the changes have on individuals. Quality of life measures might shed some light on how behavioral changes affect participants' perception of their quality of life and may play a critical role in the patient's decision to engage in health behavior changes. For example, for some individuals, making certain health behavior changes such as restricting dietary fat to $\leq$15% of total caloric intake may not be worth the reduction in quality of life imposed by such dietary changes. Third, it has been hypothesized that modifying risk behaviors may reduce the risk for cancer recurrence via effects on adherence to medical treatment and cancer screening or through immune system functioning (7), but these outcomes and mechanisms have yet to be examined. Finally, since cancer patients are being diagnosed earlier and surviving longer, exploration of outcomes including other diseases, such as

cardiovascular disease, respiratory problems, and obesity, should also be addressed. For example, what is the risk of cardiovascular disease in a 35-year-old woman who has been precipitated into early menopause by chemotherapy and lost the cardioprotective effects of estrogen? Should the focus of health behavior interventions be the prevention of cardiovascular disease or cancer or both?

Interventions: Delivery Channel and Content

Cancer treatments necessitate frequent follow-ups and monitoring of patients which offer ample opportunities for health care providers to encourage the patient to consider changing health risk behaviors. Interestingly, in one study, subjects who had received physician recommendations to exercise reported significantly greater exercise participation versus those who had not received such a recommendation, suggesting the importance of encouragement from health care providers in promoting healthy behaviors (54). However, in many of the studies reviewed, the role of the oncologist in recommending behavior change was often not discussed. It is clear that physicians face many barriers in promoting preventive health care (e.g. smoking cessation, altering sedentary behaviors) (71,72). Despite recommendations and evidence to support the effectiveness of physician advice to patients to quit smoking (73), begin exercising (74–76), or encourage dietary improvements (77), particularly in the absence of reimbursement for preventive counseling and system reminders to counsel, reliance on physicians to provide intensive interventions on one or more of these behaviors does not appear practical. However, brief, medical office-based interventions have been shown to be effective for smoking cessation, dietary changes, and physical activity (73,77) among noncancer populations. Such interventions should be evaluated among cancer patients and survivors. Finally, due to the many barriers to physician counseling, health behavior interventions in cancer populations will likely need to involve nonphysician interventionists such as telephone counselors (78) and incorporate interactive health technology (79) as has been successfully done in noncancer populations.

When developing an intervention, health educators should recognize that patients or survivors may not be ready to change behaviors, but they may be responsive to messages highlighting the potential benefits of life-style change (while not placing blame or offering the hope of cure) as personalized to their individual health profile. Offering interventions suitable for various levels of readiness to change diet (80,81), exercise (82,83), or smoking (84) enhance behavior change in noncancer populations. As seen in our literature review, it is premature to speculate on the most effective intervention for this group of patients/survivors. It is not known whether brief, self-help materials are appropriate and a sufficient first step among cancer patients and survivors, or whether more intensive interventions will be required. For example, at a minimum, smoking status should be assessed in all patients, and those who smoke should receive clear, consistent, and personalized (to the specific health concerns of the patient) advice to quit smoking from their health care providers (85). More intensive interventions including pharmacological adjuncts should be offered when indicated (73,85). Given the critical importance of stopping smoking for those with smoking-related disease, existing smoking cessation guidelines should be followed for all such smokers including cancer patients. Future research can then begin to address the issue of how to maximize cessation rates in specific cancer populations. A similar approach can be used in offering programs that target dietary change or exercise adoption.

Timing of Interventions

One could expect that individuals may be catapulted in their readiness to alter life-style risk factors by a diagnosis of cancer and its treatment. It has been suggested that it is important to intervene as proximal to the illness experience as possible (as has been found with smoking cessation among patients hospitalized for cardiac events [86,87]), since once patients recover their health, they may be less willing to begin to make life-style changes (59). Conversely, the distress of a cancer diagnosis may overwhelm the patient. Shortly after diagnosis the primary issue of relevance is to determine treatment options, make treatment decisions, and adhere to treatment regimens. It is likely that surgery and/or radiation and chemotherapy may present numerous demands of the patients and their families, making life-style behavior changes difficult during this phase. The optimum timing of the delivery of interventions remains to be established, although there is some suggestion that interventions too soon after diagnosis may lead to early withdrawals from the intervention. In the dietary studies described above, there was a decreased likelihood of participation and larger attrition in the intervention group when the dietary program was offered close to the time of diagnosis (32,33). Among the exercise studies, there is evidence that exercise adoption was feasible while patients were receiving adjuvant therapies (i.e. chemotherapy or radiation), but the small sample sizes limit the conclusions regarding optimal timing of interventions. Future studies should examine the time point in the illness–recovery continuum at which individuals diagnosed with cancer will be more amenable to changing behavior and maintaining these changes.

CONCLUSIONS

With improved survival from cancer, life-style risk behaviors such as smoking, poor diet, and sedentary behavior among cancer patients and survivors require attention from health promotion experts. There is a need to assess the relevance and prevalence of these behaviors and to develop interventions that target these behaviors so as to enhance recovery, improve quality of life, and possibly extend survival. In this paper, we have reviewed the current status of these efforts and described issues that should be considered in future research. Prospective studies focusing on behavior change after cancer diagnosis and treatment and the variables that contribute to increased motivation and successful change are needed.

REFERENCES

(1) Garfinkel L: Cancer statistics and trends. In Murphy GP, Lawrence W, Lenhard RE (eds), *American Cancer Society Textbook of Clinical Oncology* (2nd Ed.). Atlanta, GA: American Cancer Society, 1995.
(2) Wingo PA, Tony T, Bolden S: Cancer statistics, 1995. *CA: A Cancer Journal for Clinicians.* 1995, *45:*8–30.
(3) Andersen BL: Psychological interventions for cancer patients to enhance the quality of life. *Journal of Consulting and Clinical Psychology.* 1992, *60:*552–568.
(4) Fawzy FI, Fawzy NW, Arndt LA, Pasnau RO: Critical review of psychosocial interventions in cancer care. *Archives of General Psychiatry.* 1995, *52:*100–113.
(5) Krupnick JL, Rowland JH, Goldberg RL, Daniel UV: Professionally-led support groups for cancer patients: An intervention in search of a model. *International Journal of Psychiatry in Medicine.* 1993, *23:*275–294.
(6) Trijsburg RW, Van Knippenberg FC, Rijpma SE: Effects of psychological treatment on cancer patients: A critical review. *Psychosomatic Medicine.* 1992, *54:*489–517.
(7) Andersen BL: Surviving cancer. *Cancer.* 1994, *74:*1484–1495.

(8) Irvine D, Vincent L, Graydon JE, Bubela N, Thompson L: The prevalence and correlates of fatigue in patients receiving treatment with chemotherapy and radiotherapy. *Cancer Nursing.* 1994, *17*(5): 367–378.

(9) Cohen RE, Blanchard EB, Ruckdeschel JC, Smolen RC: Prevalence and correlates of posttreatment and anticipatory nausea and vomiting in cancer chemotherapy. *Journal of Psychosomatic Research.* 1986, *30:*643–654.

(10) Gritz ER: Smoking and smoking cessation in cancer patients. *British Journal of Addiction.* 1991, *86:*549–554.

(11) Spitz MR, Fueger JJ, Eriksen MP, Newell GR: Cigarette smoking patterns of cancer patients. In Engstrom PF, Rimer B, Mortensen LE (eds), *Advances in Cancer Control: Screening and Prevention Research.* New York: Wiley-Liss, 1990, 73–82.

(12) Orleans CT, Lindblad A, Davis S, et al: The need for brief physician-initiated quit smoking strategies in CCOP settings. The 14th Annual Meeting of the American Society of Preventive Oncology. Bethesda, MD: March, 1990.

(13) Johnston-Early A, Cohen MH, Minna JD, et al: Smoking abstinence and small cell lung cancer survival. *Journal of the American Medical Association.* 1980, *244:*2175–2179.

(14) Gail MH, Eagan RT, Feld R, et al: Prognostic factors in patients with resected Stage I non-small cell lung cancer, a report from the Lung Study Group. *Cancer.* 1984, *54:*1802–1813.

(15) Moore C: Cigarette smoking and cancer of the mouth, pharynx, and larynx. *Journal of the American Medical Association.* 1971, *218*(4): 553–558.

(16) Stevens MH, Gardner JW, Parkin JL, Johnson KP: Head and neck cancer survival and lifestyle change. *Archives of Otolaryngology.* 1983, *109:*746–749.

(17) Castigliano SG: Influence of continued smoking on the incidence of second primary cancers involving mouth, pharynx, and larynx. *Journal of the American Dental Association.* 1968, *77:*580–585.

(18) Davison G, Duffy M: Smoking habits of long-term survivors of surgery for lung cancer. *Thorax.* 1982, *37:*331–333.

(19) Knudsen N, Schulman S, Van Den Hoek J, Fowler R: Insights on how to quit smoking: A survey of patients with lung cancer. *Cancer Nursing.* 1985, *8*(3):145–150.

(20) Corkery JC, Li FP, McDonald JA: Kids who really shouldn't smoke. *New England Journal of Medicine.* 1979, *300:*1279.

(21) Haupt R, Byrne J, Connelly RR, et al: Smoking habits in survivors of childhood and adolescent cancer. *Medical and Pediatric Oncology.* 1992, *20:*301–306.

(22) Troyer H, Homes GE: Cigarette smoking among childhood cancer survivors. *American Journal of Diseases of Children.* 1988, *142:* 123.

(23) Tyc VL, Hudson MM, Hinds P, Elliott V, Kibby MY: Tobacco use among pediatric cancer patients: Recommendations for developing clinical smoking interventions. *Journal of Clinical Oncology.* 1997, *15:*2194–2204.

(24) Tao ML, Guo MD, Weiss R, et al: Smoking in adult survivors of childhood acute lymphoblastic leukemia. *Journal of the National Cancer Institute.* 1998, *90*(3):219–225.

(25) Shaw NJ, Tweeddale PM, Eden OB: Pulmonary function in childhood leukaemia survivors. *Medical and Pediatric Oncology.* 1989, *17:*149–154.

(26) Lipshultz SE, Colan SD, Gelber RD, et al: Late cardiac effects of doxorubicin therapy for acute lymphoblastic leukemia in childhood. *New England Journal of Medicine.* 1991, *324:*808–815.

(27) Gritz ER, Carr CR, Rapkin D, et al: Predictors of long-term smoking cessation in head and neck cancer patients. *Cancer Epidemiology, Biomarkers and Prevention.* 1993, *2:*261–270.

(28) Griebel B, Wewers ME, Baker CA: The effectiveness of a nurse-managed minimal smoking-cessation intervention among hospitalized patients with cancer. *Oncology Nursing Forum.* 1998, *25*(5):897–902.

(29) Wewers ME, Bowen JM, Stanislaw AE, Desimone VB: A nurse-delivered smoking cessation intervention among hospitalized postoperative patients—Influence of a smoking-related diagnosis: A pilot study. *Heart and Lung.* 1994, *23*(2):151–156.

(30) Stanislaw AE, Wewers ME: A smoking cessation intervention with hospitalized surgical cancer patients: A pilot study. *Cancer Nursing.* 1994, *17:*81–86.

(31) Kristal AR, Shattuck AL, Bowen DJ, Sponzo RW, Nixon DW: Feasibility of using volunteer research staff to deliver and evaluate a low-fat dietary intervention: The American Cancer Society Breast Cancer Dietary Intervention Project. *Cancer Epidemiology, Biomarkers and Prevention.* 1997, *6:*459–467.

(32) Chlebowski RT, Blackburn GL, Buzzard IM, et al, for the Women's Intervention Nutrition Study: Adherence to a dietary fat intake reduction program in postmenopausal women receiving therapy for early stage breast cancer. *Journal of Clinical Oncology.* 1993, *11:*2072–2080.

(33) Nordevang E, Callmer E, Marmur A, Holm LE: Dietary intervention in breast cancer patients: Effects on food choice. *European Journal of Clinical Nutrition.* 1992, *46:*387–396.

(34) Pierce JP, Faerber S, Wright FA, et al: Feasibility of a randomized trial of a high-vegetable diet to prevent breast cancer recurrence. *Nutrition and Cancer.* 1997, *28:*282–288.

(35) Pinto BM, Maruyama NC, Engebretson TO, Thebarge RW: Exercise participation, mood, and coping in early-stage breast cancer survivors. *Journal of Psychosocial Oncology.* 1998, *16:*45–58.

(36) Young-McCaughan S, Sexton DL: A retrospective investigation of the relationship between aerobic exercise and quality of life in women with breast cancer. *Oncology Nursing Forum.* 1991, *18:*751.

(37) Courneya KS, Friedenreich CM: Determinants of exercise during colorectal cancer treatment: An application of the theory of planned behavior. *Oncology Nursing Forum.* 1997, *24:*1715–1723.

(38) Schwartz AL: Patterns of exercise and fatigue in physically active cancer survivors. *Oncology Nursing Forum.* 1998, *25:*485–491.

(39) U.S. Department of Health and Human Services: *Physical Activity and Health: A Report of the Surgeon-General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

(40) Decker WA, Turner-McGlade JT, Fehir KM: Psychosocial aspects and the physiological effects of a cardiopulmonary exercise program in patients undergoing bone marrow transplantation (BMT) for acute leukemia (AL). *Transplantation Proceedings.* 1989, *21:*3068–3069.

(41) Dimeo F, Bertz H, Finke J, et al: An aerobic exercise program for patients with haematological malignancies after bone marrow transplantation. *Bone Marrow Transplantation.* 1996, *18:*1157–1160.

(42) Dimeo F, Rumberger BG, Keul J: Aerobic exercise as therapy for cancer fatigue. *Medicine and Science in Sports and Exercise.* 1998, *30:*475–478.

(43) Peters C, Lotzerich H, Niemeier B, Schule K, Uhlenbruch G: Influence of a moderate exercise training on natural killer cytotoxicity and personality traits in cancer patients. *Anticancer Research.* 1994, *14:*1033–1036.

(44) Dimeo FC, Tilmann MH, Bertz H, et al: Aerobic exercise in the rehabilitation of cancer patients after high dose chemotherapy and autologous peripheral stem cell transplantation. *Cancer.* 1997, *79:*1717–1722.

(45) MacVicar MG, Winningham ML: Promoting the functional capacity of cancer patients. *Cancer Bulletin.* 1986, *38:*235–239.

(46) Mock V, Burke MB, Sheehan P, et al: A nursing rehabilitation program for women with breast cancer receiving adjuvant chemotherapy. *Oncology Nursing Forum.* 1994, *21:*899–907.

(47) Dimeo F, Fetscher S, Lange W, Mertelsmann R, Keul J: Effects of aerobic exercise on the physical performance and incidence of treatment-related complications after high-dose chemotherapy. *Blood.* 1997, *90:*3390–3394.

(48) Berglund G, Bolund C, Gustafsson U, Sjoden P: Starting Again—A comparison study of a group rehabilitation program for cancer patients. *Acta Oncologica.* 1993, *32:*15–21.

(49) Berglund G, Bolund C, Gustafsson U, Sjoden P: A randomized study of a rehabilitation program for cancer patients: The "Starting Again" Group. *Psycho-Oncology.* 1994, *3:*109–120.
(50) MacVicar M, Winningham ML, Nickel JL: Effects of aerobic interval training on cancer patients' functional capacity. *Nursing Research.* 1989, *38:*348–351.
(51) Winningham ML, MacVicar MG, Bondoc M, Anderson J, Minton JP: Effect of aerobic exercise on body weight and composition in patients with breast cancer on adjuvant chemotherapy. *Oncology Nursing Forum.* 1989, *16:*683–689.
(52) Winningham ML, MacVicar MG: The effect of aerobic exercise on patient reports of nausea. *Oncology Nursing Forum.* 1988, *15:*447–450.
(53) Mock V, Dow KH, Meares CJ, et al: Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. *Oncology Nursing Forum.* 1997, *24:*991–1000.
(54) Segar ML, Katch VL, Roth RS, et al: The effect of aerobic exercise on self-esteem and depressive and anxiety symptoms among breast cancer survivors. *Oncology Nursing Forum.* 1998, *25:*107–113.
(55) Berglund G, Bolund C, Gustafsson U, Sjoden P: One-year follow-up of the "Starting Again" group rehabilitation program for cancer patients. *European Journal of Cancer.* 1994, *30A:*1744–1751.
(56) Roy C, Andrews HA: *The Roy Adaptation Model. The Definitive Statement.* Norwalk, CT: Appleton & Lange, 1991.
(57) Winningham ML, Glass EC, MacVicar MG: *Rhythmic Walking-Exercise for People Living with Cancer.* Columbus, OH: James Cancer Hospital and Research Institute, Ohio State University, 1990.
(58) Pinto BM, Maruyama NC: Exercise in the rehabilitation of breast cancer patients. *Psycho-Oncology.* 1999, *8:*191–206.
(59) Gritz ER, Ward PH, Beumer J, Carr CR, Rapkin DA: Increasing adherence to a provider-implemented smoking cessation intervention for head and neck cancer patients. In Engstrom PF, Rimer B, Mortenson L (eds), *Advances in Cancer Control: Screening and Prevention.* New York: Wiley-Liss, 1990, 83–93.
(60) Hall SM, Turnstall CD, Vila KL, Duffy J: Weight gain prevention and smoking cessation: Cautionary findings. *American Journal of Public Health.* 1992, *82:*799–803.
(61) Pirie PL, McBride CM, Hellerstedt W, et al: Smoking cessation in women concerned about weight. *American Journal of Public Health.* 1992, *82:*1238–1243.
(62) Emmons KM, Marcus BH, Linnan L, Rossi JS, Abrams DB: Mechanisms in multiple risk factor interventions: Smoking, physical activity, and dietary fat intake among manufacturing workers. *Preventive Medicine.* 1994, *23:*481–489.
(63) Epstein LH: Integrating theoretical approaches to promote physical activity. *American Journal of Preventive Medicine.* 1998, *15:*257–265.
(64) Rosenstock IM: Historical origins of the health belief model. *Health Education Monographs.* 1974, *2:*328–335.
(65) Ajzen I: The theory of planned behavior. *Organizational Behavior and Human Decision Processes.* 1991, *50:*179–211.
(66) Rogers RW: Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In Cacioppo JR, Petty RE (eds), *Social Psychology: A Source Book.* New York: Guilford Press, 1983, 153–176.
(67) Rotter JB: *Social Learning and Clinical Psychology.* New York: Prentice Hall, 1954.
(68) Bandura A: *Social Learning Theory.* Englewood Cliffs, NJ: Prentice Hall, 1977.
(69) Prochaska JO, DiClemente CC: Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology.* 1983, *51:*663–674.
(70) Reardon KK, Aydin CE: Changes in lifestyle initiated by breast cancer patients: Who does and who doesn't? *Health Communication.* 1993, *5:*263–282.
(71) Orleans CT, George LK, Houpt JL, Brodie KH: Health promotion in primary care: A survey of U.S. family practitioners. *Preventive Medicine.* 1985, *14:*636–647.
(72) Frank E, Kunovich-Frieze T: Physicians' prevention counseling behaviors: Current status and future directions. *Preventive Medicine.* 1995, *24:*543–545.
(73) Fiore M, Bailey W, Cohen SJ, et al: *Smoking Cessation: Clinical Practice Guidelines No. 18,* AHCPR Publication No. 96-0692. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research, 1996.
(74) U.S. Preventive Services Task Force: *Guide to Clinical Preventive Services: An Assessment of the Effectiveness of 169 Interventions.* Baltimore, MD: Williams & Wilkins, 1989.
(75) Calfas KJ, Long BJ, Sallis JF, et al: A controlled trial of physician counseling to promote the adoption of physical activity. *Preventive Medicine.* 1996, *5:*225–233.
(76) Goldstein MG, Pinto BM, Marcus BM, et al: Physician-based physical activity counseling for middle-aged and older adults: A randomized trial. *Annals of Behavioral Medicine.* 1999, *21:*40–47.
(77) Marcus BH, Pinto BM, Clark MM, et al: Physician delivered interventions for dietary and exercise promotion. *Medicine, Exercise, Nutrition and Health.* 1995, *4:*325–334.
(78) Marcus AC, Morra ME, Bettinghaus E, et al: The Cancer Information Service Research Consortium: An emerging laboratory for cancer control research. *Preventive Medicine.* 1998, *27:*S3–S15.
(79) De Vries H, Brug J: Computer-tailored interventions motivating people to adopt health promoting behaviours: Introduction to a new approach. *Patient Education and Counseling.* 1999, *36:*99–105.
(80) Brug J, Glanz K, Assema PV, Kok G, van Breukelen GJP: The impact of computer-tailored feedback and iterative feedback on fat, fruit, and vegetable intake. *Health Education and Behavior.* 1988, *25:*517–531.
(81) Campbell MK, DeVellis BM, Strecher VJ, et al: Improving dietary behavior: The effectiveness of tailored messages in primary care settings. *American Journal of Public Health.* 1994, *84:*783–787.
(82) Marcus BH, Banspach SW, Lefebvre RC, et al: Using the stages of change model to increase the adoption of physical activity among community participants. *American Journal of Health Promotion.* 1992, *6:*424–429.
(83) Marcus BH, Bock BC, Pinto BM, et al: Efficacy of an individualized, motivationally-tailored physical activity intervention. *Annals of Behavioral Medicine.* 1998, *20:*174–180.
(84) Prochaska JO, DiClemente CC, Velicer WF, Rossi JS: Standardized, individualized, interactive and personalized self-help programs for smoking cessation. *Health Psychology.* 1993, *12:*399–405.
(85) Glynn TJ: Relative effectiveness of physician-initiated smoking cessation programs. *Cancer Bulletin.* 1988, *40:*359–364.
(86) Ockene J, Kristeller NL, Goldberg R, et al: Smoking cessation and severity of disease: The Coronary Artery Smoking Intervention Study. *Health Psychology.* 1992, *11:*119–126.
(87) Taylor CB, Houston-Miller N, Killen JD, DeBusk RF: Smoking cessation after acute myocardial infarction: Effects of a nurse-managed intervention. *Annals of Internal Medicine.* 1990, *113:*118–123.