



저작자표시-비영리-변경금지 2.0 대한민국

이용자는 아래의 조건을 따르는 경우에 한하여 자유롭게

- 이 저작물을 복제, 배포, 전송, 전시, 공연 및 방송할 수 있습니다.

다음과 같은 조건을 따라야 합니다:



저작자표시. 귀하는 원저작자를 표시하여야 합니다.



비영리. 귀하는 이 저작물을 영리 목적으로 이용할 수 없습니다.



변경금지. 귀하는 이 저작물을 개작, 변형 또는 가공할 수 없습니다.

- 귀하는, 이 저작물의 재이용이나 배포의 경우, 이 저작물에 적용된 이용허락조건을 명확하게 나타내어야 합니다.
- 저작권자로부터 별도의 허가를 받으면 이러한 조건들은 적용되지 않습니다.

저작권법에 따른 이용자의 권리는 위의 내용에 의하여 영향을 받지 않습니다.

이것은 [이용허락규약\(Legal Code\)](#)을 이해하기 쉽게 요약한 것입니다.

[Disclaimer](#)

Nursing Doctoral Dissertation

Efficacy of a Web-based Self-management
Exercise and Diet Intervention Program with
Tailored Motivation and Action Planning for
Breast Cancer Survivors:
A Randomized Controlled Trial

유방암환자에서 맞춤형 동기부여와
행위계획을 이용한 웹 기반 운동과
식이 자가관리 중재프로그램의 효과:
무작위배정임상시험

August 2012

Seoul National University
Graduate School of Nursing
Lee, Myung Kyung

Efficacy of a Web-based Self-
management Exercise and Diet
Intervention Program with Tailored
Motivation and Action Planning for
Breast Cancer Survivors: A
Randomized Controlled Trial

지도교수 박 현 애

이 논문을 간호학박사 학위논문으로 제출함

2012년 4월

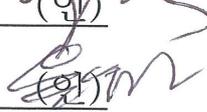
서울대학교 대학원

간호학과

이 명 경

이명경의 박사 학위논문을 인준함

2012년 6월

| | | |
|---------|------|---|
| 위 원 장 | 김 정은 |  |
| 부 위 원 장 | 서 문영 | (인)  |
| 위 원 | 박 현애 | (인)  |
| 위 원 | 이 은숙 | (인)  |
| 위 원 | 유 영호 | (인)  |

Efficacy of a Web-based Self-management
Exercise and Diet Intervention Program with
Tailored Motivation and Action Planning for
Breast Cancer Survivors:
A Randomized Controlled Trial

by

Lee, Myung Kyung

A thesis submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Nursing

Seoul National University, Seoul Korea
June, 2012

Doctorial Thesis Committee:

| | | |
|-----------|------------------------|------------------|
| Professor | <u>Kim, Jeongeun</u> | Chairperson |
| Professor | <u>Suh, Eunyoung</u> | Vice Chairperson |
| Professor | <u>Yun, Young Ho</u> | |
| Professor | <u>Lee, Eun Sook</u> | |
| Professor | <u>Park, Hyeoun-Ae</u> | |

Abstract

Efficacy of a Web-based Self-management Exercise and Diet Intervention Program with Tailored Motivation and Action Planning for Breast Cancer Survivors: A Randomized Controlled Trial

Lee, Myung Kyung
Graduate School of Nursing
Seoul National University

The aim of the present study was to develop a Web-based self-management diet and exercise intervention program and to determine whether the program was effective in improving breast cancer survivors' diet and exercise behaviors. Fifty-nine breast cancer patients with stage 0–III cancer identified within 12 months of completion of primary cancer treatment were recruited from 4 Korean hospitals. Participants were randomly assigned either to a 12-week, Web-based, tailored self-management exercise and diet intervention program featuring the delivery of education, the development of the capacity to plan, and automatic feedback employing TTM-based strategies; or they were assigned to the attention control group, which used booklets. Web-based surveys were

conducted at the baseline, 4, 8, and 12 weeks, and the stage of change, perceived self-efficacy, behaviors practiced at the goal level, dietary consumption, moderate-intensity exercise, body composition, health-related quality of life (HRQOL), anxiety, depression, and fatigue were assessed. The 12-week intervention course was completed by 29 (96.7%) participants in the experimental group and 28 (96.6%) in the attention control group. No significant difference between the two study groups was evident in terms of any sociodemographic or clinical characteristic at the baseline. The program effectively increased the number of desired lifestyle behaviors practiced at recommended levels ($p=.002$), the duration of exercise taken each week ($p<.0001$), the daily intake of F&V ($p=.025$), and overall dietary quality ($p=.001$). The present program significantly improved scores on specific HRQOL domains including physical functioning ($p=.016$) and appetite loss ($p=.024$), and reduced fatigue evaluated using the BFI ($p=.002$). In conclusion, a Web-based program with tailored motivation and action planning for change in exercise and dietary behaviors for breast cancer survivors was effective when TTM theory was used to inform program strategy.

Keywords : Web-based, action planning, exercise and diet, self-management program, randomized controlled trial, breast cancer

Student Number : 2009-30119

Table of Contents

| | |
|--|----|
| Abstract | i |
| I. Introduction | 1 |
| 1. Background and significance | 1 |
| 2. Aims of the research | 5 |
| 3. Research hypotheses | 5 |
| 4. Definition of terms | 7 |
| II. Literature review | 11 |
| 1. Significance of lifestyle intervention in cancer survivors | 11 |
| 2. Significance of weight management in cancer survivors | 12 |
| 3. The Trans-Theoretical Model (TTM) | 21 |
| 4. A Web-based health management program for cancer survivors | 28 |
| 5. A Web-based exercise or diet program using TTM theory, encouraging healthy behavioral change | 31 |
| III. Research framework | 34 |
| IV. Methods | 38 |
| 1. Development of the Web-based self-management exercise and diet intervention program | 38 |

| | |
|---|-----|
| 2. The efficacy test of the Web-based self-management exercise and diet intervention program | 42 |
| V. Results | 58 |
| 1. Development of a Web-based self-management exercise and diet intervention program, Health Planner | 58 |
| 2. The Efficacy of a Web-based self-management exercise and diet intervention program, Health Planner | 82 |
| VI. Discussion | 99 |
| References | 107 |
| Appendices | 136 |
| 국문초록 | 166 |

List of Tables

| | |
|--|----|
| Table 1. The TTM Construct | 25 |
| Table 2. Gradual Progress of the Extent of Exercise within the Web-based Self-management Exercise and Diet Intervention Program | 69 |
| Table 3. The Recommended Number of Servings from Individual Food Groups | 74 |
| Table 4. Protocol of the Web-based Self-management Exercise and Diet Intervention Program | 76 |
| Table 5. Usability Evaluation of Health Planner by End-user Responses .. | 81 |
| Table 6. Characteristics of Study Participants | 84 |
| Table 7. Distribution of Least-square Means of Behavioral Outcomes Compared between the Control and the Experimental Groups at All Four Timepoints at Which Evaluations Were Conducted .. | 87 |
| Table 8. Least-square Means of Psychosocial Outcomes, Comparing Data from the Control and Experimental Groups at Four Timepoints | 90 |
| Table 9. Comparison of Readiness Stages and Self-efficacy Outcomes between the Control and Experimental Group at Four Timepoints | 97 |

List of Figures

| | |
|---|----|
| Figure 1. TTM strategies by stage of change | 25 |
| Figure 2. The conceptual framework of the present research adapted from TTM theory and the results of previous researches | 35 |
| Figure 3. Research framework | 37 |
| Figure 4. Design of the randomized controlled trial | 42 |
| Figure 5. The five components of the program and the flow of scenario .. | 63 |
| Figure 6. Assessment screen from Health Planner | 65 |
| Figure 7. Education screen from Health Planner | 67 |
| Figure 8. Exercise planning screen from Health Planner | 71 |
| Figure 9. Visual graph on the comparison of the current status and the goal levels of exercise and diet | 72 |
| Figure 10. The main screen from Health Planner | 80 |
| Figure 11. Consort diagram: Recruitment and eligibility screening, randomization, and follow-up | 83 |
| Figure 12. Least-square means of HRQOL, anxiety, depression scores, fatigue, diet quality, and number of daily servings of F&V, comparing data from the control and experimental groups at four distinct timepoints | 95 |

List of Appendicies

| | |
|--|-----|
| Appendix 1. Booklet used in attention control group | 136 |
| Appendix 2. The amount of one serving for food in each food group | 138 |
| Appendix 3. Consent form | 142 |
| Appendix 4. Follow-up questionnaire | 147 |

Efficacy of a Web-based Self-management Exercise and Diet Intervention Program with Tailored Motivation and Action Planning for Breast Cancer Survivors: A Randomized Controlled Trial

I. Introduction

1. Background and significance

Breast cancer is the most common cancer among women in many countries, and survival rates of breast cancer have improved steadily over the past 30 years (American Cancer Society, 2011). In Korea, the estimated relative 5-year survival rates for women diagnosed with breast cancer between 1996 and 2000, between 2001 and 2005, and between 2004 and 2008, were 83.2%, 88.2%, and 90% respectively (Jung et al., 2011). This trend toward improved survival appears likely to continue. Such increases in the number of breast cancer survivors indicate that quality-of-life (QOL) issues among survivors must be addressed.

Breast cancer itself and the treatment for breast cancer adversely affect QOL (Ganz et al., 2004; Shapiro & Recht, 2001). Such QOL issues include “late-occurring effects of treatment”; these encompass recurrent pain (Baron et al., 2000; Ferrell, Grant, Funk, Otis-Green, & Garcia, 1998), fear of cancer recurrence (Ferrell et al., 1998), depression (Burgess et al., 2005),

sexual dysfunction (Schover et al., 1995), chronic fatigue (Bower et al., 2000), and sleep disturbance (Savard, Simard, Blanchet, Ivers, & Morin, 2001). In Korea, breast cancer survivors function more poorly in the physical, emotional, cognitive, and social domains, and exhibit more severe symptoms of fatigue, pain, insomnia, and constipation than the general female population. These problems persist for years after treatment in a significant proportion of patients (Ahn et al., 2007; Lee et al., 2011). As the number of breast cancer survivors increases, quality-of-life issues arising in such survivors will attain greater significance.

One common health problem in cancer survivors at diagnosis, during treatment, and after treatment is being underweight or overweight. Substantial weight loss has been documented in more than 50% of patients at diagnosis, but this varies widely across cancer types (Langstein & Norton, 1991; McMahon, Decker, & Ottery, 1998). Symptoms including anorexia, early satiety, changes in taste and smell, and disturbances of the gastrointestinal tract are common side-effects of cancer treatment, and such symptoms lead to substantial weight loss.

Also, many cancer survivors are overweight or obese at diagnosis. Weight gain (i.e., sarcopenic obesity) can be a complication of cancer treatment (Chlebowski, Aiello, & McTiernan, 2002) and is commonly observed during or after treatment of various cancers including breast cancer (Jones & Demark-Wahnefried, 2006). In particular, weight gain after cancer diagnosis increases the incidence of subsequent chronic disease. Such

conditions include cardiovascular disease, diabetes, hypertension, secondary cancers, and cancer recurrence (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005; Herman, Ganz, Petersen, & Greendale, 2005; Rock & Demark-Wahnefried, 2002).

Both being underweight and overweight negatively affect health-related QOL (HRQOL) (Darga et al., 2007; Demark-Wahnefried, Kenyon, Eberle, Skye, & Kraus, 2002; Herman et al., 2005) and survival (Lichtenstein et al., 2006; Nitenberg & Raynard, 2000). For these reasons, maintaining a healthy weight is one of the top priorities when the healthcare needs of cancer survivors are addressed (Jones & Demark-Wahnefried, 2006).

Regular exercise and a balanced diet are essential for healthy weight management. Most dietary and exercise interventions developed to date have employed intensive clinic-based face-to-face counseling sessions (Jones & Demark-Wahnefried, 2006). Although the efficacy of such interventions are apparent immediately after delivery, once sufficient time has elapsed, the effects of the intervention cannot be found (Blanchard et al., 2004; Courneya et al., 2003; Ohira, Schmitz, Ahmed, & Yee, 2006; Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005a) or sustained (Daley et al., 2007). The reason is that when the clinic-based face-to-face intervention ends, the participants cannot receive feedback from the experts, and the motivation for regular exercise and diet practices decreases (Daley et al., 2007). In addition, the location of the clinic, travel time, and transportation issues are substantial barriers to the successful implementation of clinic-based face-to-

face programs (Demark Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000; Jones et al., 2007; Karvinen et al., 2006; Vallance, Courneya, Jones, & Reiman, 2006).

One way to overcome the shortcomings of clinic-based face-to-face intervention is to employ the internet to this end. Earlier work suggested that initiation and maintenance of healthy behaviors are greatly assisted by the provision of timely feedback on progress toward desired outcomes (Frenzel, Kee, Ensor, Riedel, & Ruiz, 2010), enhancement of self-efficacy (Koring et al., 2011; Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011), and motivation (Frith et al., 2010). Also, action planning promotes the initiation and maintenance of healthy behaviors by identifying and filling intention-behavior gaps (Conner, Sandberg, & Norman, 2010; Lippke, Wiedemann, Ziegelmann, Reuter, & Schwarzer, 2009; Reuter, Ziegelmann, Lippke, & Schwarzer, 2009; Scholz & Schwarzer, 2005). Enhancing motivation and improving perceived self-efficacy using strategies such as tailored feedback and action planning can be delivered via a Web-based program accessible anywhere and anytime (Ruland et al., 2007). To maximize effectiveness when providing Web-based interventions, action planning should be able to start at the right time, education should be tailored to motivational readiness, and self-efficacy should be enhanced at appropriate intervals. The Transtheoretical Model (TTM) (Prochaska & DiClemente, 1983) integrates the concepts of self-efficacy and motivation with strategies including tailored feedback and action planning, and arranges these concepts and

strategies to guide timely intervention. Therefore, it seemed appropriate to develop a Web-based self-management program using the TTM; the program sought to promote regular exercise and the adoption of a balanced diet to facilitate weight management.

2. Aims of the research

Within the background described above, the overall aim of the present study was to develop a Web-based self-management exercise and diet program featuring the delivery of education, the development of the capacity to plan, and automatic feedback employing TTM-based strategies, and to determine whether the program was effective in promoting lifestyle changes in breast cancer patients. The efficacy of the program was compared to that of booklets which contained the same information but did not feature the use of TTM strategies.

3. Research hypotheses

- 1) Breast cancer patients participating in a Web-based self-management exercise and diet program employing TTM-based strategies (hereinafter termed the ‘experimental group’) will attain the set behavioral goals to a greater extent than the control group, which

receives booklets.

- 2) The experimental group will consume a diet of a higher quality than the control group.
- 3) The experimental group will achieve exercise changes to a greater extent than the control group.
- 4) The experimental group will consume more fruit and vegetables than the control group.
- 5) The experimental group will achieve healthy weight changes to a greater extent than the control group.
- 6) The experimental group will exhibit a better HRQOL than the control group.
- 7) The experimental group will exhibit less anxiety than the control group.
- 8) The experimental group will exhibit less depression than the control group.
- 9) The experimental group will exhibit less fatigue than the control group.
- 10) The experimental group will exhibit a higher level of self-efficacy than the control group.
- 11) The experimental group will exhibit stages of change to a greater extent than the control group.

4. Definition of terms

A Web-based self-management exercise and dietary program employed in the present study was optimized to improve dietary and exercise behavior and ran for 12 weeks; each intervention was tailored to the stage of motivational readiness of each patient. The program had five components, of which the first component was an introduction to the program, and the second was assessment. The third component was tailored education. The fourth component featured tailored exercise and dietary planning. The fifth component was tailored automatic feedback.

An attention-control group provided comparable data, allowing the effects of any particular intervention to be assessed. Those in the experimental group received the experimental treatment under study, whereas those in the attention-control group received a treatment mimicking that of the treatment group in terms of information disseminated. In the present study, the attention control group received a 50-page educational booklet on exercise and diet.

Aerobic exercise is defined as any activity that uses large muscle groups, that can be maintained continuously, and that is rhythmic in nature (The American College of Sports Medicine, 2007). This type of exercise places demands on the heart and lungs and causes them to work harder than they do at rest. In the present study, the aerobic exercise goal was moderate exercise for at least 30 min/day on at least 5 days/week, reflecting the

consumption of at least 12.5 metabolic equivalents.

Dietary quality reflects the type and range of food that is regularly consumed. In the present study, dietary quality was operationalized using scores on eight items of the Korean-specific revision (K. W. Oh et al., 2003) of the Diet Quality Index (DQI) (Patterson, Haines, & Popkin, 1994).

The HRQOL reflects the extent to which the usual or expected physical, emotional, and social well-being of an individual is affected by a medical condition and/or its treatment (Cella et al., 1993). In the present study, HRQOL was operationalized using scores derived from 30 items of the Korean version (Yun et al., 2004b) of the European Organization for Research and Treatment of Cancer (EORTC) questionnaire (Aaronson et al., 1993).

Anxiety is defined as a generalized mood that can occur in the absence of an identifiable triggering stimulus (Nick Bouras & Geraldine Holt, 2007). In the present study, anxiety was operationalized using total scores derived from the seven items of the anxiety subscale of the Korean version (S. M. Oh, Min, & Park, 1999) of the Hospital Anxiety and Depression Questionnaire (HADS) (Zigmond & Snaith, 1983).

Depression is a mental condition characterized by ongoing feelings of sadness, despair, and loss of energy, and difficulties in dealing with normal daily life. Other symptoms of depression include feelings of worthlessness and hopelessness, loss of pleasure in usual activities, changes in eating or sleeping habits, and thoughts of death or suicide (NCI, 2007). In the present

study, depression was operationalized using total scores from the seven items of the depression subscale of the Korean version (S. M. Oh et al., 1999) of the HADS (Zigmond & Snaith, 1983).

Cancer-related fatigue, defined as a persistent and subjective sense of tiredness that can occur before or after cancer is treated (NCCN 2007), was operationalized using total scores derived from nine items of the Korean version (Yun et al., 2005) of the Brief Fatigue Inventory (BFI) (Mendoza et al., 1999).

The stage of change is a core construct of the TTM. The five stages are precontemplation, contemplation, preparation, action, and maintenance (Prochaska & DiClemente, 1983). In the present study, staging was domain-specific, and five stages of each of three goal behaviors (exercise, diet, and maintenance of a healthy weight) were operationalized. For exercise, the stages were precontemplation (no intention to exercise); contemplation (intending to exercise within the next 6 months); preparation (exercising sometimes, but not regularly); action (exercising regularly for less than 6 months); and maintenance (exercising regularly for 6 months).

Perceived self-efficacy is defined as the belief that one is capable of performing in a certain manner to attain a particular set of goals (Bandura, 1977). In the present study, the perceived self-efficacy items were domain-specific, and were operationalized as scores derived from the belief that one was capable of attaining each goal behavior. The questions were: How sure are you that you can (exercise at least 30 minutes a day at least 5 days a

week?; eat at least six servings of V&F per day?; and maintain a healthy weight?).

II. Literature review

In the present section, the significance of lifestyle interventions for cancer survivors, specifically the significance of weight management for cancer survivors, the TTM for incorporating concepts such as self-efficacy and motivation, and the strategies of tailored action planning, feedback and education, a Web-based health management program for cancer survivors, and finally, the Web-based exercise or diet programs for cancer survivors using the TTM, are reviewed.

1. Significance of lifestyle intervention in cancer survivors

With improvements in early cancer detection and treatment, an increasing number of patients can expect to live for at least 5 years after being diagnosed with cancer (Jemal et al., 2011). Such survivors form a vulnerable population with distinct healthcare needs. These patients are at an increased risk for reduction in HRQOL, cancer recurrence, and late-occurring adverse effects, and experience a variety of symptoms attributable to cancer and its treatment (Chirikos, Russell-Jacobs, & Jacobsen, 2002). It is clear that cancer survivors are at a greater risk of developing secondary malignant diseases and other conditions, including cardiovascular disease, diabetes, and osteoporosis, compared with general age-matched populations

(B. W. Brown, Brauner, & Minnotte, 1993; Hewitt, Rowland, & Yancik, 2003; Parkin, Bray, Ferlay, & Pisani, 2005). These competing causes of death and the development of co-morbid conditions are believed to be caused by cancer treatment, genetic predisposition, general lifestyle factors, or some combination thereof. For example, cancer survivors may not consume a healthy diet and may not exercise appropriately (B. W. Brown et al., 1993). Hewitt and colleagues reported that cancer survivors were almost twice as likely as controls to exhibit at least one functional limitation (Hewitt et al., 2003). If a co-morbid condition was present, the odds ratio for the presence of a limitation increased to 5.06 (95% CI: 4.47–5.72). Given that the number of cancer survivors is increasing, targeting of this high-risk group can potentially achieve positive and broad public health outcomes (Demark-Wahnefried et al., 2005; Demark Wahnefried et al., 2000; Ganz, 2005).

2. Significance of weight management in cancer survivors

Cancer survivors may exhibit either a positive energy balance (when calorific intake exceeds the number of calories expended) or a negative energy balance (the reverse); both behaviors are of concern (Jones & Demark-Wahnefried, 2006). All major modalities of cancer treatment, including surgery, radiation, and chemotherapy, can significantly impact nutritional needs, alter regular eating habits, and adversely affect how the

body digests, absorbs, and uses food (Schattner & Shike, 2006). Commonly experienced cancer symptoms and side effects of treatment include changes in taste or smell, loss of appetite, nausea, vomiting, changes in bowel habits, weight change, loss of lean mass, sarcopenia, pain, and fatigue. All of these may impact nutritional status (Duffy; Grosvenor, Bulcavage, & Chlebowski, 1989) and the symptoms persist after primary treatment (Dewys et al., 1980). Weight loss and inadequate nutrient intake can adversely affect treatment outcomes and reduce both QOL and survival rate (Dewys et al., 1980; Nitenberg & Raynard, 2000; Ollenschlaeger, Konkol, Wickramanayake, Schrappe-Baecher, & Mueller, 1989).

Although weight loss and inadequate nutrient intake are major problems in the care of cancer patients, obesity and being overweight are also crucial issues that are much more prevalent in most cancer survivors (J. K. Brown et al., 2003; Demark-Wahnefried et al., 2005). Obesity is a well-established risk factor for various types of cancer including cancers of the breast (postmenopausal), colon, kidney, esophagus, and endometrium (WHO, 2002). Thus, many cancer survivors are overweight or obese at the time of diagnosis. Because sarcopenic obesity (a gain in adipose tissue at the expense of lean body mass) is a side-effect of both chemotherapy and hormonal treatment (Demark-Wahnefried et al., 2001; Harvie, Howell, Thatcher, Baildam, & Campbell, 2005; Rock & Demark-Wahnefried, 2002; Smith, 2003), additional weight gain is common during or after the treatment of various cancers. The largest study (Kroenke, Fung, Hu, &

Holmes, 2005) conducted to date (on 5,204 patients) suggested that breast cancer survivors exhibiting an increase in body-mass index (BMI) of 0.5–2.0 kg/m² had a risk ratio of recurrence of 1.40 (95% CI: 1.02–1.92), and those who gained more than 2.0 kg/m² in BMI had a risk ratio of 1.53 (95% CI: 1.54–2.34). Both groups also showed significantly higher mortality levels than did survivors with stable weight. In addition, several studies (Herman et al., 2005; Rock & Demark-Wahnefried, 2002) have found that an increase in body weight after diagnosis negatively affects QOL. This accumulating evidence on the adverse effects of obesity and weight loss on overall health, physical functioning, and survival renders weight management a priority for cancer survivors (Caan et al., 2005; Calle, Rodriguez, Walker-Thurmond, & Thun, 2003; Demark-Wahnefried et al., 2005; Herman et al., 2005; Kroenke et al., 2005).

Despite the adverse effects of obesity in cancer survivors, only seven studies (de Waard, Ramlau, Mulders, de Vries, & van Waveren, 1993; Demark-Wahnefried et al., 2002; Djuric et al., 2002; Goodwin et al., 1998; Howard et al., 2006; Loprinzi et al., 1996; Mefferd, Nichols, Pakiz, & Rock, 2007) have assessed the effects of weight management intervention in cancer populations, and all were performed on women with breast cancer. Two of these studies (de Waard et al., 1993; Djuric et al., 2002) were conducted principally on survivors who had completed active treatment, and it was found that individual dietary counseling by a dietician was effective at promoting weight loss. One study (Djuric et al., 2002) found that

counseling by a dietician combined with the use of a specific structured Weight Watchers program that included an exercise regimen was more effective than counseling by a dietician alone. At 12 months, patients who received counseling alone lost a mean of 8.0 kg (SD 5.5 kg) whereas those who received counseling and also participated in the Weight Watchers program lost a mean of 9.4 kg (SD 8.6 kg). Below, work on exercise and dietary intervention for weight management will be reviewed in detail.

1) Research on dietary interventions for cancer survivors

This section will discuss the various types of interventions, goals, and efficacy levels. Dietary intervention studies on cancer survivors can be divided into three groups: 1) energy restriction (Darga et al., 2007; de Waard et al., 1993; Djuric et al., 2002; Loprinzi et al., 1996); 2) fat restriction (Boyar et al., 1988; Kristal, Shattuck, Bowen, Sponzo, & Nixon, 1997; Rose, Connolly, Chlebowski, Buzzard, & Wynder, 1993); and 3) use of a plant-based low-fat diet (Chlebowski et al., 2006; Hebert et al., 2001; Howard et al., 2006; Nordevang, Callmer, Marmur, & Holm, 1992; Pierce et al., 1997; Pierce et al., 2004; Pierce et al., 2007).

Three large-scale randomized controlled trials have been conducted on either breast cancer survivors alone, or patients who survived breast or colorectal cancer. The first study was the Women's Intervention Nutrition Study (WINS) (Chlebowski et al., 2006) (n=2,437); the second, the

Women's Health and Eating and Living Study (WHEL) (Pierce et al., 2004) (n=3,088); and the third, the Women's Health Initiative (WHI) Dietary Modification Trial (Howard et al., 2006). The duration of intervention ranged from 15 weeks to 7 years. The goal of the WINS was fat restriction (to <15% of caloric intake); that of the WHEL study a daily intake of 454 g of vegetable juice and 30 g of dietary fiber with limitation of fat intake to 15–20% of total calories; and that of the WHI study limitation of fat intake to <20% of caloric intake with consumption of 5–6 servings of vegetables, fruit, and whole grain daily. The results of the WINS suggested that women assigned to the low-fat dietary group (targeting the derivation of 20% of total energy from fat) exhibited a 24% reduction in risk for cancer recurrence; subset analysis suggested that the effect was even greater among women with estrogen receptor-negative disease (Chlebowski et al., 2006). The WHEL study suggested that the experimental group achieved and maintained the following statistically significant differences (compared to controls) for 4 years: servings of vegetables consumed daily (+65%), fruit (+25%), fiber (+30%), and the level of energy derived from fat (–13%). Although adoption of a diet that was very high in vegetables, fruit, and fiber, and low in fat, did not reduce the incidence of additional breast cancer events (Pierce et al., 2004), observation during a 7.3-year follow-up period did show a significant survival advantage (Pierce et al., 2007). The WHI study revealed that women in the experimental group lost weight (a mean of 2.2 kg) in the first year and maintained a lower weight than did controls

during a mean of 7.5 years of follow-up (the differences were 1.9 kg at 1 year and 0.4 kg at 7.5 years). Adoption of a low-fat eating pattern did not cause weight gain in postmenopausal women.

In summary, the cited studies show that high proportional intakes of fruit, vegetables, and whole grain, and adoption of a low-fat diet significantly reduce cancer recurrence (Chlebowski et al., 2006), promote weight loss (Howard et al., 2006), and reduce mortality from non-cancer causes (Pierce et al., 2007).

2) Research on exercise interventions for cancer survivors

Several systematic reviews (Knols, Aaronson, Uebelhart, Fransen, & Aufdemkampe, 2005; McNeely et al., 2006; Schmitz et al., 2005) have summarized the evidence showing that exercise benefits adult cancer survivors. The cited articles identified 16 independent research projects that explored the role played by exercise in assisting cancer survivors after completion of primary treatment. Most studies were performed on breast cancer survivors; some works dealt with survivors of colorectal cancer and non-Hodgkin's lymphoma; and some studied mixed cancer populations. All studies explored the effects of either an endurance program or a mixed exercise program (in which endurance was combined with progressive resistance training) delivered at moderate-to-vigorous intensity (employing 50-75% of baseline exercise capacity) on at least 3 days per week; each

exercise session ran for 10–60 min. The duration of the programs varied from 2–15 weeks. Various outcomes were measured, including cardiorespiratory fitness, strength, QOL, pain level, immune system functioning, and depression levels.

Six further independent studies (Damush, Perkins, & Miller, 2006; McNeely et al., 2004; Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005b; Spruit, Janssen, Willemsen, Hochstenbag, & Wouters, 2006; Thorsen et al., 2005; Wilson, Porter, Parker, & Kilpatrick, 2005), appeared over the past year, focused principally on breast cancer survivors (Damush et al., 2006; Pinto et al., 2005b; Wilson et al., 2005). One study was conducted on patients with lung cancer (Spruit et al., 2006); one work dealt with head-and-neck cancer patients (McNeely et al., 2004); and one study was performed on mixed cancer patients (Thorsen et al., 2005). Three studies (Damush et al., 2006; Spruit et al., 2006; Thorsen et al., 2005) compared the effects of exercise before and after intervention, and three (McNeely et al., 2004; Pinto et al., 2005b; Thorsen et al., 2005) were randomized controlled trials. Most studies (Pinto et al., 2005b; Spruit et al., 2006; Thorsen et al., 2005) tested the effects of combined endurance and progressive resistance training programs, although two works (Damush et al., 2006; Wilson et al., 2005) used endurance training only whereas one (McNeely et al., 2004) employed resistance training alone. The duration of intervention was 2–12 months and study endpoints included cardiorespiratory fitness, QOL, extent of lymphedema, body compositional data, and metabolic hormone profiles.

The recent findings confirm the conclusions of previous studies, suggesting that exercise has a moderately positive effect on cardiorespiratory fitness and QOL. Exercise also has a small positive effect on other negative symptoms including fatigue, anxiety, range of motion, pain, and depression. Importantly, no study reported any exercise-related adverse events. Three works explored the association between physical activity, cancer recurrence, and overall survival in patients diagnosed with breast (Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005) or colon cancer (Ahmed, Thomas, Yee, & Schmitz, 2006; Meyerhardt et al., 2006). The results suggested that survivors who engaged in routine physical activity were at a significantly lower risk for cancer recurrence or death, compared to those who were physically inactive. These were the first reports to assess the effect of exercise on cancer recurrence and survival. Overall, the results significantly strengthen the body of evidence revealing a beneficial role for exercise in cancer survivors after completion of primary treatment. Large-scale randomized controlled trials are needed to confirm these important findings.

The work that has appeared to date suggests that exercise is a safe and well-tolerated supportive intervention that oncologists should recommend to patients after completion of primary treatment. However, cancer survivors should obtain clearance from a physician or oncologist before embarking on any exercise intervention or program. Such clearance is especially important for cancer survivors who are at high risk for late-occurring toxic effects secondary to treatment if such events might increase the risk of

cardiovascular disease development (B. W. Brown et al., 1993). Thus, screening for cardiac and cardiovascular disease should be conducted before an exercise program is commenced.

3) Exercise and dietary guidelines for cancer survivors

Exercise and dietary guidelines for cancer survivors have been established. The American Cancer Society, the Centers for Disease Control and Prevention, the American College of Sports Medicine, and the WHO advise that patients should engage in at least moderate activity for 30 min or more on at least 5 days per week (J. K. Brown et al., 2003; Warburton, Nicol, & Bredin, 2006; WHO).

The dietary guidelines (Djuric et al., 2002; WHO) for cancer survivors emphasize the importance of energy balancing, and generally endorse dietary recommendations that were earlier established for the primary prevention of cancer and other chronic diseases. In general, the choice of foods and the relative proportions thereof within an overall diet (i.e., the dietary pattern) seem to be more important (a balanced diet is achieved) than is the absolute amount of food consumed (Demark-Wahnefried et al., 2005; Djuric et al., 2002; Rock & Demark-Wahnefried, 2002; WHO). Because cancer survivors are at high risk for other chronic diseases, the levels of fat, protein, and carbohydrate consumption that reduce the risk of development of such diseases are also relevant (J. K. Brown et al., 2003).

4) Combined exercise and dietary interventions for cancer survivors

Interventions that include both dietary and exercise components (Demark-Wahnefried et al., 2002; Djuric et al., 2002) and those relying on either component alone (Knols et al., 2005; Tangney, Young, Murtaugh, Cobleigh, & Oleske, 2002; Wayne et al., 2006) are both effective. One study compared interventions that featured individual dietary counseling and those structured to combine both exercise and dietary counseling interventions; the latter interventions were more effective (Djuric et al., 2002). Behavioral interventions that take a comprehensive approach toward energy balancing, thus including both dietary and exercise components, are more likely to be effective than are interventions relying on either component alone (Agency for Healthcare Research and Quality, 2004; Djuric et al., 2002; Jones & Demark-Wahnefried, 2006).

3. The Trans-Theoretical Model (TTM)

In the present study, a TTM (Prochaska & DiClemente, 1983) was employed as the conceptual framework for the development of a Web-based self-management exercise and diet intervention. The TTM is an integrative bio-psychosocial model that conceptualizes the process of intentional behavioral change. The TTM seeks to include and integrate key elements of other theories (including the Decision-Making theory of Janis and Mann

(Prochaska, 2001) and Bandura's self-efficacy theory (Bandura, 1977, 1982)) into a comprehensive theory of change that can be applied to a variety of behaviors, populations, and settings.

As identified in previous studies, motivation (Daley et al., 2007) and enhancement of self-efficacy (Frith et al., 2010) are both required to sustain health behaviors. The TTM explains changes in health behavior by using the core elements of stage of change (motivational readiness) and self-efficacy. The core construct of the TTM, around which the other dimensions are organized, is the stage of change. Individuals adopting a new behavior such as exercise or a diet progress can move along a continuum of five stages of motivational readiness: precontemplation (not intending to change); contemplation (intending to change in the foreseeable future); preparation (intending to change in the near future and/or making a small change); action (engaging in a new behavior); and maintenance (sustaining the behavioral change). In particular, in the stage of preparation, the individual makes a commitment to take action to change the behavior pattern and develops a viable and realistic action plan to be implemented in the near future. In the stage of action, the individual implements the action plan and takes steps to change the current behavior pattern and to begin creating a new behavior pattern. In this stage, it is sometimes necessary to revise the plan (Prochaska & DiClemente, 1983).

Change is a process that occurs over time. Progression through the stages of change can occur in a linear fashion. However, nonlinear

progression is more common. Often, individuals recycle through the stages, or regress to earlier stages from later stages, rather than progress through the stages in a linear sequence.

The TTM posits that stage transition is achieved via a stage-specific cognitive-behavioral process. Transitions between the stages of change are caused by the actions of a set of independent variables that together constitute the process of change. The variables are activities that help an individual progress through the stages of change. The 10 processes of change are “covert and overt activities that people use to progress through the stages” and include consciousness-raising, dramatic relief, self-reevaluation, environmental reevaluation, self-liberation, assisting with relationships, counter-conditioning, reinforcement management, stimulus control, and social liberation. Use of the TTM allows the provision of tailored feedback and education based on the process of change corresponding to individual behavior patterns (Prochaska & DiClemente, 1983).

The model also incorporates a series of intervening or outcome variables, including decisional balance (the “pros” and “cons” of change) (Janis & Mann, 1977); self-efficacy (confidence in the ability to change when faced with a difficult situation) (Bandura, 1977); situational temptations to engage in the problem behavior; and certain behaviors specific to the problem area (DiClemente & Prochaska, 1998) (Figure 1).

The TTM serves as a decisional “balance sheet” of comparative

potential gains (“pros”) and losses (“cons”). As individuals progress through the stages of change, decisional balance shifts in a critical manner. When an individual is in the precontemplation stage, the “pros” in favor of behavioral change are outweighed by the “cons” and maintenance of the existing behavior is probable. In the contemplation stage, the pros and cons tend to be of equal weight, rendering the individual ambivalent toward change. If, however, the decisional balance is tipped, such that the “pros” outweigh the “cons”, many individuals move to the preparation or even action stage. As individuals enter the maintenance stage, the “pros” must continue to outweigh the “cons” to reduce the risk of relapse (Table 1).

Use of the TTM allows the acquisition of the conceptual framework of motivation and self-efficacy, and strategies of provision of tailored feedback and education, and action planning (C. J. Kim, Hwang, & Yoo, 2004; Peterson & Aldana, 1999).

Stages by Processes of Change

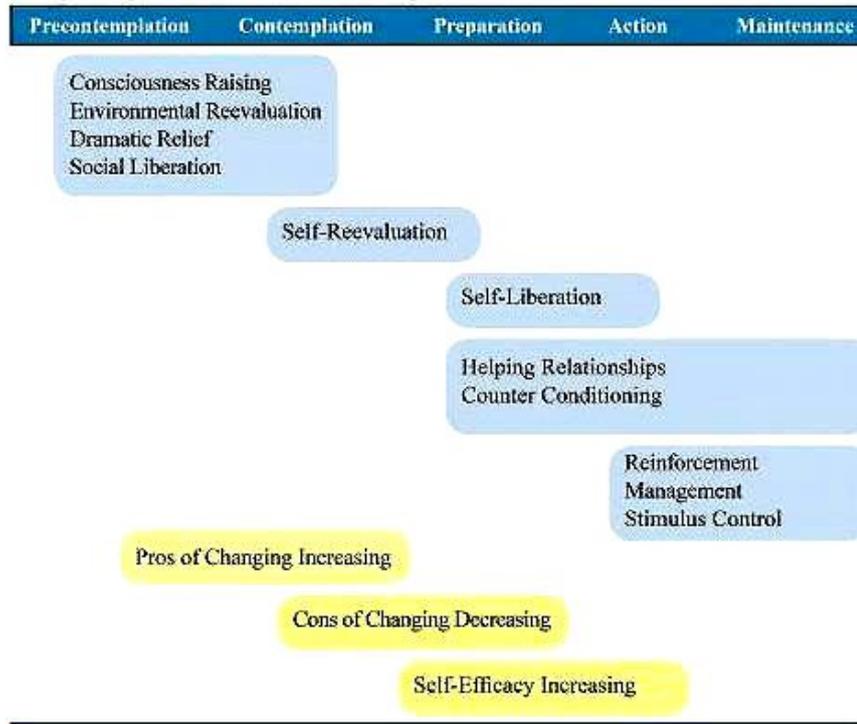


Figure 1. TTM strategies by stage of change (K. Glanz, B. K. Rimer, & K. Viswanath, 2008)

Table 1. The TTM Construct (K. Glanz, B. K. Rimer, & K. Viswanath, 2008)

| TTM Construct | Definition |
|-------------------|---|
| Stage of change | |
| Pre-contemplation | Has no intention to take action within the next 6 months. |
| Contemplation | Intends to take action within the next 6 months. |
| Preparation | Intends to take action within the next 30 days and has taken some behavioral steps in this direction. |
| Action | Has changed overt behavior for less than 6 months. |
| Maintenance | Has changed overt behavior for more than 6 months. |

| TTM Construct | Definition |
|----------------------------|---|
| Decisional Balance | |
| Pros | The benefits of changing. |
| Cons | The costs of changing. |
| Self-efficacy | |
| Confidence | Confidence in the ability to engage in the healthy behavior even when facing different challenges. |
| Temptation | Temptation to engage in the unhealthy behavior when facing different challenges. |
| Processes of Change | |
| Consciousness-raising | Finding and learning new facts, ideas, and tips that will support the healthy behavioral change. |
| Dramatic relief | Experiencing the negative emotions (fear, anxiety, worry) that are associated with unhealthy behavioral risks. |
| Selfreevaluation | Realizing that the behavioral change is an important part of individual identity. |
| Environmental reevaluation | Realizing the negative impact of the unhealthy behavior or the positive impact of the healthy behavior on his/her proximal social and physical environment. |
| Self-liberation | Making a firm commitment to change. |
| Helping relationships | Seeking and using social support for the healthy behavioral change. |
| Counter-conditioning | Substituting healthier alternative behaviors and cognitions for the unhealthy behavior. |
| Reinforcement management | Increasing rewards for the positive behavioral change and decreasing rewards for unhealthy behavior. |
| Stimulus control | Removing reminders or cues to engage in the unhealthy behavior and adding cues or reminders to engage in the healthy behavior. |
| Social liberation | Realizing that social norms are changing in the direction of supporting the healthy behavioral change. |

Several studies have explored the efficacy of behavioral interventions incorporating TTM theory, and these data informed the present research framework. A TTM-based exercise intervention for patients with low bone density had positive effects on the perceived self-efficacy for initiation of exercise, stage progress, social support, and the level of exercise performed (Litt, Kleppinger, & Judge, 2002). A home-based TTM-based exercise intervention for breast cancer survivors had positive effects on physical activity, stage progress, fatigue, and emotional distress (Pinto et al., 2005b). A home-based TTM-based physical activity intervention for prostate cancer survivors increased perceived self-efficacy, the rate of change processes, and decisional balance (Taylor et al., 2006). A TTM-based exercise intervention program for women in general (Huang, Hung, Chang, & Chang, 2009) and type 2 diabetes patients (C. J. Kim et al., 2004) positively influenced perceived self-efficacy (Huang et al., 2009) and the level of physical activity (C. J. Kim et al., 2004).

In summary, TTM-based exercise programs positively affect the following outcomes: perceived self-efficacy (Dyrlund & Wininger, 2006; Taylor et al., 2006); motivation (Litt et al., 2002; Pinto et al., 2005a); behavior, including exercise and the level of physical activity (Dyrlund & Wininger, 2006; C. J. Kim et al., 2004; Litt et al., 2002; Pinto et al., 2005b); and psychosocial features including fatigue (Pinto et al., 2005b) and emotional distress (Pinto et al., 2005b).

4. A Web-based health management program for cancer survivors

The aim of the present study was to develop a Web-based self-management exercise and diet intervention for cancer survivors, and to test the efficacy of the intervention. Thus, the status and efficacy of health management systems for cancer survivors after primary cancer treatment were initially reviewed, and the functional elements to be included in modern health management systems were next explored. Finally, the program was provided to a group of patients, in a randomized controlled trial, to test efficacy.

1) The status and efficacy of health management programs for cancer survivors after primary cancer treatment

A previous Web-based program, similar to the present program in terms of user groups and purpose, has been developed to assist breast and mixed cancer populations. “Oncolife” was developed to inform survivorship care planning for cancer survivors after primary treatment. The efficacy and ease-of-use of the program have been evaluated by users, medical staff, and cancer survivors (Hill-Kayser, Vachani, Hampshire, Jacobs, & Metz, 2009). Ruland et al. developed “WebChoice”, a Web-based program that assists cancer survivors after primary treatment (Ruland et al., 2007). With this program, cancer survivors can play leading roles in their own health

management. Each patient assesses his/her symptoms on an hourly basis and a professional nurse provides personalized information employing both such patient-reported symptoms and responses to intervention. The program allows the experiences of cancer survivors to be shared. The efficacy of the program has not yet been assessed.

Web-based programs for breast cancer survivors have been more actively developed than have programs for patients of other cancers, and the efficacy of such programs has been tested in randomized controlled trials. For example, a Web-based program allowing breast cancer survivors to manage adverse effects associated with cancer treatment, and to communicate with medical staff, has been developed (Golant, Altman, & Martin, 2003). The “CHESS” program provides information and emotional support, and aids in decision-making in terms of survivorship care planning (Gustafson et al., 2001). Another Web-based program for breast cancer survivors seeks to develop psychological and emotional coping skills (Owen et al., 2005). All Web-based programs have improved HRQOL (Golant et al., 2003; Gustafson et al., 2001; Owen et al., 2005), increased social support (Gustafson et al., 2001), alleviated anxiety and depression (Owen et al., 2005), and encouraged patient participation in health management (Gustafson et al., 2001).

2) Functional elements included in Web-based health management programs for cancer survivors

To identify functional elements to be included in the Web-based program developed in the present study, previously employed elements were surveyed. Earlier health management systems for cancer survivors after primary treatment included information provision, feedback, evaluation, and communication with medical staff or cancer survivors. In terms of information provision, previous programs provided information tailored to medical conditions and not to information-seeking attitudes or patient motivation. In terms of feedback, when cancer survivors responded to baseline questionnaires or posed a question, the patients' needs were assessed by a professional nurse who then provided information tailored to the needs (Ruland et al., 2007). Thus, existing Web-based health management programs for cancer survivors feature human intervention (by nurses) to offer tailored information and communication.

3) Services provided to the attention control group in a randomized controlled trial (RCT) performed to test program efficacy

The services provided to attention control groups, in RCTs that tested the efficacy of Web-based programs, have included the provision of usual care (Fogel, Albert, Schnabel, Ditkoff, & Neugut, 2002a, 2002b, 2003),

delivery of a combination of usual care and oral counseling (Green et al., 2005), provision of printed materials (Gustafson et al., 2001), non-interactive group or one-on-one education (Heller, Parker, Youssef, & Miller, 2008), provision of educational audio or video material (Pignone, Harris, & Kinsinger, 2000), delivery of regular newsletters (Kelders, Van Gemert-Pijnen, Werkman, Nijland, & Seydel, 2011), and wait-list control (Chiu et al., 2009; Owen et al., 2005). The services provided to attention control groups depended on the nature of each individual study. A literature review identified the services to be provided to the attention control group of the present study. These were determined on the basis of the desired outcomes for breast cancer survivors assisted by a Web-based program informed by TTM theory.

5. A Web-based exercise or diet program using TTM theory, encouraging healthy behavioral change

The potential of TTM theory has been recognized in previous studies for application in Web-based physical activity intervention (Huang et al., 2009; C. J Kim & Kang, 2006), but not for Web-based diet programs. Individual exercise regimens were prescribed using TTM theory, with reference to stages of change, in an interventional Web-based program developed for patients with type 2 diabetes (C. J Kim & Kang, 2006). Program clarity, simplicity, recommendations, accuracy, consistency, and

efficiency were rated as acceptable. However, the extent of physical activity did not differ significantly between groups receiving Web-based and printed materials (C. J Kim & Kang, 2006). In another study, a Web-based TTM-based program was developed to promote physical activity in the general female population (Huang et al., 2009). The four core constructs of stage of change, self-efficacy, decisional balance, and change process were refined to yield screen pages, and information was tailored to the stage of change of each individual subject. The program was a full success, having promoted self-efficacy, physical activity, and exercise. To date, however, no Web-based TTM-based exercise and diet program for cancer survivors has been developed. A review of previous studies identified the possibility that the TTM could be applied to a Web-based program seeking to encourage healthy behavioral changes.

In summary, the literature review identified the significance of lifestyle modification when weight management is required. In particular, the significance of exercise and dietary modification for cancer survivors after primary treatment was evident. However, no Web-based program aimed at such lifestyle modifications in cancer survivors is yet available. The program developed in the present work applies the core concepts of the TTM, including stage of change (motivation) and perceived self-efficacy, with functions such as tailored feedback, education, and action planning. Use of these concepts, allied to the provision of feedback, allowed a computer-based system to be employed to enhance the sustainability of

modified healthy behaviors (Daley et al., 2007; Frenzel et al., 2010; Murray, Burns, See, Lai, & Nazareth, 2005).

III. Research framework

The conceptual framework of the present work is shown in Figure 2. According to TTM theory, and the results of previous reports, the extent of the motivation to change behavior that is difficult to alter is associated with the level of perceived self-efficacy. (Prochaska et al., 1994; Vancouver & Kendall, 2006). According to TTM theory, motivation, perceived self-efficacy, decisional balance, and the change process are interrelated (Velicer, DiClemente, Prochaska, & Brandenburg, 1985). Increasing motivation (Frith et al., 2010; Milan & White, 2010), enhancing self-efficacy (Frith et al., 2010; Koring et al., 2011; Lippke et al., 2009; Luszczynska et al., 2011; Milan & White, 2010), enhancing decisional balance (pros outweigh cons) (Milan & White, 2010; Prochaska et al., 1994), and encouraging change processes (Pollak, Carbonari, DiClemente, Niemann, & Mullen, 1998) create behavioral changes that, in turn, lead to psychological changes and/or changes in physical symptoms. In detail, the practice of regular exercise affects psychosocial changes such as HRQOL (Courneya et al., 2003; Daley et al., 2007; Duijts, Faber, Oldenburg, van Beurden, & Aaronson, 2011; Eyigor, Karapolat, Yesil, Uslu, & Durmaz, 2010; Trinh, Plotnikoff, Rhodes, North, & Courneya, 2011; Voskuil et al., 2010), depression (Daley et al., 2007; Duijts et al., 2011; Eyigor et al., 2010; Pinto et al., 2005a), and anxiety (Pinto et al., 2005a); and physical symptoms including fatigue (Courneya et al., 2003; Duijts et al., 2011; Pinto

et al., 2005a; Trinh et al., 2011; Voskuil et al., 2010). Healthy dietary behavior affects psychosocial changes such as HRQOL (Blanchard, Courneya, & Stein, 2008; Rock & Demark-Wahnefried, 2002; Trabal, Leyes, Forga, & Hervas, 2006); depression (Tangney et al., 2002); and physical symptoms including fatigue (Trabal et al., 2006). Effective weight management affects psychosocial changes such HRQOL (Darga et al., 2007; Voskuil et al., 2010) (Dewys et al., 1980; Herman et al., 2005) and physical symptoms such as fatigue (Voskuil et al., 2010).

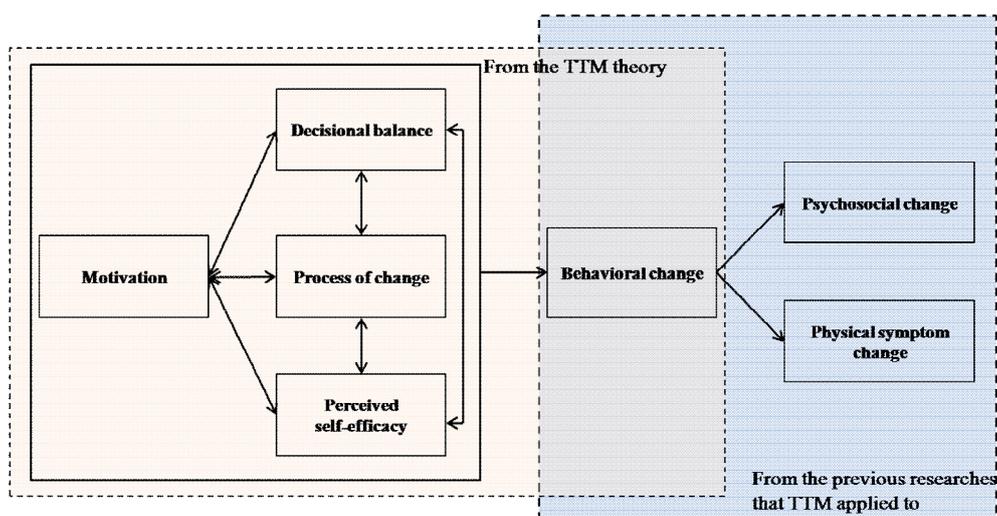


Figure 2. The conceptual framework of the present research adapted from TTM theory and the results of previous researches.

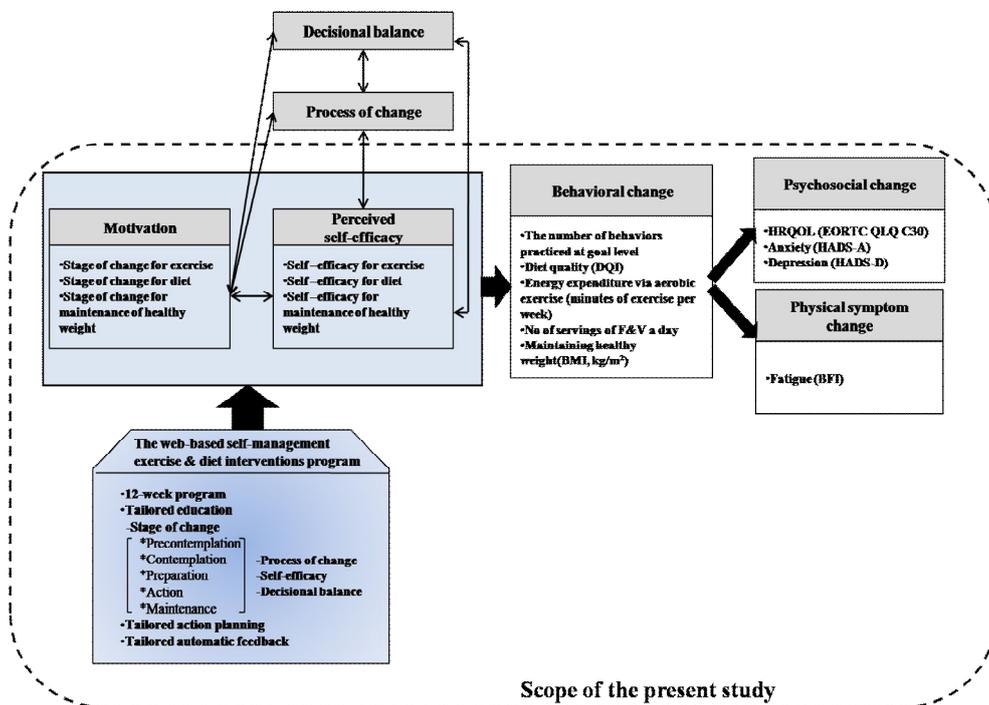
Our research approach was based on this conceptual framework. In the present study, each intervention sought to increase motivation and perceived self-efficacy, to allow healthy behavior to be sustained. The intervention

was a program 12 weeks in duration, and incorporated the core concepts of the TTM, including stage of change, process of change, perceived self-efficacy, and decisional balance. The interventions were developed with these core concepts in mind, and were: tailored education, tailored automatic feedback aiming toward achievement of desired goal behavior, and tailored action planning focusing on diet and exercise. When constructing the research framework, the concepts of decisional balance and process of change were not included. Earlier work suggested that the need to enhance decisional balance and support the process of change may not be essential to sustain healthy behavior, although these variables do predict behavioral (Velicer et al., 1985) and psychosocial change (Fennell & Teasdale, 1987; Hayes & Feldman, 2004; Simons, Garfield, & Murphy, 1984; Wagner, Burg, & Sirois, 2004).

Thus, if a 12-week program applying TTM concepts (including stage of change, perceived self-efficacy, decisional balance, and process of change; and featuring tailored education, tailored automatic feedback toward desired goal behavior, and tailored action planning in terms of diet and exercise) is effective, self-efficacy and motivation will be enhanced. The variable relevant to motivation is stage of change, whereas the variables pertaining to self-efficacy are perceived domain-specific competencies in terms of exercising, taking a balanced diet, and maintaining a healthy weight.

Improved motivational readiness and enhanced self-efficacy can sustain regular exercise, a balanced diet, and a healthy weight. Behavioral changes

were measured as the number of behaviors practiced at the goal level, dietary quality, energy expenditure via aerobic exercise (min of exercise/week), number of servings of F&V a day, and maintenance of a healthy weight ($18.5 \leq \text{BMI} < 23 \text{ kg/m}^2$). Sustained exercise and a balanced diet can positively change psychosocial and physical symptoms. Psychosocial outcomes were measured via evaluation of HRQOL, anxiety, and depression; the physical symptom assessed was fatigue. The research framework is shown in Figure 3.



The propositions represented by bold arrows will be tested in the present study.

Figure 3. Research framework

IV. Methods

The methods of the present study are described in two sections. First, the development of the Web-based self-management exercise and dietary intervention program is described, and second, the mode by which program efficacy was evaluated is explained.

1. Development of the Web-based self-management exercise and diet intervention program

The present Web-based self-management exercise and diet intervention program was developed between February 1 and September 30, 2011, employing a five-phase system development life-cycle (SDLC) method; the five phases were identification of user requirements, system design, system development, system evaluation, and system application.

1) Phase I : Identification of user requirements

System requirements included content and functionality. The content requirements of the Web-based self-management exercise and diet intervention program, called Health Planner, was determined via a review of the literature on the diet and exercise requirements of cancer patients after

primary treatment. In addition, the development of Health Planner had been referenced to the prior Web-based application, “Health Navigation”(Yun, Lee, Kim, et al., 2012), and the present study was part of a larger study; the TTM-based health management program for cancer survivors, called “Leadership and Coaching for Health (LEACH)”, that might be applied to empower patients’ ability to take care of themselves in the Chronic Care Model (Yun, Lee, You, et al., 2012). For LEACH, interviews were conducted from September, 2010 to July, 2011 using semi-structured questions to seek case information on the healthy habits (i.e., positive mindset, regular exercise, healthy diet, regular check-ups, no smoking, not overworking), leadership, and commitment possessed by 46 cancer survivors (those who survived more than 5 years after diagnosis). Of the brief notes derived from the interviews, content on exercise and diet habits was extracted and reflected in Health Planner. Before each interview, each participant was informed as to the aim of the project. With semi-structured interviews (Laforest, 2009), participants were encouraged to suggest, based on personal experience, information that should be provided to cancer patients. We prioritized information derived from cancer survivors, and selected content items after a consideration of the relevance of such items to our aim of providing effective weight management techniques to cancer survivors.

The functional requirements of the Web-based self-management exercise and diet intervention program were assessed by a review of existing

Web-based health management programs for cancer survivors, and were also informed by TTM-based strategies (i.e., functions such as stage-matched education, feedback, and action planning).

2) Phase II : System design

During system design, the content and function of the program were clearly defined with reference to the scope and the objectives. This was achieved by the selection of requirements identified in the first phase. Such clearly defined content and functional requirements were incorporated into the system with the aid of TTM theory. Screen layouts were designed to encompass these; all on-screen were designed with these principles in mind. To render visual communication effectively, and to provide users with a clear and consistent conceptual structure, the user interfaces were designed to be consistent and to be easily navigable.

3) Phase III : System Development

The system was developed in theon MS Windows, the Web server application Apache Tomcat 6.0, and the database management system Oracle 10g environment. The Pprogram was written using Java and the JSP Standard Template Library (JSTL). Photoshop 8.0 and Flash 8 were used for Webpage design. A short message service (SMS) module was integrated

into the program.

4) Phase IV : System evaluation

In this phase, the usability and accuracy of the content were evaluated by an expert group, composed of three content experts (a nutritionist, an exercise physiologist, and a clinical nurse, all of whom had PhDs); a web developer; and two web designers. Each component of the program, each element of the content, and all design features were repeatedly tested 20 times to determine whether any usability problem persisted, the content was accurate, the program had been appropriately modified, and the group feedback had been incorporated.

The perceived ease of use of the program was evaluated by 29 breast cancer survivors. These 29 end-users completed questionnaires exploring perceptions of the program (Brooke, 1996; Davis, 1989). The scores of items couched in negative terms were reversed; higher scores thus reflect a greater perceived ease of use. Cronbach's alpha coefficient was 0.87.

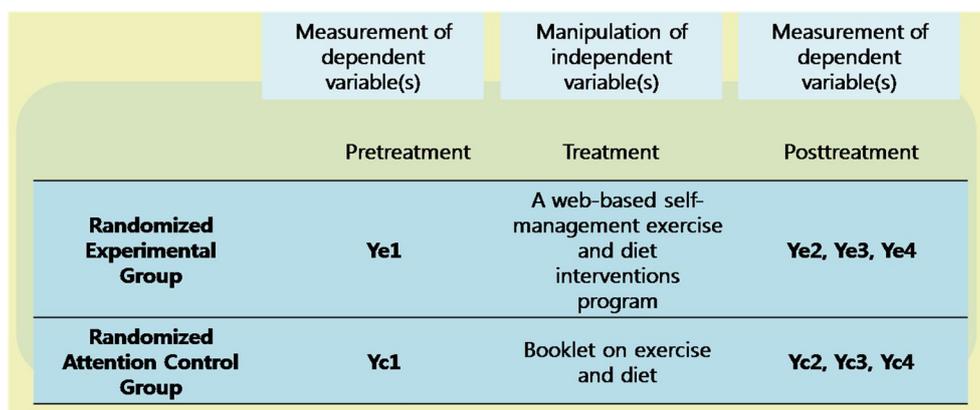
5) Phase V : Applying the system

The system developed in this study was applied to the experimental group to test program efficacy.

2. The efficacy test of the Web-based self-management exercise and diet intervention program

1) Study design

The efficacy of a Web-based self-management exercise and diet intervention program was evaluated by a randomized controlled trial using an attention control group (Figure 4).



Ye1, Yc1, Pretest measurement in the experimental group and control group, respectively; Ye2, Yc2, measurement after 4 weeks in the experimental group and control group, respectively; Ye3, Yc3, measurement after 8 weeks in the experimental group and control group, respectively; Ye4, Yc4, measurement after 12 weeks in the experimental group and control group, respectively.

Figure 4. Design of the randomized controlled trial.

The experimental group was exposed to a 12-week, Web-based self-management exercise and diet intervention program aimed to improve dietary and exercise behaviors; all interventions were individually tailored to the stage of motivational readiness of each patient. The program had five components. The first was the introduction to this program, including an overview and usage of Health Planner. The second was assessment. The third was education tailored according to the principal constructs of the TTM theory; thus considering the stage of change, the change process, decisional balance, and the extent of self-efficacy. The fourth was exercise and dietary planning. This involved completing exercise and diet diaries, setting goals, and measuring body weight and levels of physical activity. The fifth was daily or weekly automatic tailored SMS-based feedback on attainment of exercise and dietary goals (i.e., participation in aerobic exercise at least at moderate levels for at least 30 min on at least 5 days per week, an energy expenditure of at least 12.5 metabolic equivalents; progress toward attainment of a balanced diet).

The attention control group received a 50-page educational booklet on exercise and diet. The content of the booklet was identical to that of the Web-based self-management exercise and diet intervention program. The booklet did not incorporate the core constructs of the TTM such as the stage of change, process of change, decisional balance, or self-efficacy. Participants in the control group had no access to the Web-based self-management exercise and diet intervention.

The values of dependent variables were measured at the baseline and at 4, 8, and 12 weeks into the program: Progress toward the goals of (a) exercising for a minimum of 150 min/week; (b) taking a balanced diet including the consumption of six or more F&V servings per day and/or restriction of total and saturated fat intake to less than 30% and 6% of total calories consumed, respectively; (c) maintaining a healthy weight; (d) attaining good HRQOL scores; (e) lowering levels of fatigue, anxiety, and depression; (f) progressing through the stages of change; and (g) raising perceived self-efficacy was evaluated.

The protocol was approved by the Institutional Review Boards of the four study hospitals and written informed consent was obtained from each participant. The study was conducted from October 1, 2011 through February 28, 2012 at four study hospitals.

2) Study participants

Breast cancer patients who had received curative breast cancer surgery with histologically confirmed stage 0–III cancer were identified within 12 months of the completion of their primary cancer treatment and within 2 years of the first diagnosis from participating cancer registries of the study hospitals. Breast cancer patients meeting the following inclusion criteria were recruited.

Inclusion criteria

- 1) Age of 20 years or older
- 2) Histologically confirmed stage 0–III breast cancer treated with curative breast cancer surgery within 12 months of completion of primary cancer treatment and within 2 years of diagnosis.
- 3) Serum platelets $\geq 100,000/\text{mm}^3$
- 4) Serum hemoglobin $\geq 10 \text{ g/dl}$
- 5) Has not met at least one behavioral goal aimed at in this study.
 - i) Energy expenditure achieved by conduct of at least moderate exercise for at least 150 min/week or 12.5 metabolic equivalents/week.
 - ii) Intake of fruit and vegetables ≥ 6 servings per day
 - iii) Healthy weight ($18.5 \text{ kg/m}^2 \leq \text{BMI} < 23 \text{ kg/m}^2$)
- 6) Ability to use the internet, and home internet access
- 7) Mobile phone user.
- 8) Consent to participate in the study.

However, those who met the following exclusion criteria were removed from the study.

Exclusion criteria

- 1) Currently receiving any cancer treatment.
- 2) Conditions that might compromise adherence to an unsupervised exercise program, such as congestive heart failure or angina; recent

myocardial infarction; breathing difficulties requiring oxygen use or hospitalization; walker or wheelchair use; or planned hip or knee replacement surgery.

- 3) Conditions that could interfere with ingestion of a diet high in vegetables and fruit, such as kidney failure or chronic warfarin use.
- 4) Progressive malignant disease or an additional primary cancer.
- 5) A serious psychological disorder (e.g., bipolar disease, schizophrenia, or an eating disorder).
- 6) An infectious condition (body temperature $\geq 37.2^{\circ}\text{C}$ or WBC $\geq 11,000$ mm³).
- 7) Visual or motor dysfunction.
- 8) Pregnancy.

3) Recruitment and eligibility screening

Oncology care physicians and research nurses at four study hospitals were involved in the patients' recruitment and eligibility screening. Permission to contact patients was granted by oncology care physicians at four study hospitals. Outpatients at four study hospitals where the Institutional Review Boards approved the study protocol were screened. Sixty patients from four hospital cancer registries (23 from hospital A; 17 from hospital S; 10 from hospital N; 10 from hospital K) from a pool of 645 breast cancer patients who had received curative breast surgery for stage 0-

III cancers (please see the CONSORT diagram of Figure 11) were recruited from October 1 to November 30, 2011. Breast cancer patients who had completed primary treatment within the 12 months prior to the study, and who had been diagnosed within 2 years prior to the study, were identified. Oncologists screened for conditions precluding unsupervised exercise or ingestion of a high-F&V diet; and for the absence of a progressive cancer or an additional primary tumor. Recruitment was conducted through invitation letters sent by investigators in each involved hospital. Participants were subsequently screened based on aforementioned inclusion criteria. The participants who met the inclusion criteria and who provided written informed consent were provided with an explanation regarding the details of the study.

The trial design ensured that 29 patients per group (n=58) would afford a power of 81% (two-sided alpha; 0.05) to detect a difference of 5% in the attention control group (the estimated Hawthorne effect) (Braunholtz, Edwards, & Lilford, 2001) compared to a difference of 34% in the experimental group (Demark-Wahnefried et al., 2007).

4) Randomization

Participants who met the inclusion criteria and who signed a written informed consent form were randomly assigned to either the experimental (n=30) or the attention control group (n=29) using a computerized random

number generator (SAS 9.1.3; Proc plan). To minimize the effects of potentially confounding variables on outcome, block randomization into six strata defined by disease stage (\leq IIa / \geq IIb) and number of goal behaviors practiced at study entry (zero/one/two) was performed. No participant was formally informed of their assignment to either the intervention or the attention control group. However, some may have deduced that the Web-based self-management exercise and diet intervention program was the test modality.

Brief training on ‘Health Planner’

After treatment randomization, some brief training (less than 30 min) on how to use ‘Health Planner’ was offered to the experimental group members; training was routinely scheduled during the week of study enrollment. Research protocol prescribed that trainers not deal with any content of Health Planner. Each participant was given a manual describing how Health Planner should be used. All members of both the control and experimental groups were registered on the website (using IDs and passwords); baseline and follow-up measurements were made through self-reports. Personalized SMS messages reminded study members of upcoming assessment points and invited those members to access the web program. Experimental group members were encouraged to use Health Planner regularly at least twice a week.

5) Measurements

All data were collected via Web-based surveys conducted at the baseline and at 4, 8, and 12 weeks into the program. The mediating variables manipulated by the present intervention were the stage of change and the level of perceived self-efficacy. The behavioral outcomes were: first, how many out of three behaviors were practiced at the goal level (150 min per week or 12.5 metabolic equivalents of a moderate, high, or very high level of aerobic exercise consuming at least four metabolic equivalents [kcal/kg/h] pursued for the purpose of fitness; six servings of F&V per day; and maintenance of a healthy weight); second, the quality of the diet measured by the Diet Quality Index (DQI) and 3-day dietary recall; third, the amount of exercise taken; fourth, the extent of F&V intake; and, fifth, BMI. The psychosocial outcomes were HRQOL scores, anxiety, and depression. The physical symptom outcome was fatigue. The measurement tools used were, respectively: the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30; the Hospital Anxiety and Depression Scale (HADS); and the Brief Fatigue Inventory (BFI).

Mediating variables

Stage of change

Staging items derived from TTM theory were domain-specific, and explored goal behavior. Participants were asked: “On average, do you exercise at least 30 minutes a day, 5 days a week (J. K. Brown et al., 2003;

Warburton et al., 2006; WHO); do you eat at least six servings of fruit and vegetables a day (Demark-Wahnefried et al., 2003; Djuric et al., 2002); and is your weight within normal range?" If a response was affirmative, the following questions were posed: "How long have you been exercising at least 30 minutes a day, 5 days a week; eating at least six servings of V&F a day; or maintaining your weight within normal range?" The responses included: "less than six months" (interpreted as the action stage) and "6 months or longer" (interpreted as the maintenance stage). If a patient responded negatively or replied "I don't know", that patient was asked: "Are you seriously thinking about (exercising at least 30 minutes a day, 5 days a week; eating at least six servings of V&F a day; or attaining a normal weight) within the next 6 months?" The responses included: "No" or "don't know" (interpreted as the precontemplation stage), and "yes". Those responding affirmatively were next asked: "Are you planning to start (exercising at least 30 minutes a day, 5 days a week; eating at least six servings of V&F a day; or attaining a normal weight) within the next 30 days?" Those responding affirmatively were classified as being in the preparation stage; those responding negatively or those who did not know were classified as being in the contemplation stage.

Perceived self-efficacy

Because self-efficacy is domain-specific, participants were asked, in terms of each goal behavior: "How sure are you that you could (exercise at

least 30 minutes a day at least 5 days a week; eat at least six servings of V&F per day; or attain a healthy weight)?” The answers were: Very sure, sure, somewhat sure, unsure, and very unsure.

Prior to questioning, exercise, F&V servings, and healthy weight were described. For example: “Examples of exercise are brisk walking, cycling, swimming, mountain climbing, or another form of exercise that makes your heart pound, or makes you break out in a sweat, and is not part of your normal job activity”. Also: “One serving of vegetables is equal to 1/2 cup of cooked (or parboiled) vegetables or one cup of greens, and one serving of fruit is equal to one piece of fruit, 1/2 cup of canned fruit, 1/4 cup of dried fruit, or 3/4 cup of 100% juice.” Also: “Healthy weight is assessed based on the person’s body-mass index (BMI, kg/m²); this is weight in kilograms divided by the square of the height in meters, and subjects are classified as overweight, normal, or underweight”. If a participant reported a normal current BMI, the system stated: “Your BMI is to be regarded as normal, 18.5 kg/m² or more but less than 23 kg/m²”.

Behavioral outcomes

Exercise, intake of F&V, and healthy weight

Based on the 7-day exercise diary via Health Planner, exercise was assessed as minutes per week of moderate, hard, or very hard aerobic exercise consuming at least four metabolic equivalents (kcal/kg/h) and pursued for the purpose of improving fitness. The number of F&V servings

consumed per day was assessed based on 3-day dietary recall. Participants were asked to recall all food and beverages consumed on 3 non-consecutive days (two weekdays and one weekend day). A dietician telephoned each participant to review food records in terms of accuracy and completeness. Healthy weight was assessed based on body-mass index (BMI, kg/m^2) (weight in kg divided by the square of the height in meters). Healthy weight is defined as a BMI of 18.5 kg/m^2 or more but less than 23 kg/m^2 .

Dietary quality

Initial food intake was assessed based on 3-day dietary recall, with participants being asked to recall all food and beverages consumed over 3 non-consecutive days (2 weekdays and 1 weekend day). Dietary quality was measured using the DQI (Patterson et al., 1994), as revised for use with Korean populations (K. W. Oh et al., 2003). The modification involved not only a translation of Patterson's original instrument, but also the incorporation of Korean dietary guidelines (Korean Nutrition Society, 1995; Korean Society of Lipidology and Atherosclerosis, 1996). The DQI contains eight questions exploring nutrition; these are the proportions of energy derived from fat (as a % value) and saturated fatty acids (SFA) (again as a % value); cholesterol intake (mg/day); the proportion of energy derived from carbohydrates (as a % value); the intake of vegetables and fruit (servings/day); protein intake (as a % of the RDA); calcium intake (again as a % of the RDA); and sodium intake (in mg/day). The fruit and vegetable

group encompasses all fruit (including dried fruit), vegetables, fruit juices, and mixed foods that contain fruit or vegetables, but excludes desserts such as apple pie (Patterson et al., 1994). All nutrient intake data were calculated using the Korean Nutrition Society computer-aided nutritional analysis program (CAN Pro 4.0) (<http://www.kns.or.kr>) and were scored with reference to the recommended Korean dietary allowance (Korean Nutrition Society, 2010). Each of the eight components is linked to a score ranging from zero (poor) to two (good). Scores were summed across the eight categories; the score range thus lay between 0–16, where a higher score was indicative of better dietary quality. Diet quality scores were also categorized as follows: Excellent (11–16); Good (9–10); Fair (6–8); or Poor (0–5) (Wayne et al., 2006).

Psychosocial outcomes

Health-related quality of life (HRQOL).

The European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 is a 30-item cancer-specific questionnaire that assesses the general QOL of cancer patients (Aaronson et al., 1993). The questionnaire addresses five functional domains (physical, role, cognitive, emotional, and social); has three symptom scales (for fatigue, pain, and nausea and vomiting); contains global health and overall QOL scales; addresses several single problems associated with additional symptoms commonly reported by cancer patients (insomnia, dyspnea, appetite loss,

constipation, and diarrhea); and also measures the perceived financial impact of disease and treatment. All QLQ-C30 items were scored according to the guidelines of the EORTC scoring manual (Fayers, 2001). On scales evaluating global health and functioning (overall QOL), a higher score represents a greater level of function and health. On scales evaluating symptoms, a higher score indicates the existence of more problems and a greater magnitude of existing symptoms. The Korean version of the EORTC QLQ-C30 has previously been validated (Yun et al., 2004a).

Anxiety and Depression

The Hospital Anxiety and Depression Scale is a self-reporting measurement tool designed for use in medical settings; the Scale contains 14 items. Of these, seven explore anxiety (HADS-A) and seven depression (HADS-D) (Zigmond & Snaith, 1983). Each subscale is scored from 0–21; higher scores indicate greater levels of distress. The HADS is highly reliable, as has been shown in earlier studies (Cronbach's alpha values for the HADS-A lay within 0.68–0.93, and those for the HADS-D, between 0.67–0.90) (Bjelland, Dahl, Haug, & Neckelmann, 2002). The Korean version of the HADS (S. M. Oh et al., 1999) has been validated. In the present study, Cronbach's alpha values for the HADS-A and HADS-D were 0.81 and 0.84, respectively.

Physical symptom outcome

Fatigue

The Brief Fatigue Inventory was used to assess fatigue. This inventory is a one-page assessment tool that contains nine items, each rating the severity of fatigue on a 0–10 scale. The Brief Fatigue Inventory includes subscales assessing the severity of fatigue and the extent to which fatigue has interfered with various aspects of life over the prior 24 hours (Mendoza et al., 1999). The Korean version of the Brief Fatigue Inventory (BFI-K) has previously been validated (Yun et al., 2005). In the present study, Cronbach's alpha value for the BFI-K was 0.95.

6) Statistical analyses

Intervention effects were explored using an intention-to-treat approach that compared data from the original randomized groups regardless of individual use of experimental or control interventions.

The characteristics of the experimental and control groups were described using frequencies and means, SDs, and ranges, for all variables. The t-test (for evaluation of continuous variables) and the Chi-squared test (for evaluation of categorical variables) were used to explore the homogeneity of baseline characteristics between the two groups.

Cronbach's alpha values were computed to evaluate the extent of internal consistency on all scales used. All EORTIC QLQ-C30, HADS, BFI,

and DQI data were scored according to the recommended manual (Fayers et al., 2001; K. W. Oh et al., 2003; Yun et al., 2005; Zigmond & Snaith, 1983).

Between-group differences at the 12-week point of the test – in terms of the number of behaviors practiced at goal level, the stage of change, the level of self-efficacy, the categorized protein intake (i.e., poor, fair, good) and the categorized calcium intake (i.e., poor, fair, good) – were explored using an ordinal logistic regression model, controlling for baseline values. Group difference in the percentage of patients achieving goal behavior, such as exercising at moderate intensity for at least 150 minutes per week, being a normal weight, and eating six servings of F&V per day, was tested with the logistic regression model. Between-group differences at the 12-week point in HRQOL, the levels of fatigue, anxiety, depression, and the DQI were explored using an analysis of covariance (ANCOVA) after adjustment for baseline scores.

Between-group differences over the 12 weeks of the test, in terms of the number of behaviors practiced at the goal level, the stage of change, and the level of self-efficacy, were explored using an ordinal logistic regression model, controlling for baseline values. Between-group differences over the 12 weeks in HRQOL, the levels of fatigue, anxiety, depression, and the DQI were explored using a mixed model that estimated the effect of Health Planner interventions over time (thus, the “intervention x time” interaction was evaluated) by correlating repeat observations on particular participants after adjustment for baseline scores.

SAS version 9.1 (SAS Institute, Cary, NC) was used in all statistical analyses. Two-sided p values are reported and a p value of <0.05 was considered to be statistically significant.

V. Results

In this section, the system development data will be presented first, followed by the results of RCTs used to evaluate program efficacy.

1. Development of a Web-based self-management exercise and diet intervention program, Health Planner

1) Identifying user requirements

The content requirements of the Web-based self-managed exercise and diet intervention program were identified by interviewing one key group (cancer patients who survived more than 5 years after diagnosis) and by reviewing the literature.

Cancer survivors, questioned on their habits regarding healthy diets, reported that they wished to know what to eat and what not to eat. They wished to be informed as to whether antioxidants (folate or beta-carotene) reduce cancer risk; whether drinking coffee causes cancer; whether eating less fat lowers cancer risk; whether ingestion of omega-3 or fish oil supplements affords the same potential benefits as consumption of fish; whether food additives cause cancer; whether processed meats should be avoided; how to cook meat to reduce cancer risk; whether foods labeled “organic” were more effective in lowering cancer risk; whether pesticides in

foods cause cancer; whether cancer survivors should follow a specific diet or what the ideal diet for cancer survivors is; and what foods, nutrients, or supplements cancer patients should avoid. The cancer survivors described the difficulties they faced in maintaining a healthy diet that included at least five servings of F&V per day; these included lack of preparation time, taste concerns, and fear of pesticide exposure. Several survivors were skeptical about dietary recommendations because information from mass media and research studies often conflicted. However, because most believed that consumption of more F&V afforded overall health benefits, such informational conflicts did not deter the adoption of balanced diets. Some cancer survivors emphasized that it was very difficult to become motivated to change their diet to include more healthy foods. Participants gradually changed their diet over time. Participants noted that recommendations from doctors to eat more F&V were important motivators. Some reported that tight schedules prompted them to eat out more often than they would prefer. They also reported difficulties having healthy foods in restaurants. A few survivors commented on the high cost of organic vegetables and that F&V spoiled quickly. Even though cost and spoilage were thus identified as barriers, F&V were still consumed.

The main concerns of cancer survivors in terms of exercise were whether being overweight increases the risk of cancer recurrence, how to exercise during treatment and recovery, and what kinds of special precautions should be taken when exercising. Many women reported that it

was difficult to schedule exercise time. A few mentioned that they had followed a routine at one time, but had stopped because cancer treatment had interrupted it or because they lacked an exercise partner. Several barriers rendering it difficult to get adequate amounts of exercise were identified. These included side effects (especially fatigue) of cancer treatment, not having a local gym, and not living near a park. Bad weather sometimes prevented exercise. Some women commented that it was difficult to feel motivated to exercise. Encouragement from friends, or a few words from their doctors, made lasting impressions on them. Participants who discovered a sense of increased energy and a feeling of well-being when exercising were more highly motivated to maintain physical activity programs. Some female survivors mentioned that families and friends had encouraged them to exercise more. Some female survivors claimed that it was difficult to exercise, particularly when it was dark outside.

Program content requirements obtained by reviewing literature were as follows; the need to improve exercise and dietary behavior in cancer survivors (J. K. Brown et al., 2003); the importance of healthy weight management (Calle et al., 2003; Kroenke et al., 2005); barriers to regular exercise and a balanced diet (Rock & Demark-Wahnefried, 2002); considerations when planning exercise and diet (Jones & Demark-Wahnefried, 2006); outcomes (such as recurrence, QOL, and survival) associated with the performance of regular exercise and a balanced diet (Agency for Healthcare Research and Quality, 2004; Rock & Demark-

Wahnefried, 2002); exercise and dietary guidelines for cancer survivors (WHO); and maintenance of regular exercise and balanced diet programs (Doyle et al., 2006).

The functional requirements of the Web-based self-management exercise and dietary intervention program identified by a review of existing Web-based health management programs for cancer survivors were provision of information, feedback, and evaluation. The functional requirements obtained from a consideration of TTM-based strategies were tailored education, action planning (Conner et al., 2010; Lippke et al., 2009; Scholz & Schwarzer, 2005), automatic feedback (Frenzel et al., 2010), and comparison between the current status and recommended goal levels of exercise and diet (Wing, Tate, Gorin, Raynor, & Fava, 2006).

2) System design and development.

After the content and functional requirements were clearly defined within the scope and objectives of the program, they were arranged and refined with the aid of TTM theory. To arrange and refine the requirements based on TTM theory, the Web-based self-managed exercise and diet intervention program contained four components differing in screen layout; these are assessment, education (tailored information provision), action planning (goal setting, scheduling, keeping a diary), and automatic feedback. That is, the program was designed to deliver education, action

planning, and automatic feedback relevant to each of the stages of change. Education, action planning, and automatic feedback were tailored to each participant through the assessment. The processes of change, self-efficacy, and decisional balance, which are the principal strategies encouraging behavioral change in TTM theory, were reflected in the education (Demark-Wahnefried et al., 2003; C. J. Kim et al., 2004; S. H. Kim et al., 2011), and self-efficacy was also reflected in the automatic feedback. Figure 5 shows the five components of the present program.

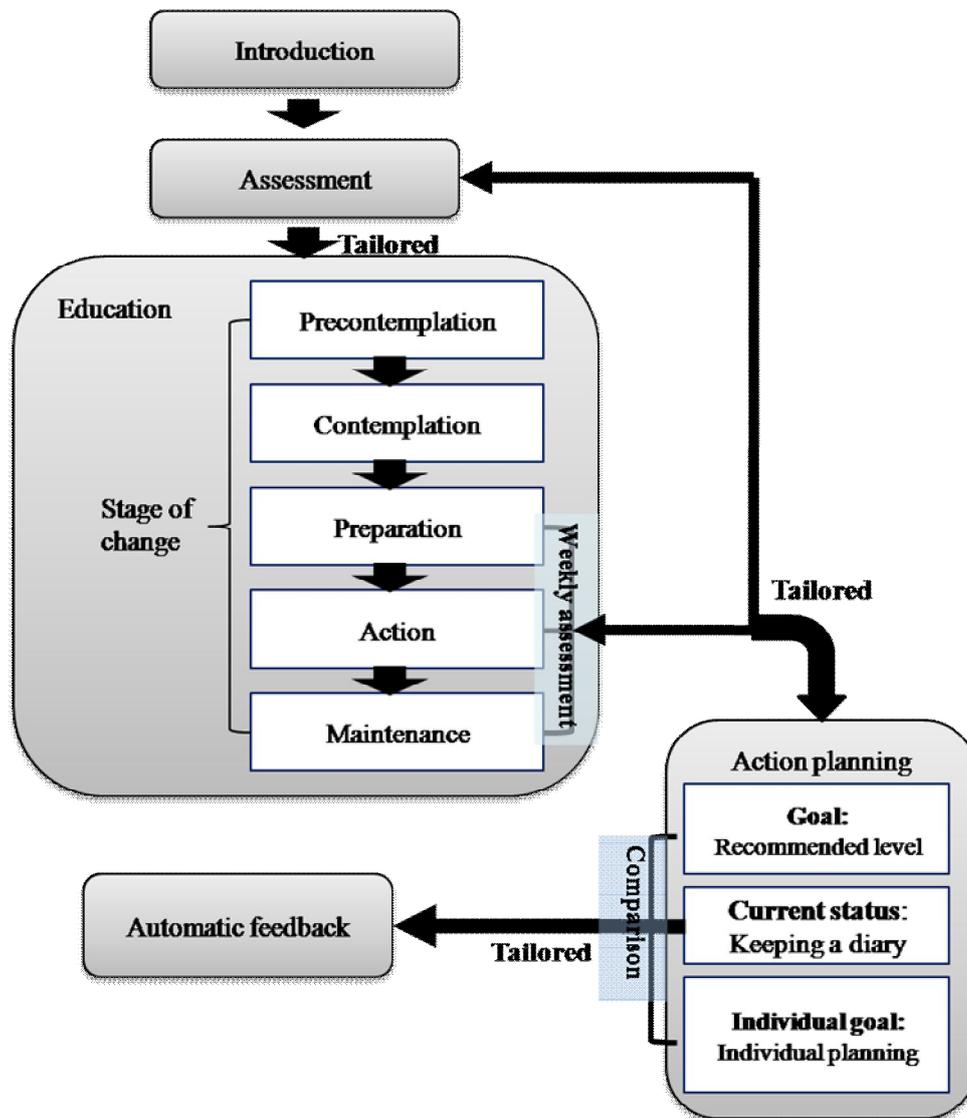


Figure 5. The five components of the program and the flow of scenario (introduction, assessment, education, action planning, and automatic feedback)

The details of each component of the program are as follows.

Introduction

The introduction informed participants of the overall background of developing Health Planner, the usage of the program, and the importance of exercising regularly and eating properly in maintaining health for cancer survivors. The total number of screens for the introduction was four.

Assessment

The assessment section allowed participants to input their physical activity level, body weight, and stage of motivational readiness (Figure 6). All participants were screened for any contraindication to exercise using the Physical Activity Readiness Questionnaire (Thomas, Reading, & Shephard, 1992) during assessment. Using algorithms based on input data, each patient can access tailored information appropriate to each stage of change, and is prescribed the appropriate number of portions of six food groups given their physical activity level and BMI (measured on a daily basis). The total number of screens for assessment was twenty three.

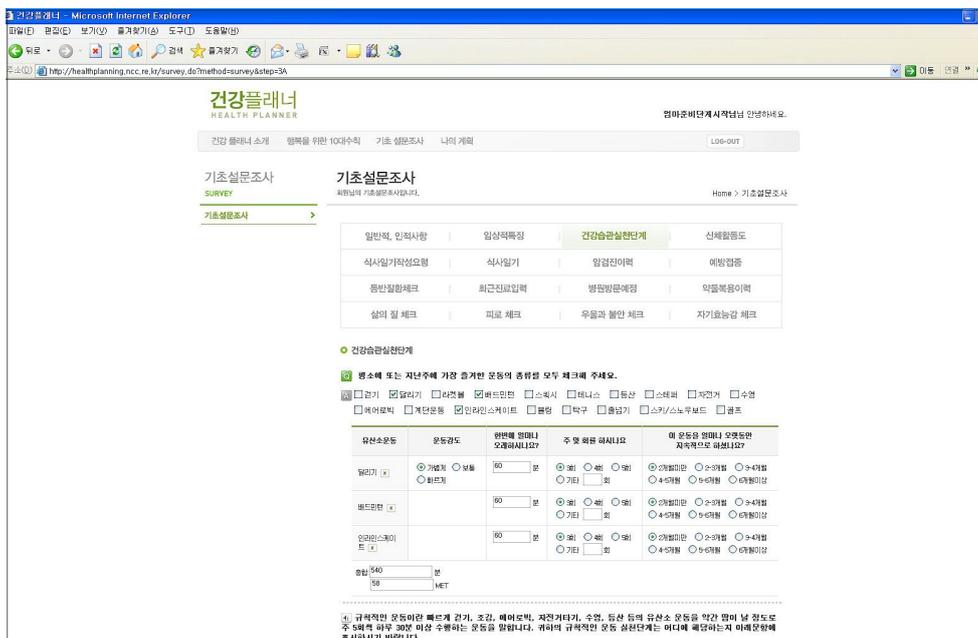


Figure 6. Assessment screen from Health Planner.

Education

Each participant was scheduled to be online for 5–10 min each week over 12 weeks. The educational content was divided into five modules based on the current stage of motivational readiness of each patient through assessment. For patients in the precontemplation stage, education focused on consciousness-raising, dramatic relief, environmental reevaluation, and increasing the number of “pros”. For patients in the contemplation stage, education focused on self-reevaluation, increasing the number of “pros”, decreasing the number of “cons”, and building self-efficacy. For patients in the preparation stage, education focused on self-liberation, and remembering and increasing the number of “pros”. For patients in the action and

maintenance stages, education focused on reinforcement, assisting with relationships, counter-conditioning, stimulus control, and management of temptation (Figure 7). The total number of screens for education was ten.

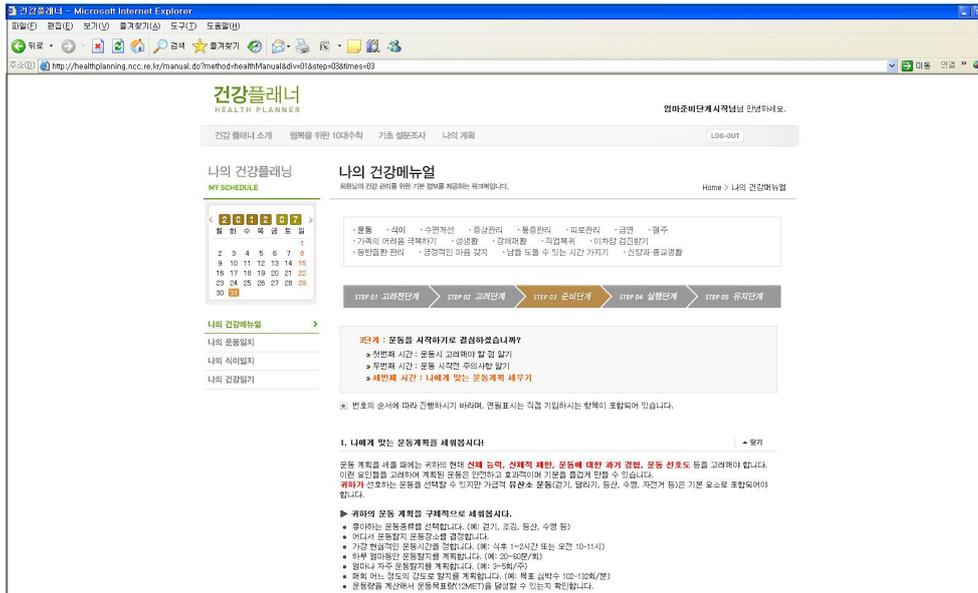
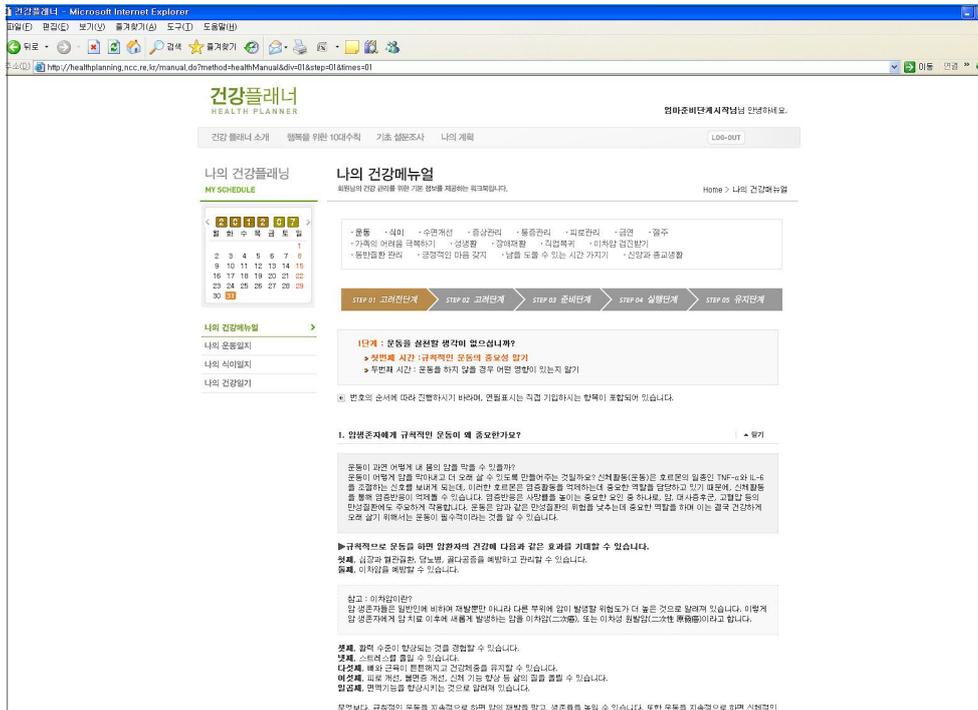


Figure 7. Education screen from Health Planner.

Action planning

The action planning included setting a recommended goal, planning, keeping a diary, and comparing between current and recommended levels of exercise and diet. Each participant was encouraged to actively plan their exercise behavior in line with ACS guidelines for cancer survivors, and to achieve an excellent dietary score (measured using the Korean version of the Diet Quality Index). The details of exercise and diet planning delivered via Health Planner are as follows.

Exercise planning

The goal of exercising was to perform at least moderate-intensity aerobic exercise for at least 30 min on at least 5 days each week (to yield 12.5 metabolic equivalents of energy expenditure, in line with ACS guidelines for cancer survivors). Health Planner generated a tailored plan for each participant through assessment. If a patient had no history of exercise prior to cancer treatment, exercise was gradually introduced, as described in Table 2 (J. K. Brown et al., 2003; Jones & Demark-Wahnefried, 2006; WHO).

Table 2. Gradual Progress of the Extent of Exercise within the Web-based Self-management Exercise and Diet Intervention Program

| | Proportion of reserve heart rate used | MET | Duration (per day) | Frequency (days per week) | Time | Aerobic exercise |
|-------------------------------------|---------------------------------------|-----|--------------------|---------------------------|--------|---|
| Low-intensity aerobic exercise | 20–39% | 2–4 | 45–60 min | 5–7 | Week 1 | Slow walking, use of a shopping cart |
| Moderate-intensity aerobic exercise | 40–59% | 4–6 | 30–60 min | 3–5 | Week 2 | Brisk walking, golf, slow cycling |
| Vigorous aerobic exercise | 60–84% | 6–8 | 20–45 min | 3–5 | Week 3 | Jogging, swimming, climbing, vigorous cycling |

Note. MET: metabolic equivalents.

Planning regular exercise was set to start at the preparation stage. The exercise was to be aerobic in nature, and the specific type of exercise was based on individual patient preference. The type, intensity, duration, and frequency of exercise could be self-adjusted as necessary depending on patient age, history of exercise, and subjective experience of tiredness (Figure 8).

3단계 : 운동을 시작하기로 결심하셨습니까?

- ▶ 첫번째 시간 : 운동시 고려해야 할 점 알기
- ▶ 두번째 시간 : 운동 시작전 주의사항 알기
- ▶ 세번째 시간 : 나에게 맞는 운동계획 세우기

㉞ 번호의 순서에 따라 진행하시기 바라며, 연필표시는 직접 기입하시는 항목이 포함되어 있습니다.

1. 나에게 맞는 운동계획을 세워봅시다!

▶ 달기

운동 계획을 세울 때에는 귀하의 현재 **신체 능력, 신체적 제한, 운동에 대한 과거 경험, 운동 선호도** 등을 고려해야 합니다. 이런 요인들을 고려하여 계획된 운동은 안전하고 효과적이며 기분을 즐겁게 만들 수 있습니다.

귀하가 선호하는 운동을 선택할 수 있지만 가끔씩 **유산소 운동**(걷기, 달리기, 등산, 수영, 자전거 등)은 기본 요소로 포함되어야 합니다.

▶ 귀하의 운동 계획을 구체적으로 세워봅시다.

- 좋아하는 운동종류를 선택합니다. (예: 걷기, 조깅, 등산, 수영 등)
- 어디서 운동할지 운동장소를 결정합니다.
- 가장 현실적인 운동시간을 정합니다. (예: 식후 1~2시간 또는 오전 10~11시)
- 하루 얼마동안 운동할지를 계획합니다. (예: 20~60분/회)
- 얼마나 자주 운동할지를 계획합니다. (예: 3~5회/주)
- 매회 어느 정도의 강도로 할지를 계획합니다. (예: 목표 심박수 102~132회/분)
- 운동량을 계산해서 운동목표량(12MET)을 달성할 수 있는지 확인합니다.

▶ 둘째주에 시작할 중강도 운동을 선택하세요.

| 운동명 | 강도/MET | 운동시간 | | 주당횟수 | |
|----------------|---------|------|---|------|---|
| 걷기 (빠르게) | 중강도/4 | 60 | 분 | 5 | 회 |
| 고정식 자전거 (보통) | 중강도/5 | 0 | 분 | 0 | 회 |
| 배드민턴 | 중강도/4.5 | 0 | 분 | 0 | 회 |
| 자전거 (천천히) | 중강도/4 | 0 | 분 | 0 | 회 |
| 탁구 | 중강도/4 | 0 | 분 | 0 | 회 |
| 골프 | 중강도/4.5 | 0 | 분 | 0 | 회 |
| 나의 주간 운동 계획 총합 | 20/MET | 60분 | | 5/회 | |

▶ 중강도 운동시, 귀하의 목표심박수를 구해볼까요?

1) 최대 심박수: 220에서 당신의 나이를 뺍니다

$$220 - 4 = (216)$$

2) 안정시 심박수: 맥박수 또는 심박수를 측정하여 적습니다.

(70)

3) 최대심박수에서 안정시심박수를 뺀 후 정해진 운동 강도(0.4-0.59)를 곱하세요. 안정시 심박수를 다시 더하면 목표심박수가 계산됩니다.

$$(\text{최대심박수} - \text{안정시심박수}) \times \text{운동강도} + \text{안정시 심박수} = (128 \sim 156 \text{회/분})$$

중강도 운동시, 귀하의 목표심박수는: 분당 (128) ~ (156) 회 입니다.

운동의 종류와 운동시간을 정할 때는 자신의 목표심박수를 넘지 않는 범위에서 정하세요.

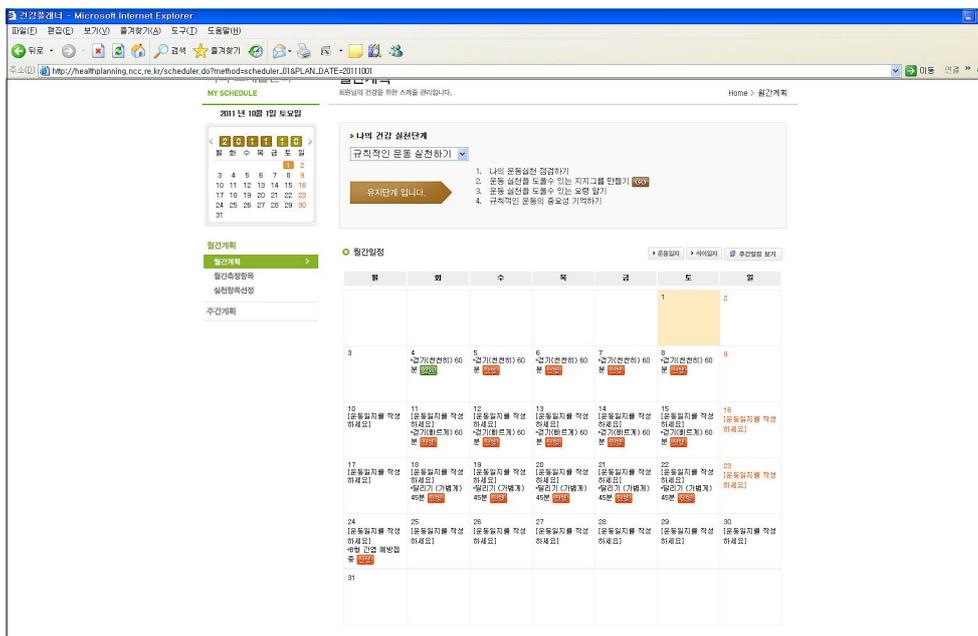


Figure 8. Exercise planning screen from Health Planner.

Participants recorded daily exercise behavior (type, intensity, and duration) in an exercise diary. These data were used to give automatic feedback on progress toward goal attainment (the SMS module was employed toward this end). The data were presented visually; a graph compared actual exercise and dietary behavior to what was recommended (Figure 9). The total number of screens for action planning was nine.

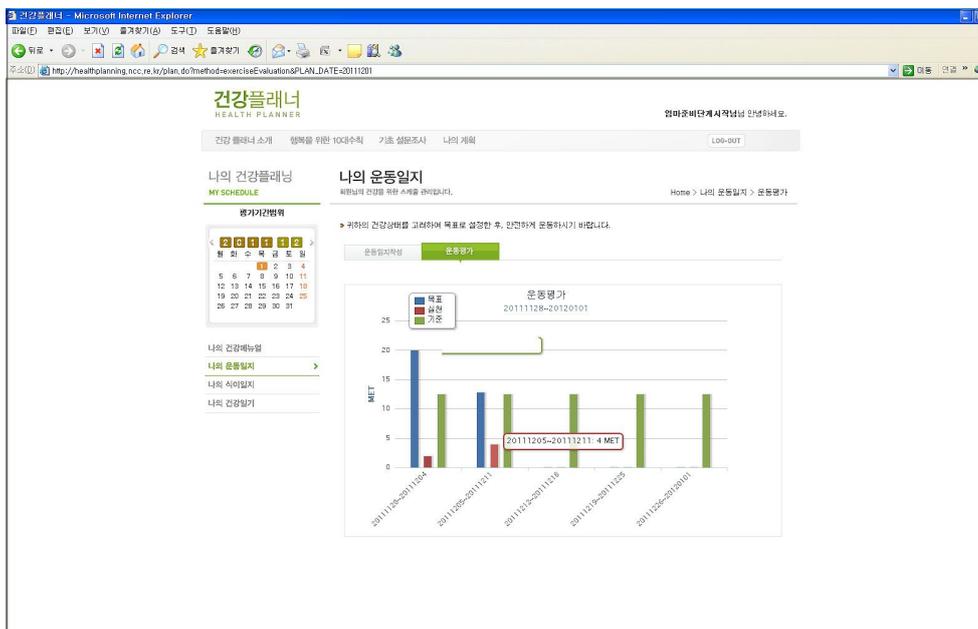


Figure 9. Visual graph on the comparison of the current status and the goal levels of exercise and diet

Dietary Planning

The goal of dietary planning was to achieve an excellent dietary quality score (measured using the DQI). The aims included the following: An energy level derived from fat of $\leq 20\%$; an energy level derived from saturated fat of $\leq 6\%$; cholesterol ≤ 300 mg/day; an energy level derived from carbohydrates of $\leq 65\%$; an intake of vegetables and fruit of ≥ 7 servings/day; a protein recommended dietary allowance (RDA) of 75–125%; a calcium RDA of 75–125%; and a sodium intake of $\leq 3,500$ mg/day. Dietary planning was based on individual BMI values, ideal body weights, and daily calorific requirements. Each patient was educated in

terms of the recommended daily number of portions from the six food groups (grain; meat/fish/eggs/beans; vegetables; fruit; milk and dairy products; and fats and oils) as suggested by the Korean Nutrition Society (2010) (Table 3); all participants were encouraged to achieve a balanced diet. The quantities of food in a single serving from each group are listed in Appendix 1. In a dietary diary, participants recorded daily exercise behavior (type, intensity, and duration) in an exercise diary and the daily number of portions of six food groups consumed.

Table 3. The Recommended Number of Servings from Individual Food Groups

| Food group/kcal | 1,200 | 1,300 | 1,400 | 1,500 | 1,600 | 1,700 | 1,800 | 1,900 | 2,000 | 2,100 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 2,700 | 2,800 |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Grain | 2 | 2 | 2 | 2.3 | 2.5 | 2.8 | 3 | 3 | 3 | 3.3 | 3.5 | 3.8 | 4 | 4.3 | 4.5 | 4.8 | 5 |
| Meat, fish, eggs, or beans | 2 | 2.5 | 3 | 3.5 | 4 | 4 | 4 | 4.5 | 5 | 5 | 5 | 5 | 5 | 5.5 | 6 | 6 | 6 |
| Vegetables | 5 | 5.5 | 6 | 6 | 6 | 6.5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7.5 | 8 |
| Fruit | 1 | 1 | 1 | 1.5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 3 | 3 | 3 | 3 | 3 |
| Milk and dairy products | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Fats and oils | 3 | 3 | 3 | 3 | 3 | 3.5 | 4 | 4 | 4 | 4.5 | 5 | 5 | 5 | 5.5 | 6 | 6 | 6 |

Automatic feedback

Participants were asked to input, on a daily basis, the number of portions from the six food groups consumed and the details of their exercise behavior (type, intensity, and duration of exercise) as shown in the exercise and dietary diaries. This information was used to provide feedback on progress toward goal attainment in the SMS module. Comparisons of the daily number of portions from the six food groups consumed with the recommended number, and of the weekly energy expenditure on aerobic exercise with the exercise goal, identified patients who attained goal behaviors. These patients were given immediate reinforcement via positive automated messaging. Patients who did not attain goal behavior were encouraged to restart active exercise or to increase their dietary efforts. Such patients were encouraged to increase their level of physical activity or to seek to attain a balanced diet by increasing fruit and vegetable intake or moving to a low-carbohydrate or low-fat diet.

The protocol on the interventional goal, principal strategies, content theme in the educational component, and functions used for delivering interventions at each stage of change are briefly summarized in Table 4.

Table 4. Protocol of the Web-based Self-management Exercise and Diet Intervention Program

| Stage of change | Interventional goal | Principal strategies (process of change, self-efficacy, decisional balance) | Content theme in the educational component | Functions used for delivering interventions |
|-----------------------|---|--|--|--|
| Pre- contemplation | - Increase awareness of the need to change exercise and dietary behavior. | - Consciousness- raising - Dramatic relief - Environmental reevaluation - Increase the “pros” | - Effect of exercise and a balanced diet on health - Specific reasons for not considering exercise or use of a balanced diet - Risks associated with a sedentary lifestyle and an unbalanced diet | - Weekly Web-based tailored education (5-10 min daily). |
| Contemplation | - Motivate and increase confidence in the ability to change; build motivation for change. | - Self reevaluation - Increase the “pros”/decrease the “cons” - Build self-efficacy | - Specific benefits of exercise and use of a balanced diet; barriers toward such achievements - Solutions to overcome the specific barriers to exercise and use of a balanced diet - Contemplation of improved health following exercise and use of a balanced diet | - Weekly Web-based tailored education (5-10 min daily) |
| Preparation | - Develop and negotiate a plan for exercise and use of a balanced diet. | - Self-liberation - Remember the “pros” - Increase self-efficacy | - Recalling the effects of exercise and a balanced diet on health - Individualized exercise and dietary prescription and creation of specific aims of exercise - Keeping and monitoring of a daily exercise and dietary diary - Planning gradual progress in terms of exercise. - Exercise planning in line with ACS | - Weekly Web-based tailored education (5-10 min daily) - Use of an exercise and diet diary - Weekly planning exercise and diet |

| Stage of change | Interventional goal | Principal strategies (process of change, self-efficacy, decisional balance) | Content theme in the educational component | Functions used for delivering interventions |
|-----------------|--|---|---|---|
| Action | <ul style="list-style-type: none"> - Reaffirm the commitment to exercise and to use of a balanced diet. | <ul style="list-style-type: none"> - Reinforcement management - Assisting with relationships - Counter- conditioning - Stimulus control - Managing of temptation | <ul style="list-style-type: none"> - Evaluation of current exercise and dietary pattern - Self-reward for regular exercise and use of a balanced diet - Recall of the specific aims or reasons for performing regular exercise and using a balanced diet - Substitution of exercise for sedentary behavior and a balanced diet for one that was unbalanced - Social and/or family support to help maintain exercise and dietary programs - Avoidance of stimuli and other triggers provoking inactivity or use of an unbalanced diet. - Individualized exercise and dietary prescription detailing the specific aims of exercise. - Keeping and monitoring of a daily exercise and dietary log. - Planning gradual progress toward more exercise. - Exercise planning in line with ACS. | <ul style="list-style-type: none"> - Weekly Web-based tailored education (5-10 min daily) - Use of an exercise and diet diary - Weekly planning of exercise and diet - Daily or weekly feedback on progress toward goal attainment - Comparison of the current status and the goal levels of exercise and diet |

| Stage of change | Interventional goal | Principal strategies (process of change, self-efficacy, decisional balance) | Content theme in the educational component | Functions used for delivering interventions |
|-----------------|--|---|--|---|
| Maintenance | - Develop strategies to prevent relapse. | <ul style="list-style-type: none"> - Reinforcement management. - Assisting with relationships. - Counter- conditioning - Stimulus control. - Management of temptation. | <ul style="list-style-type: none"> - Evaluation of current exercise and dietary pattern. - Self-reward for regular exercise and use of a balanced diet. - Recall of the specific aims or reasons for performing regular exercise and using a balanced diet. - Substitution of exercise for sedentary behavior and a balanced diet for one that was unbalanced. - Social and/or family support to help maintain exercise and dietary programs. - Avoidance of stimuli and other triggers provoking inactivity or use of an unbalanced diet. - Individualized exercise and dietary prescription detailing the specific aims of exercise. - Keeping and monitoring of a daily exercise and dietary log. - Planning gradual progress toward more exercise. - Exercise planning in line with ACS. | <ul style="list-style-type: none"> - Weekly Web-based tailored education (5-10 min daily) - Use of an exercise and diet diary - Weekly planning of exercise and diet - Daily or weekly feedback on progress toward goal attainment - Comparison of the current status and the goal levels of exercise and diet |

Abbreviation, ACS, American Cancer Society

3) System evaluation

In this phase, experts who had participated in the usability evaluation were contacted again and asked to advise on problems that arose in terms of usability and content accuracy during system operation. For example, the confusing array of content was re-arranged to ensure consistency and relevance. Input speed was improved. The functions (i.e., keeping a diary, setting a weekly exercise goal, measuring weekly body weight for a revised diet prescription, measuring the stage of change, SMS-based feedback) which depend on the stage of change and timing were modified to activate at an appropriate stage or timing. Images of various food servings were added and an example of the written 3-day dietary recall report was included. The number of pop-ups (negatively affecting concentration) was reduced. Tasks that were shown as incomplete on the calendar were identified. An SMS alarm was added to inform patients of the weekday on which education would be given. In addition, various bugs and errors were corrected. After iterative testing, the program was modified and installed on a server. Patients can access Health Planner from a home computer using an Internet browser (URL: <http://healthplanning.ncc.re.kr>) (Figure 10).

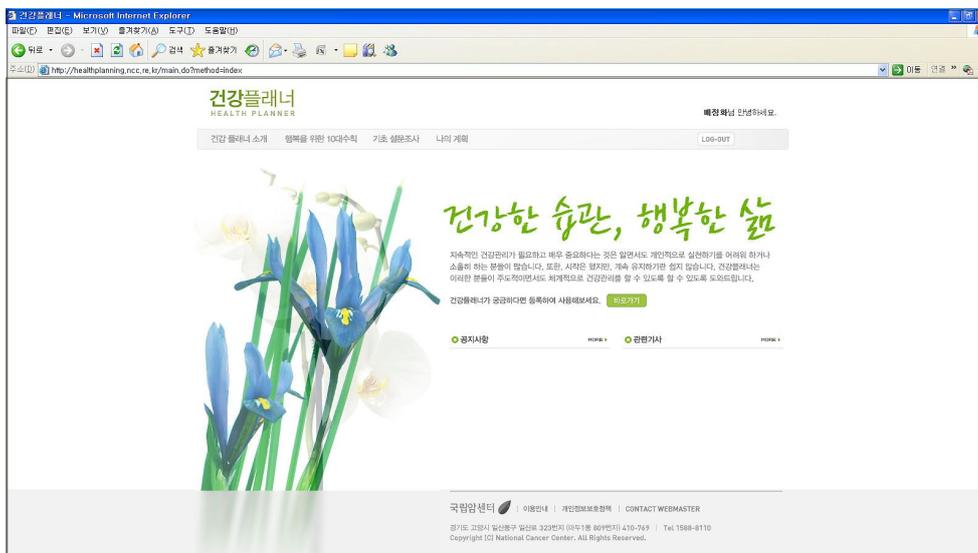


Figure 10. The main screen from Health Planner.

End-users participating in usability evaluation rated the program as being easy to understand and use (a total usability score of 81.3 points) (Table 5). In addition, program feasibility was evaluated using the percentage of patients (89.6%) who consistently used the program during the interventional period and the number of patients who adhered to final exercise and dietary goals.

Table 5. Usability Evaluation of Health Planner by End-user Responses

| | N=29 Mean (SD)* |
|---|--------------------|
| 1. I thought this program was easy to understand. | 5.9 (1.4) |
| 2. I could complete the tasks that were asked of me in this program. | 5.7 (1.4) |
| 3. I found this program confusing. | 1.5 (1.1) |
| 4. I thought that this program was easy to use. | 5.9 (2.0) |
| 5. I would choose to use this type of program in the future to complete an intervention that aims to improve my health. | 6.5 (1.5) |
| 6. The program was too complex. | 2.2 (1.3) |
| 7. I would need help from a technical support person to be able to use this program. | 1.3 (1.8) |
| 8. The program ran smoothly. | 6.0 (1.7) |
| 9. The program was inconsistent (there were parts of the program that seemed out of place). | 2.0 (1.3) |
| 10. I think that most people would learn to use this program quickly. | 5.7 (1.3) |
| 11. Using this program felt awkward to me. | 1.9 (1.4) |
| 12. I felt very confident using this program. | 6.0 (1.8) |
| 13. I needed to learn a lot of things before I could get going with this program. | 2.4 (1.6) |
| Total Usability Score** | 81.3 (20.2) |

Notes. * Responses were on a 7-point scale, ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). ** This is a composite of the responses to all usability questions (a 100-point score); higher scores indicate greater perceived usability.

2. The Efficacy of a Web-based self-management exercise and diet intervention program, Health Planner

1) Characteristics of study participants

The 12-week course was completed by 29 (96.7%) participants in the experimental group and 28 (96.6%) in the attention control group (Figure 11). The baseline characteristics of the 59 participants who underwent randomization are shown in Table 8. No significant difference between the two study groups was evident in terms of any sociodemographic or clinical characteristic. No significant difference between the two groups was evident in the number of behaviors practiced at the goal level; F&V consumption and the maintenance of a healthy weight; DQI, EORTIC QLQ-C30, BFI, and HADS scores; stage of readiness; and extent of perceived self-efficacy facilitating attainment of each baseline goal behavior.

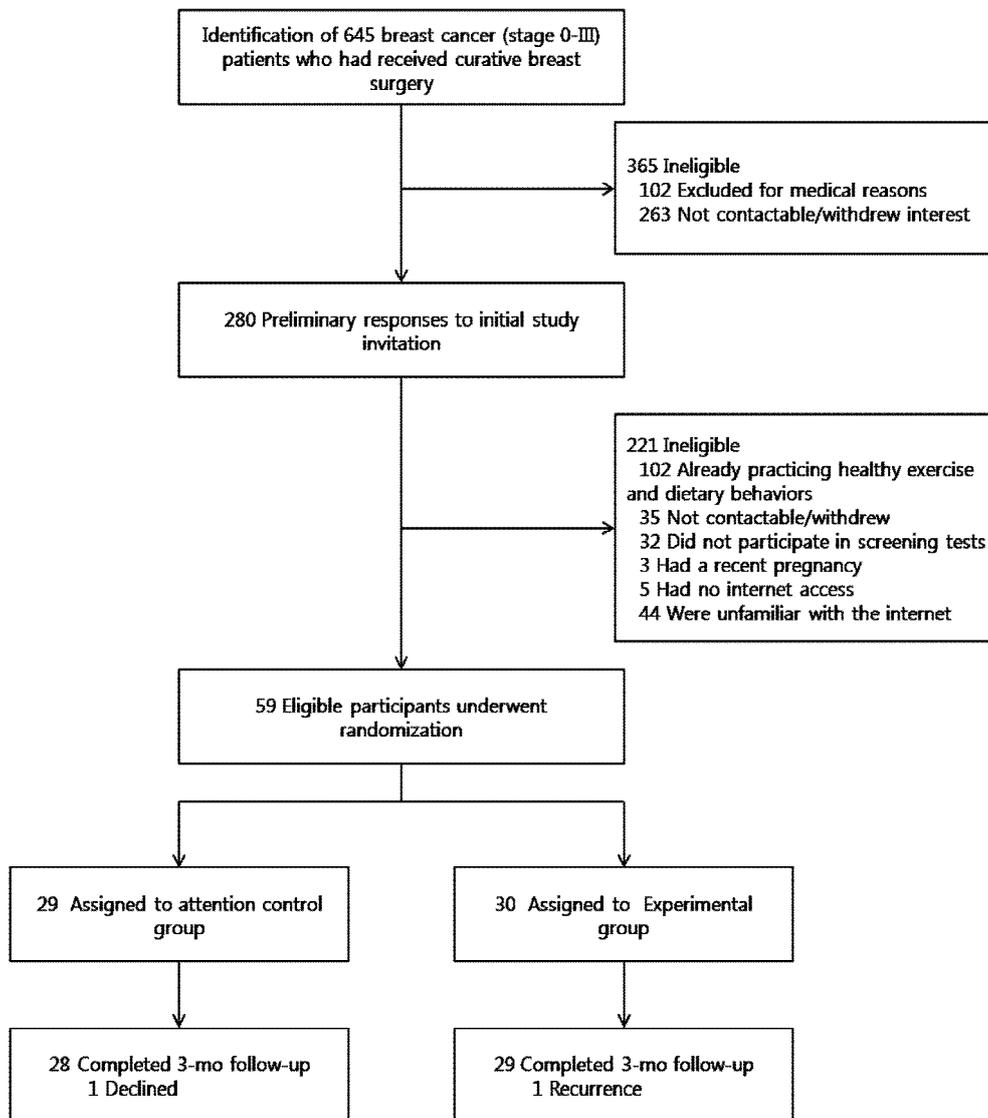


Figure 11. Consort diagram: Recruitment and eligibility screening, randomization, and follow-up

Table 6. Characteristics of Study Participants

| Characteristic | Attention control group (n=29) | | Health Planner intervention group (n=30) | | <i>p</i> |
|---------------------------------------|-----------------------------------|------|--|------|----------|
| | No. | % | No. | % | |
| Age, years | | | | | |
| mean (SD) | 43.2 (5.1) | | 41.5 (6.3) | | .256 |
| Educational level | | | | | |
| High school | 9 | 31.0 | 7 | 23.3 | |
| College or beyond | 19 | 69.0 | 24 | 76.7 | .506 |
| Marital status | | | | | |
| Married | 24 | 82.8 | 27 | 90.0 | |
| Not married | 5 | 17.2 | 3 | 10.0 | .318 |
| Time elapsed since treatment, days | | | | | |
| Mean (SD) | 156.6(102.8) | | 161.6(107.8) | | |
| Range | 3–363 | | 26–349 | | .857 |
| Surgery type | | | | | |
| Breast-conserving | 23 | 79.3 | 20 | 66.7 | |
| Mastectomy | 6 | 20.7 | 10 | 33.3 | .239 |
| Receiving chemotherapy | | | | | |
| No | 6 | 20.7 | 4 | 13.3 | |
| Yes | 23 | 79.3 | 26 | 86.7 | .452 |
| Receiving radiotherapy | | | | | |
| No | 4 | 13.8 | 3 | 10.0 | |
| Yes | 25 | 86.2 | 27 | 90.0 | .652 |
| Clinical stage | | | | | |
| Stage 0 | 0 | 0 | 2 | 6.7 | |
| Stage I | 11 | 37.9 | 12 | 40.0 | |
| Stage II | 15 | 51.7 | 13 | 43.3 | |
| Stage III | 3 | 10.3 | 3 | 10.0 | .538 |

2) Changes in behavioral outcomes

Group differences at 12 weeks

In terms of behavioral outcome, 12 patients (showing a 18.8% change) in the attention control group and 24 (showing a 66% change) in the experimental group practiced at least two of the three behavioral domains at 12 weeks of follow-up ($p=.0002$).

At 12 weeks, exercise ($p=.016$) and F&V consumption ($p=.020$) increased to a greater extent in the experimental group than in controls. The experimental group also showed a greater improvement in overall diet quality than did controls ($p=.001$). The proportion of patients in whom protein intake met the recommended daily allowance was also significantly higher in the experimental group than in controls ($p=.016$). The proportion of patients in whom calcium intake met the recommended daily allowance was significantly higher in the experimental group than in controls ($p=.003$) (Table 7).

Differences of changes between groups over the 12 weeks

In terms of behavioral outcome, there was a significant between-group difference in the change in the number of people that practiced at least two of the three behavioral domains; this difference persisted for 12 weeks ($p=.002$).

Exercise and F&V consumption, measured at 4 timepoints, continuously increased to a greater extent in the experimental group than in controls;

these effects continued for 12 weeks (exercise, $p < .0001$; F&V consumption, $p = .025$). The experimental group also showed a greater improvement in overall diet quality ($p = .001$). At the 12-week mark, the proportion of patients in whom calcium intake met the recommended daily allowance was significantly higher in the experimental group than in controls ($p = .038$) (Table 7).

Table 7. Distribution of Least-square Means of Behavioral Outcomes Compared between the Control and the Experimental Groups at All Four Timepoints at Which Evaluations Were Conducted

| | Attention control group | | | | Health Planner intervention group | | | | At 12 weeks <i>P</i> * | Over time <i>P</i> ** |
|--|-------------------------|----------|----------|----------|-----------------------------------|----------|----------|----------|---------------------------|--------------------------|
| | Baseline | 4 weeks | 8 weeks | 12 weeks | Baseline | 4 weeks | 8 weeks | 12 weeks | | |
| No. of behaviors practiced at goal level, n(%) | | | | | | | | | | |
| 0 | 7(24.1) | 7 (25.0) | 4 (14.3) | 5(17.9) | 5 (16.7) | 1(3.3) | 1(3.3) | 1(3.5) | | |
| 1 | 15(51.7) | 12(42.9) | 13(46.4) | 11(39.3) | 20(66.7) | 17(56.7) | 8(26.7) | 4(13.8) | | |
| 2 | 7(24.1) | 8(28.6) | 9(32.1) | 11(39.3) | 5(16.7) | 8(26.7) | 13(43.3) | 17(58.6) | | |
| 3 | 0(0.0) | 1(3.6) | 2(7.1) | 1(3.6) | 0(0.0) | 4(13.3) | 8(26.7) | 7(24.1) | .0002 | .002 |
| Moderate-intensity aerobic exercise | | | | | | | | | | |
| min/week | 129.5 | 90.7 | 111.1 | 132.3 | 129.1 | 200.9 | 221.3 | 231.3 | .016 | <.0001 |
| ≥ 150 min/week, n(%) | 10(34.5) | 4(13.8) | 7(24.1) | 10(34.5) | 10(33.3) | 19(63.3) | 18(60.0) | 19(63.3) | <.0001 | 0.009 |
| Healthy weight (18.5≤BMI<23, kg/m²), n(%) | 16(55.2) | 16(57.1) | 16(57.1) | 16(57.1) | 20(66.7) | 21(70.0) | 23(76.6) | 24(80.0) | .231 | .667 |

| | Attention control group | | | | Health Planner intervention group | | | | At 12 weeks <i>P</i> * | Over time <i>P</i> ** |
|------------------------------------|-------------------------|----------|----------|----------|-----------------------------------|----------|----------|----------|---------------------------|--------------------------|
| | Baseline | 4 weeks | 8 weeks | 12 weeks | Baseline | 4 weeks | 8 weeks | 12 weeks | | |
| Diet Quality Index | | | | | | | | | | |
| Diet Quality Index, total score | 10.3 | 9.7 | 9.6 | 9.6 | 9.7 | 11.1 | 10.4 | 11.1 | .001 | .001 |
| Daily intake of F&V | | | | | | | | | | |
| No. of daily servings of F&V | 5.3 | 5.4 | 5.3 | 5.3 | 5.3 | 6.8 | 6.7 | 6.7 | .020 | .025 |
| ≥ Six servings of F&V/day, n(%) | 14(48.3) | 10(35.7) | 9(32.1) | 9(32.1) | 13(43.3) | 18(60.0) | 16(53.3) | 16(57.1) | .001 | .032 |
| Total % calories from fat | 22.2 | 18.6 | 17.2 | 19.3 | 20.8 | 18.4 | 17.0 | 17.3 | .492 | .837 |
| Total % calories from SFA | 3.5 | 3.6 | 2.8 | 3.3 | 3.7 | 3.2 | 3.3 | 3.5 | .399 | .488 |
| Cholesterol, mg/day | 285.6 | 253.5 | 272.3 | 272.1 | 288.0 | 227.1 | 277.5 | 256.4 | .248 | .909 |
| Total % calories from carbohydrate | 60.8 | 62.5 | 64.7 | 62.8 | 61.2 | 63.9 | 63.2 | 64.0 | .707 | .632 |
| Sodium, mg/day | 3,708 | 3,238 | 3,436 | 3,427 | 3,738 | 3,390 | 3,393 | 3,218 | .399 | .382 |
| Protein, % RDA, n (%) | | | | | | | | | | |
| Poor (<75, >150) | 12(41.4) | 12(42.9) | 13(46.4) | 13(46.4) | 20(66.7) | 11(36.7) | 17(56.7) | 12(42.9) | | |
| Fair (>125, ≤150) | 6(20.7) | 5(17.9) | 5(17.9) | 8(28.6) | 5(16.7) | 9(30.0) | 4(13.3) | 9(32.1) | | |
| Good (≥75, ≤125) | 11(37.9) | 11(39.3) | 10(35.7) | 7(25.0) | 5(16.7) | 10(33.3) | 9(30.0) | 7(25.0) | .016 | .202 |
| Calcium, % RDA, n (%) | | | | | | | | | | |
| Poor (<75, >150) | 15(51.7) | 20(71.4) | 19(67.9) | 17(60.7) | 22(73.3) | 19(63.3) | 21(70.0) | 14(50.0) | | |
| Fair (>125, ≤150) | 3(10.3) | 0(0.0) | 3(10.7) | 3(10.7) | 1(3.3) | 1(3.3) | 2(6.7) | 0(0.0) | | |
| Good (≥75, ≤125) | 11(37.9) | 8(28.6) | 6(21.4) | 8(28.6) | 7(23.3) | 10(33.3) | 7(23.3) | 14(50.0) | .003 | .038 |

Notes. * Group differences at 12 weeks adjusted for baseline values

** Differences of changes between groups over the 12 weeks adjusted for baseline values

SFA, saturated fatty acids

3) Changes in psychosocial and physical symptom outcomes

Group differences at 12 weeks

At 12 weeks, in terms of psychosocial outcomes, physical functioning ($p=.023$) and appetite loss scores ($p=.034$) as revealed by the EORTC QLQ-C30 improved to a significantly greater extent in the experimental group than in controls. The severity of fatigue as revealed by the BFI improved to a significantly greater extent in the experimental group than in controls ($p=.022$) (Table 8).

Differences of changes between groups over the 12 weeks

Physical functioning and appetite loss scores as revealed by the EORTC QLQ-C30 continuously improved for 12 weeks to a significantly greater extent in the experimental group than in controls (physical functioning, $p=.016$; appetite loss scores $p=.024$). Only small changes on other subscales measuring QOL, anxiety, depression, or fatigue were observed in either group over the 12-week study period (Table 8).

The changes in least-square means of HRQOL, anxiety, depression scores, fatigue, diet quality, and number of daily servings of F&V – comparing data from the control and experimental groups at four distinct timepoints – are shown in Figure 12.

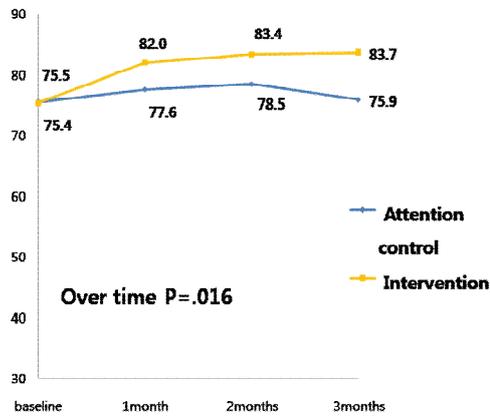
Table 8. Least-square Means of Psychosocial Outcomes, Comparing Data from the Control and Experimental Groups at Four Timepoints

| | Attention control group | | | | Health Planner intervention group | | | | At 12 weeks <i>P</i> * | Over time <i>P</i> ** |
|--|-------------------------|---------|---------|----------|-----------------------------------|---------|---------|----------|---------------------------|--------------------------|
| | Baseline | 4 weeks | 8 weeks | 12 weeks | Baseline | 4 weeks | 8 weeks | 12 weeks | | |
| EORTIC QLQ-C30 | | | | | | | | | | |
| Functioning | | | | | | | | | | |
| Physical functioning | 75.5 | 77.6 | 78.5 | 75.9 | 75.4 | 82.0 | 83.4 | 83.6 | .023 | .016 |
| Role functioning | 69.2 | 74.9 | 76.1 | 76.1 | 70.5 | 74.4 | 74.9 | 74.7 | .190 | .677 |
| Emotional functioning | 70.8 | 71.4 | 72.5 | 69.6 | 68.3 | 73.8 | 74.4 | 71.1 | .551 | .742 |
| Cognitive functioning | 74.3 | 75.3 | 74.0 | 71.7 | 74.2 | 78.1 | 73.1 | 71.7 | .658 | .260 |
| Social functioning | 73.6 | 77.9 | 80.3 | 74.4 | 73.0 | 83.6 | 76.9 | 77.4 | .294 | .706 |
| Global quality-of-life | 52.6 | 56.0 | 58.1 | 53.1 | 53.1 | 58.1 | 57.8 | 56.4 | .369 | .918 |
| Symptom | | | | | | | | | | |
| Fatigue | 42.5 | 39.0 | 35.0 | 40.2 | 43.5 | 36.8 | 37.2 | 32.6 | .308 | .534 |
| Nausea/vomiting | 8.7 | 5.9 | 8.9 | 9.4 | 6.8 | 5.7 | 7.3 | 5.8 | .479 | .899 |
| Insomnia | 27.2 | 33.1 | 24.8 | 31.9 | 29.3 | 29.3 | 27.1 | 26.1 | .423 | .720 |
| Pain | 20.3 | 18.7 | 17.5 | 25.2 | 21.4 | 20.3 | 18.6 | 21.5 | .825 | .842 |
| Dyspnea | 13.8 | 11.6 | 9.3 | 15.2 | 13.6 | 14.8 | 12.5 | 10.4 | .969 | .304 |
| Appetite loss | 12.3 | 12.5 | 15.3 | 24.4 | 14.0 | 7.3 | 9.6 | 9.6 | .034 | .024 |
| Constipation | 23.0 | 13.4 | 17.0 | 15.8 | 21.0 | 17.6 | 18.7 | 18.6 | .366 | .744 |
| Diarrhea | 7.0 | 5.9 | 4.7 | 4.7 | 13.2 | 7.6 | 4.3 | 4.1 | .212 | .332 |
| Financial difficulties | 18.1 | 23.0 | 18.7 | 17.5 | 19.3 | 16.4 | 15.8 | 17.9 | .414 | .537 |
| Hospital Anxiety Depression Scale | | | | | | | | | | |
| Anxiety | 6.3 | 7.9 | 6.8 | 7.8 | 6.7 | 7.1 | 6.7 | 6.6 | .142 | .449 |
| Depression | 6.4 | 9.1 | 7.7 | 8.0 | 6.5 | 7.9 | 7.9 | 7.3 | .271 | .535 |
| Brief Fatigue Inventory | | | | | | | | | | |
| Fatigue severity | 16.7 | 15.1 | 14.4 | 15.3 | 16.9 | 14.8 | 14.5 | 13.5 | .022 | .708 |

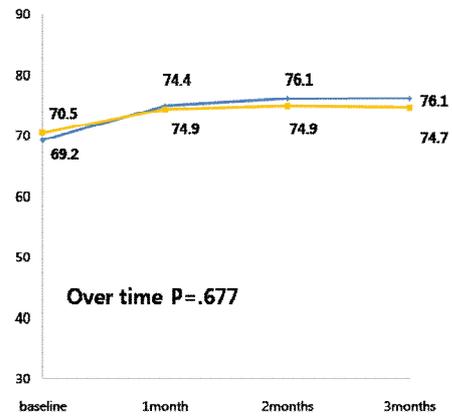
Notes. * Group differences at 12 weeks adjusted for baseline values

** Differences of changes between groups over the 12 weeks adjusted for baseline values

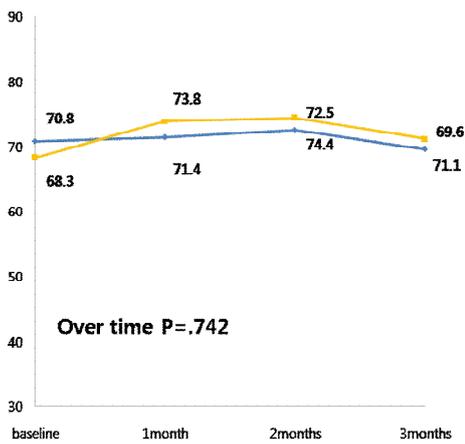
Physical functioning



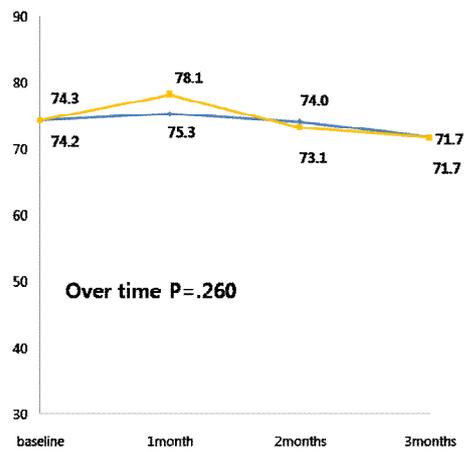
Role functioning



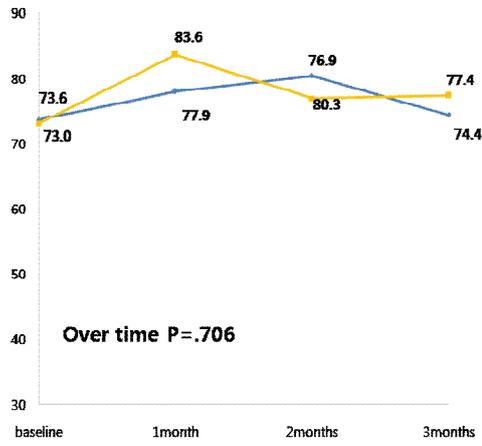
Emotional functioning



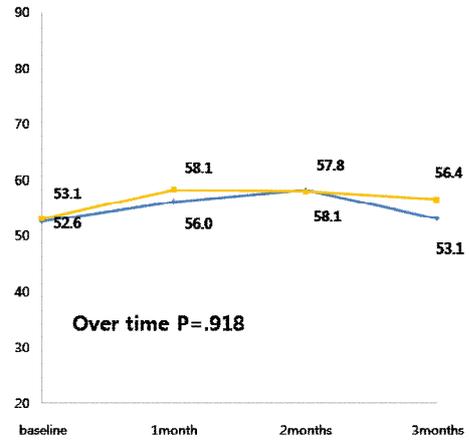
Cognitive functioning



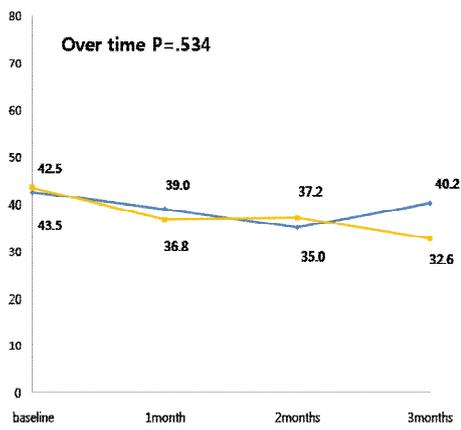
Social functioning



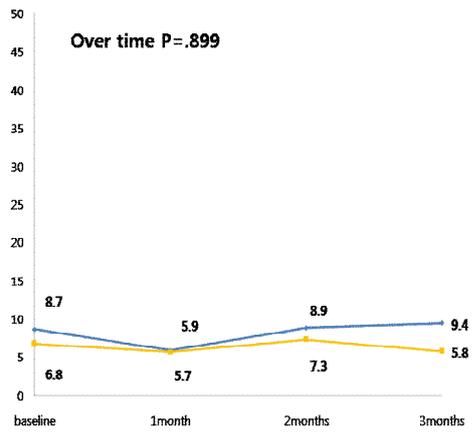
Global quality-of-life



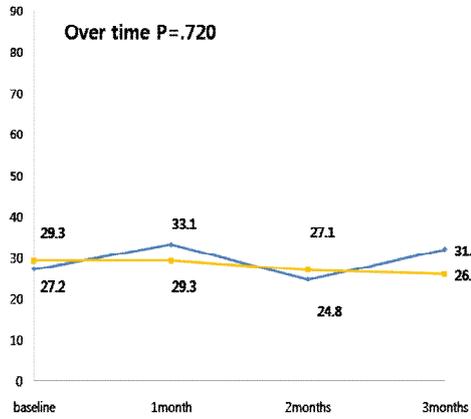
Fatigue



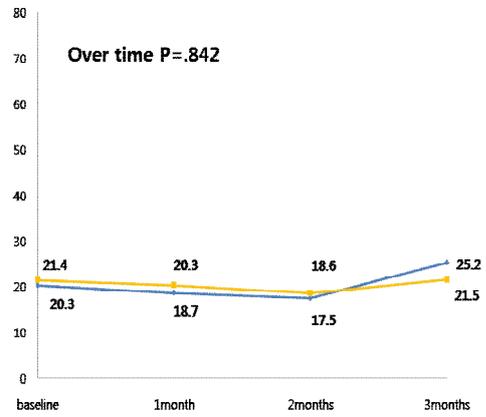
Nausea / Vomiting



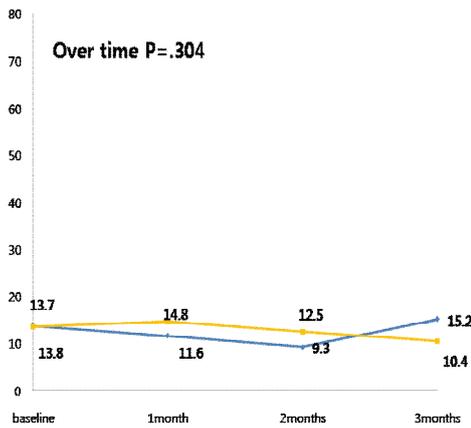
Insomnia



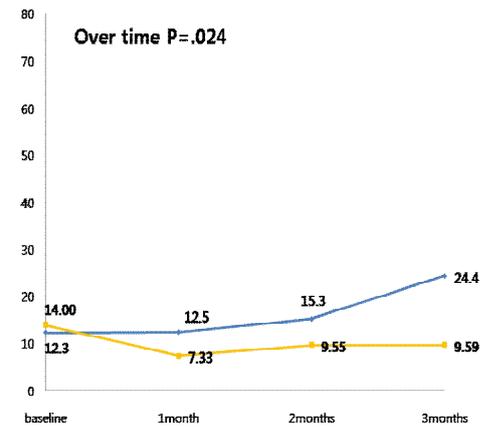
Pain



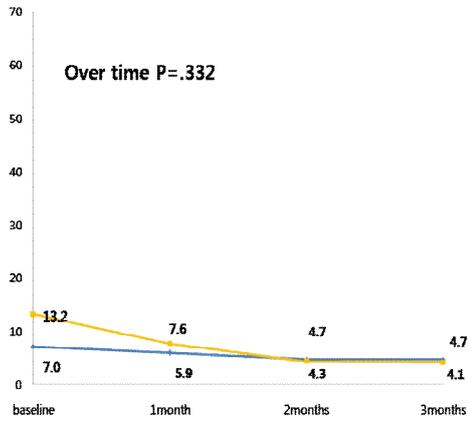
Dyspnea



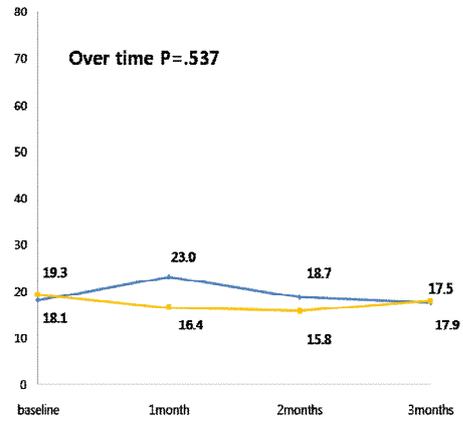
Appetite loss



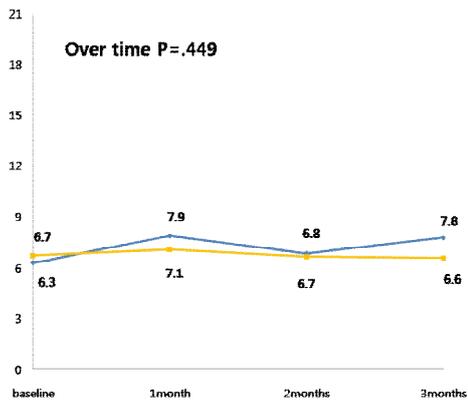
Diarrhea



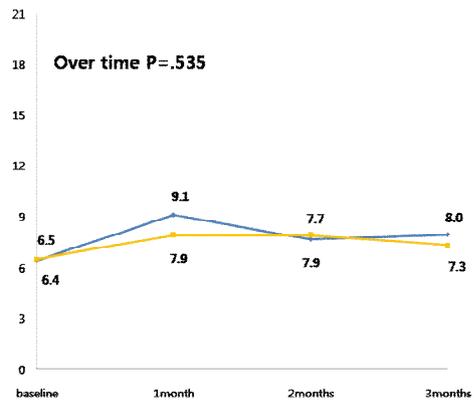
Financial difficulties



Anxiety



Depression



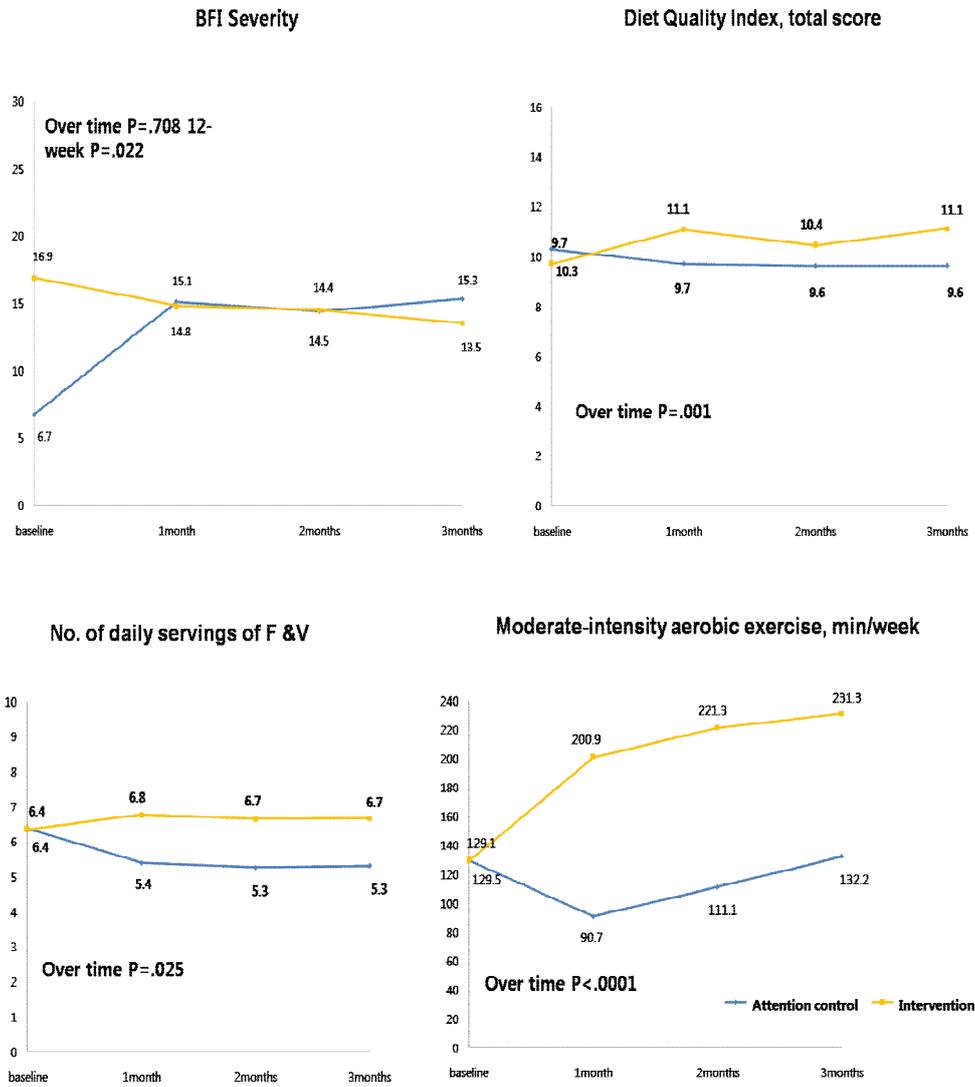


Figure 12. Least-square means of HRQOL, anxiety, depression scores, fatigue, diet quality, and number of daily servings of F&V, comparing data from the control and experimental groups at four distinct timepoints

4) Changes in mediating variables

Group differences at 12 weeks

At 12 weeks, the motivational readiness for exercise ($p < .0001$) and F&V consumption ($p = .029$) were significantly higher in the experimental group than in controls. A significant between-group difference was evident in terms of self-efficacy in the making of exercise decisions ($p = .024$). A significant between-group difference was also evident in terms of self-efficacy in the making of a decision to increase F&V consumption ($p = .023$). Also, a significant between-group difference was evident in terms of self-efficacy in deciding to maintain a healthy weight ($p = .048$) (Table 9).

Differences of changes between groups over the 12 weeks

The motivational readiness for exercise and F&V consumption were significantly higher in the experimental group than in controls, and these effects continued for 12 weeks (the p-values were, respectively, $p < .0001$ and $p = .031$). A significant between-group difference was evident in terms of self-efficacy in the making of exercise decisions, and this effect continued for 12 weeks ($p = .0002$) (Table 9).

Table 9. Comparison of Readiness Stages and Self-efficacy Outcomes between the Control and Experimental Group at Four Timepoints

| | Attention control group | | | | Health Planner intervention group | | | | At 12 weeks <i>P</i> * | Over time <i>P</i> ** |
|---|-------------------------|----------|----------|----------|-----------------------------------|----------|----------|----------|---------------------------|--------------------------|
| | Baseline | 1 mo | n=28 | n=28 | Baseline | 1 mo | 2 mo | 3 mo | | |
| | n=29 | n=28 | n=28 | n=28 | n=30 | n=30 | n=30 | n=29 | | |
| Stage of change for exercise | | | | | | | | | | |
| Precontemplation | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | | |
| Contemplation | 3(10.3) | 3(10.7) | 3(10.7) | 4(14.3) | 2(6.67) | 1 (3.33) | 0 (0.0) | 0 (0.0) | | |
| Preparation | 15(51.7) | 14(50.0) | 14(50.0) | 13(46.4) | 19(63.3) | 8 (26.7) | 3 (10.0) | 1 (3.5) | | |
| Action | 11(37.9) | 9(32.1) | 8(28.6) | 7(25.0) | 8(26.7) | 17(56.7) | 21(70.0) | 22(75.9) | | |
| Maintenance | 0(0.0) | 2(7.1) | 3(10.7) | 4(14.3) | 1(3.33) | 4 (13.3) | 6 (20.0) | 6 (20.7) | <.0001 | <.0001 |
| Stage of change to increase F&V intake | | | | | | | | | | |
| Precontemplation | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 2(6.7) | 2 (6.7) | 1 (3.3) | 1(3.6) | | |
| Contemplation | 7(24.1) | 5(17.9) | 5(17.9) | 6(21.4) | 10(33.3) | 6 (20.0) | 4 (13.3) | 3(10.7) | | |
| Preparation | 20(69.0) | 19(67.9) | 13(46.3) | 13(46.4) | 18(60.0) | 18(60.0) | 14(46.7) | 11(39.3) | | |
| Action | 0(0.0) | 2(7.1) | 8(28.6) | 8(28.6) | 0(0.0) | 4(13.3) | 11(36.7) | 13(46.4) | | |
| Maintenance | 2(6.9) | 2(7.1) | 2(7.1) | 1(3.6) | 0(0.0) | 0(0.0) | 0 (0.0) | 0(0.0) | .029 | .031 |
| Stage of change for healthy weight management | | | | | | | | | | |
| Precontemplation | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | | |
| Contemplation | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 1(3.3) | 1(3.3) | 1(3.3) | 1(3.4) | | |
| Preparation | 12(41.4) | 11(39.3) | 11(39.3) | 11(39.3) | 9(30.0) | 9(30.0) | 9(30.0) | 9(31.0) | | |
| Action | 2(6.9) | 3(10.7) | 3(10.7) | 3(10.7) | 9(30.0) | 8(26.7) | 8(26.7) | 7(24.1) | | |
| Maintenance | 15(51.7) | 14(50.0) | 14(50.0) | 14(50.0) | 11(36.7) | 12(40.0) | 12(40.0) | 12(41.4) | .492 | .935 |

| | Attention control group | | | | Health Planner intervention group | | | | At 12 weeks P* | Over time P** |
|---|-------------------------|----------|----------|----------|-----------------------------------|----------|----------|----------|-------------------|------------------|
| | Baseline | 1 mo | n=28 | n=28 | Baseline | 1 mo | 2 mo | 3 mo | | |
| | n=29 | n=28 | | | n=30 | n=30 | n=30 | n=29 | | |
| Self-efficacy for exercise management | | | | | | | | | | |
| Not at all sure | 1(3.5) | 1(3.6) | 2(7.1) | 0(0.0) | 1 (3.3) | 0(0.0) | 0(0.0) | 0(0.0) | | |
| A little sure | 3(10.3) | 6(21.4) | 11(39.3) | 11(39.3) | 7 (23.3) | 2(6.7) | 1(3.3) | 2(7.1) | | |
| Somewhat sure | 10(34.5) | 14(50.0) | 10(35.7) | 6(21.4) | 7 (23.3) | 7(23.3) | 7(23.3) | 6(21.4) | | |
| Very sure | 10(34.5) | 4(14.3) | 3(10.7) | 9(32.1) | 7 (23.3) | 12(40.0) | 14(46.7) | 17(60.7) | | |
| Extremely sure | 5(17.2) | 3(10.7) | 2(7.1) | 2(7.1) | 8 (26.7) | 9(30.0) | 8(26.7) | 3(10.7) | .024 | .0002 |
| Self-efficacy to increase F&V intake | | | | | | | | | | |
| Not at all sure | 0(0.0) | 0(0.0) | 2 (7.1) | 0(0.0) | 1 (3.3) | 1(3.3) | 0(0.0) | 0(0.0) | | |
| A little sure | 6(20.7) | 9 (32.1) | 9 (32.1) | 7 (25.0) | 8 (26.7) | 7(23.3) | 8(26.7) | 6(21.4) | | |
| Somewhat sure | 13(44.8) | 15(53.6) | 14(50.0) | 10(35.7) | 15(50.0) | 9(30.0) | 10(33.3) | 11(39.3) | | |
| Very sure | 8(27.6) | 2(7.1) | 1(3.6) | 10(35.7) | 5(16.7) | 11(36.7) | 10(33.3) | 10(35.7) | | |
| Extremely sure | 2(6.9) | 2(7.1) | 2(7.1) | 1(3.6) | 1(3.3) | 2(6.7) | 2(6.7) | 1(3.6) | .023 | .053 |
| Self-efficacy to control for healthy weight | | | | | | | | | | |
| Not at all sure | 0(0.0) | 0(0.0) | 2(7.1) | 3(10.7) | 2(6.7) | 0(0.0) | 1(3.3) | 0(0.0) | | |
| A little sure | 4(13.8) | 6(21.4) | 4(14.3) | 3(10.7) | 4(13.3) | 5(16.7) | 5(16.7) | 4(14.3) | | |
| Somewhat sure | 10(34.5) | 7(25.0) | 8(28.6) | 9(32.1) | 11(36.7) | 8(26.7) | 10(33.3) | 10(35.7) | | |
| Very sure | 10(34.5) | 11(39.3) | 10(35.7) | 9(32.1) | 9(30.0) | 10(33.3) | 6(20.0) | 9(32.1) | | |
| Extremely sure | 5(17.2) | 4(14.3) | 4(14.3) | 4(14.3) | 4(13.3) | 7(23.3) | 8(26.7) | 5(17.9) | .048 | .366 |

Notes. * Group differences at the 12 weeks adjusted for baseline values

** Differences of changes between groups over the 12 weeks adjusted for baseline values

VI. Discussion

The main findings of the present study were that the Web-based self-management exercise and dietary intervention program that we developed effectively changed behavior by increasing the number of desired lifestyle behaviors practiced at recommended levels, the duration of exercise taken each week, the daily intake of F&V, and overall dietary quality (Demark-Wahnefried et al., 2007; Pierce et al., 2004). Although some studies support the effectiveness of the Web-based lifestyle intervention program (Huang et al., 2009; C. J Kim & Kang, 2006; Milan & White, 2010; Poddar, Hosig, Anderson, Nickols-Richardson, & Duncan, 2010; Winett, Anderson, Wojcik, Winett, & Bowden, 2007), this is, to the best of our knowledge, the first randomized controlled trial to demonstrate the efficacy of a Web-based self-managed exercise and dietary intervention program targeted to women with breast cancer. To date, over 50 lifestyle interventions aiming to increase exercise and improve dietary behavior among cancer survivors have been described. Most such interventions effectively improved lifestyle behavior (Courneya et al., 2003; Demark-Wahnefried et al., 2005; Demark-Wahnefried, Pinto, & Gritz, 2006; Jones & Demark-Wahnefried, 2006; Schmitz et al., 2005). Thus, the present program is not unique; however, it does have several notable features. Critically, we embraced action planning when considering exercise and dietary behavior, which allowed effective modification of the lifestyles of breast cancer survivors. Practical and

specific action planning and scheduling promotes the initiation and maintenance of healthy behavior by identifying and filling intention-behavior gaps (Conner et al., 2010; Lippke et al., 2009; Reuter et al., 2009; Scholz & Schwarzer, 2005). The efficacy of action planning on promoting the initiation and maintenance of healthy behavior reported in the present study was that the number of lifestyle behaviors practiced at recommended levels, the duration of weekly exercise, the daily intake of F&V, overall dietary quality, physical functioning, and appetite loss in the experimental group began to improve 4 weeks into the program and such changes endured for at least 12 weeks.

The present program significantly affected scores on specific HRQOL domains including physical functioning and appetite loss; these findings are consistent with those of previous studies on subjects participating in exercise programs (J. K. Brown et al., 2003; Courneya et al., 2003; Eyigor et al., 2010), and on reports on changes in the dietary quality of women undergoing and recovering from breast cancer treatment (Wayne et al., 2006). However, the present Web-based lifestyle modification program was not associated with any beneficial effect in terms of anxiety, depression, or emotional, social, or cognitive functioning assessed by the HRQOL. The effects of lifestyle interventions bearing on exercise and diet on the emotional, social, and cognitive domains of HRQOL remain controversial. Some researchers have reported positive effects (Burnham & Wilcox, 2002; Demark-Wahnefried et al., 2007; S. H. Kim et al., 2011; R. Segal et al.,

2001; Thorsen et al., 2005) whereas others have not (Daley et al., 2007; Doyle et al., 2006; Ohira et al., 2006; Pinto et al., 2005a; Schmitz et al., 2005; R. J. Segal et al., 2003). While this Web-based program encouraging self-management of exercise and dietary behaviors did indeed motivate patients to achieve these ends, improve self-efficacy, and attain exercise and dietary goals, psychological distress did not improve to the same extent to which behavior improved. Also, because the program did not feature content or action planning particularly relevant to the development of psychosocial well-being, any such effects may be difficult to detect over a relatively short interventional period. And human resources (e.g., coaching, interactivity, communication with experts or experienced peer group) may need to be integrated in this Web-based self-managed exercise and diet intervention program in order to improve psychological distress.

We also found that the program reduced fatigue, which was evaluated using the BFI. This observation is consistent with those of most comparable studies (Courneya et al., 2003; Dimeo, Fetscher, Lange, Mertelsmann, & Keul, 1997; Pinto et al., 2005a; R. J. Segal et al., 2003; Trabal et al., 2006), although a few inconsistent reports have appeared (Thorsen et al., 2005). Fatigue is a common and distressing feature of cancer treatment and recovery, and may persist even in the breast cancer survivors with long-term remission (Curt et al., 2000). Our finding is consistent with those of several reports showing that exercise training can help to mediate fatigue in cancer survivors (Courneya et al., 2003; Dimeo et al., 1997; Pinto et al., 2005a; R.

J. Segal et al., 2003). An earlier work showed that consumption of a low-protein diet was associated with fatigue (Trabal et al., 2006). In our present study, the observed reduction in fatigue may be associated with protein intake that was increased to levels close to that of the recommended daily allowance.

It is thus clear that the extent of changes in the levels of psychological distress, fatigue, and scores on HRQOL domains are not consistent when the outcomes of various lifestyle intervention trials are compared. It is not clear whether such differences are attributable to variation in patient characteristics; and/or the type, duration, and start time of any intervention. Therefore, clinical trials directly evaluating the optimal type and timing of lifestyle change interventions for cancer survivors are needed.

There are several possible factors to explain why our program positively affected dietary and exercise behavior, dietary quality, physical functioning, appetite loss (measured by the HRQOL), and fatigue (assessed using the BFI). The Web-based self-management exercise and diet intervention program managed day-to-day health behavior via action planning and provided timely reinforcement via daily delivery of positive automated messages. The tailored feedback-based intervention may provide the relief that someone (or something) close to the patients is managing their health, motivating the patients to achieve and maintain goal behaviors at recommended levels. Earlier work suggested that maintenance of healthy behavior is greatly assisted by the provision of appropriate feedback on

progress toward desired outcomes (Frenzel et al., 2010). Although the automatic message does not provide completely individualized feedback, the tailored reaction might stimulate self-regulatory behavior through making self-judgments on progress toward desired exercise and diet behavior (Bandura, 1989). The patients' needs were reflected in this program through interviews with the patients, and the identified user requirements were combined with technologies to implement TTM theory-based functions which might improve user accessibility. Our Web-based self-management program, featuring the use of TTM theory, effectively targeted relevant variables. Thus, the program improved motivational readiness and perceived self-efficacy in terms of exercise and F&V consumption (Daley et al., 2007; Demark-Wahnefried et al., 2007; Pinto et al., 2005a). It is thus possible that our program may not only trigger the required behaviors, but may assist in sustaining such behaviors over the long-term (Daley et al., 2007; Frith et al., 2010). Self-regulation strategies, including diary keeping, an emphasis on goal-setting, and feedback on progress, may increase motivation and perceived self-efficacy (Wing et al., 2006).

Although a combination of interventions targeting dietary intake and increasing exercise levels should in theory reduce body weight, we found no significant change in body composition (Pinto et al., 2005a). This result may be explained by considering particular aspects of exercise and dietary behavior. In terms of the latter, the main effect of interventional studies seeking to reduce dietary fat levels was weight loss (Chlebowski et al.,

2006). Although, overall, patients of the present study achieved balanced diets based on dietary quality index measures, the extent of reductions in fat and saturated fat intake remains unknown. A baseline ceiling effect may be in play; fat intake by most patients may have already been within recommended range (64% of patients consumed fat at levels below 25% of total dietary intake, and 85% of patients consumed saturated fat at levels of 6% or less of such intake). Also, only 21 study patients (35%) were overweight at the baseline. Any effect size may have been too small to detect within a 35% subsample. In terms of exercise behavior, adults are recommended to exercise for at least 1 h on most weekdays to achieve weight loss (Institute of Medicine, 2002). To ensure long-term maintenance of weight loss, it is recommended that overweight and obese adults exercise for 200–300 min each week or expend more than 2,000 kilocalories per week in leisure-time physical activity (Donnelly et al., 2009; Jakicic et al., 2001). Therefore, long-term follow-up may be required to observe any effect of the program on fat intake and BMI, or a sufficient number of patients overweight at the baseline must be enrolled to observe any such effect.

Previous findings of Web-based lifestyle intervention trials remain controversial. In randomized controlled trials, delivery of theory-based messages via the Web enhanced lifestyle modifications (C. J Kim & Kang, 2006; Winett et al., 2007; Yun, Lee, Kim, et al., 2012). However, a Web-based program that apparently failed to trigger lifestyle changes lacked a theoretical basis, had low utilization, and did not suit participants' needs

(Kelders et al., 2011). The reason why this program was effective may be the high rate of utilization due to most participants' preparation stage, and due to the strategies of daily feedback and action planning. The diagnosis of cancer also provides a teachable moment when the patients' motivation for lifestyle change is especially high (Demark Wahnefried et al., 2000; Hewitt et al., 2003; McBride, Emmons, & Lipkus, 2003; McBride et al., 2008).

Fatigue scores obtained using the EORTC QLQ did not differ between the experimental and attention control group, whereas BFI scores did reveal a significant difference. The duration explored by the BFI was the last 24 hours, whereas that of the EORTC QLQ was 1 week. The EORTC QLQ thus measures fatigue experienced over a relatively long period and is retrospective in nature, whereas the BFI assesses fatigue domains (average, now, and worst) over the short-term. Knobel et al. (2003) recommended that a domain-specific instrument be used when fatigue was the end-point explored. Thus, BFI data may be more relevant in the current study.

Our study had several limitations. First, recruitment of the elderly and those with limited educational attainment was challenging; such patients cannot easily use a Web-based program. Indeed, the proportions of the elderly and those of lower educational attainment in our study group were lower than their proportions in the general population. However, our randomized controlled trial nonetheless revealed significant differences in desired outcomes between the two groups. Second, the follow-up duration was only 12 weeks. Further studies are needed to determine if a continuation

of the program, featuring tailored motivation and action planning, would effectively maintain long-term practice of desired dietary and exercise behaviors.

In conclusion, a Web-based program targeting change in exercise and dietary behaviors can be effective when TTM theory is used to inform program strategy. The use of internet technology allowed immediate and easy access to interventions, real-time monitoring of progress, online education, tailored action planning, and tailored short message services using mobile phones (Carr et al., 2009). It would be better if the technology could properly harmonize and integrate with human resources. Thus further research on the effect of the technology integrated with human resources (e.g., coaching, interaction, communication with experts or experienced peer groups) may be required to overcome the limited effect on psychosocial outcomes. Most healthcare providers in busy clinical settings rarely find time to counsel patients on health management. Given that the number of cancer survivors is increasing, targeting of such high-risk groups can potentially achieve positive and widespread public health outcomes (Demark-Wahnefried et al., 2005; Demark Wahnefried et al., 2000; Ganz, 2005).

References

- Aaronson, N. K., Ahmedzai, S., Bergman, B., Bullinger, M., Cull, A., Duez, N. J., . . . de Haes, J. C. (1993). The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst*, *85*(5), 365-376.
- Agency for Healthcare Research and Quality. (2004). Effectiveness of behavioral interventions to modify physical activity behaviors in general populations and cancer patients and survivors. *AHRQ Publication No. 04-E027-2*. (pp. 107-111). Rockville, MD.
- Ahmed, R. L., Thomas, W., Yee, D., & Schmitz, K. H. (2006). Randomized controlled trial of weight training and lymphedema in breast cancer survivors. *J Clin Oncol*, *24*(18), 2765-2772. doi: 10.1200/jco.2005.03.6749
- Ahn, S. H., Park, B. W., Noh, D. Y., Nam, S. J., Lee, E. S., Lee, M. K., . . . Yun, Y. H. (2007). Health-related quality of life in disease-free survivors of breast cancer with the general population. *Ann Oncol*, *18*(1), 173-182. doi: 10.1093/annonc/mdl333
- American Cancer Society. (2011). Breast Cancer Facts & Figures 2011-2012.
- Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*, *84*(2), 191-215.

- Bandura, A. (1982). The psychology of chance encounters and life paths. *American psychologist, 37*(7), 747.
- Bandura, A. (1989). Human agency in social cognitive theory. *Am Psychol, 44*(9), 1175-1184.
- Baron, R. H., Kelvin, J. F., Bookbinder, M., Cramer, L., Borgen, P. I., & Thaler, H. T. (2000). Patients' sensations after breast cancer surgery. A pilot study. *Cancer Pract, 8*(5), 215-222.
- Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale: an updated literature review. *Journal of psychosomatic research, 52*(2), 69-77.
- Blanchard, C. M., Courneya, K. S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: results from the American Cancer Society's SCS-II. *J Clin Oncol, 26*(13), 2198-2204. doi: 10.1200/jco.2007.14.6217
- Blanchard, C. M., Stein, K. D., Baker, F., Dent, M. F., Denniston, M. M., Courneya, K. S., & Nehl, E. (2004). Association between current lifestyle behaviors and health-related quality of life in breast, colorectal, and prostate cancer survivors. *Psychology & Health, 19*(1), 1-13.
- Bower, J. E., Ganz, P. A., Desmond, K. A., Rowland, J. H., Meyerowitz, B. E., & Belin, T. R. (2000). Fatigue in breast cancer survivors: occurrence, correlates, and impact on quality of life. *J Clin Oncol, 18*(4), 743-753.

- Boyar, A. P., Rose, D. P., Loughridge, J. R., Engle, A., Palgi, A., Laakso, K., . . . Wynder, E. L. (1988). Response to a diet low in total fat in women with postmenopausal breast cancer: a pilot study. *Nutr Cancer, 11*(2), 93-99. doi: 10.1080/01635588809513975
- Braunholtz, D. A., Edwards, S. J., & Lilford, R. J. (2001). Are randomized clinical trials good for us (in the short term)? Evidence for a "trial effect". *J Clin Epidemiol, 54*(3), 217-224.
- Brooke, J. (Ed.). (1996). *a 'quick and dirty' usability scale*. London: Taylor and Francis.
- Brown, B. W., Brauner, C., & Minnotte, M. C. (1993). Noncancer deaths in white adult cancer patients. *J Natl Cancer Inst, 85*(12), 979-987.
- Brown, J. K., Byers, T., Doyle, C., Coumeya, K. S., Demark-Wahnefried, W., Kushi, L. H., . . . Sawyer, K. A. (2003). Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. *CA Cancer J Clin, 53*(5), 268-291.
- Burgess, C., Cornelius, V., Love, S., Graham, J., Richards, M., & Ramirez, A. (2005). Depression and anxiety in women with early breast cancer: five year observational cohort study. *BMJ, 330*(7493), 702. doi: 10.1136/bmj.38343.670868.D3
- Burnham, T. R., & Wilcox, A. (2002). Effects of exercise on physiological and psychological variables in cancer survivors. *Med Sci Sports Exerc, 34*(12), 1863-1867. doi: 10.1249/01.mss.0000040995.26076.cc

- Caan, B., Sternfeld, B., Gunderson, E., Coates, A., Quesenberry, C., & Slattery, M. L. (2005). Life After Cancer Epidemiology (LACE) Study: a cohort of early stage breast cancer survivors (United States). *Cancer Causes Control, 16*(5), 545-556. doi: 10.1007/s10552-004-8340-3
- Calle, E. E., Rodriguez, C., Walker-Thurmond, K., & Thun, M. J. (2003). Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med, 348*(17), 1625-1638. doi: 10.1056/NEJMoa021423
- Carr, L. J., Bartee, R. T., Dorozynski, C. M., Broomfield, J. F., Smith, M. L., & Smith, D. T. (2009). Eight-month follow-up of physical activity and central adiposity: results from an Internet-delivered randomized control trial intervention. *J Phys Act Health, 6*(4), 444-455.
- Cella, D. F., Tulsky, D. S., Gray, G., Sarafian, B., Linn, E., Bonomi, A., . . . Brannon, J. (1993). The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. *Journal of clinical oncology, 11*(3), 570-579.
- Chirikos, T. N., Russell-Jacobs, A., & Jacobsen, P. B. (2002). Functional impairment and the economic consequences of female breast cancer. *Women Health, 36*(1), 1-20. doi: 10.1300/J013v36n01_01
- Chiu, S. C., Cheng, K. Y., Sun, T. K., Chang, K. C., Tan, T. Y., Lin, T. K., . . . Yeh, S. H. (2009). The effectiveness of interactive computer assisted instruction compared to videotaped instruction for teaching

- nurses to assess neurological function of stroke patients: a randomized controlled trial. *Int J Nurs Stud*, 46(12), 1548-1556. doi: S0020-7489(09)00165-5 [pii] 10.1016/j.ijnurstu.2009.05.008
- Chlebowski, R. T., Aiello, E., & McTiernan, A. (2002). Weight loss in breast cancer patient management. *J Clin Oncol*, 20(4), 1128-1143.
- Chlebowski, R. T., Blackburn, G. L., Thomson, C. A., Nixon, D. W., Shapiro, A., Hoy, M. K., . . . Elashoff, R. M. (2006). Dietary fat reduction and breast cancer outcome: interim efficacy results from the Women's Intervention Nutrition Study. *J Natl Cancer Inst*, 98(24), 1767-1776. doi: 10.1093/jnci/djj494
- Conner, M., Sandberg, T., & Norman, P. (2010). Using action planning to promote exercise behavior. *Ann Behav Med*, 40(1), 65-76. doi: 10.1007/s12160-010-9190-8
- Courneya, K. S., Mackey, J. R., Bell, G. J., Jones, L. W., Field, C. J., & Fairey, A. S. (2003). Randomized controlled trial of exercise training in postmenopausal breast cancer survivors: cardiopulmonary and quality of life outcomes. *Journal of Clinical Oncology*, 21(9), 1660.
- Curt, G. A., Breitbart, W., Cella, D., Groopman, J. E., Horning, S. J., Itri, L. M., . . . Vogelzang, N. J. (2000). Impact of cancer-related fatigue on the lives of patients: new findings from the Fatigue Coalition. *Oncologist*, 5(5), 353-360.
- Daley, A. J., Crank, H., Saxton, J. M., Mutrie, N., Coleman, R., & Roalfe, A. (2007). Randomized trial of exercise therapy in women treated for

- breast cancer. *J Clin Oncol*, 25(13), 1713-1721. doi: 10.1200/jco.2006.09.5083
- Damush, T. M., Perkins, A., & Miller, K. (2006). The implementation of an oncologist referred, exercise self-management program for older breast cancer survivors. *Psychooncology*, 15(10), 884-890. doi: 10.1002/pon.1020
- Darga, L. L., Magnan, M., Mood, D., Hryniuk, W. M., DiLaura, N. M., & Djuric, Z. (2007). Quality of life as a predictor of weight loss in obese, early-stage breast cancer survivors.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.
- de Waard, F., Ramlau, R., Mulders, Y., de Vries, T., & van Waveren, S. (1993). A feasibility study on weight reduction in obese postmenopausal breast cancer patients. *Eur J Cancer Prev*, 2(3), 233-238.
- Demark-Wahnefried, W., Aziz, N. M., Rowland, J. H., & Pinto, B. M. (2005). Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol*, 23(24), 5814-5830. doi: 10.1200/jco.2005.01.230
- Demark-Wahnefried, W., Clipp, E. C., Lipkus, I. M., Lobach, D., Snyder, D. C., Sloane, R., . . . Kraus, W. E. (2007). Main outcomes of the FRESH START trial: a sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *J Clin*

Oncol, 25(19), 2709-2718. doi: 10.1200/jco.2007.10.7094

Demark-Wahnefried, W., Clipp, E. C., McBride, C., Lobach, D. F., Lipkus, I., Peterson, B., . . . Kraus, W. E. (2003). Design of FRESH START: a randomized trial of exercise and diet among cancer survivors. *Medicine & Science in Sports & Exercise*, 35(3), 415.

Demark-Wahnefried, W., Kenyon, A. J., Eberle, P., Skye, A., & Kraus, W. E. (2002). Preventing sarcopenic obesity among breast cancer patients who receive adjuvant chemotherapy: results of a feasibility study. *Clin Exerc Physiol*, 4(1), 44-49.

Demark-Wahnefried, W., Peterson, B. L., Winer, E. P., Marks, L., Aziz, N., Marcom, P. K., . . . Rimer, B. K. (2001). Changes in weight, body composition, and factors influencing energy balance among premenopausal breast cancer patients receiving adjuvant chemotherapy. *J Clin Oncol*, 19(9), 2381-2389.

Demark-Wahnefried, W., Pinto, B. M., & Gritz, E. R. (2006). Promoting health and physical function among cancer survivors: potential for prevention and questions that remain. *Journal of clinical oncology*, 24(32), 5125-5131.

Demark Wahnefried, W., Peterson, B., McBride, C., Lipkus, I., & Clipp, E. (2000). Current health behaviors and readiness to pursue life style changes among men and women diagnosed with early stage prostate and breast carcinomas. *Cancer*, 88(3), 674-684.

Dewys, W. D., Begg, C., Lavin, P. T., Band, P. R., Bennett, J. M., Bertino,

- J. R., . . . Tormey, D. C. (1980). Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. *Am J Med*, 69(4), 491-497.
- DiClemente, C. C., & Prochaska, J. O. (1998). Toward a comprehensive, transtheoretical model of change. *Treating addictive behaviors*, 3-24.
- Dimeo, F., Fetscher, S., Lange, W., Mertelsmann, R., & Keul, J. (1997). Effects of aerobic exercise on the physical performance and incidence of treatment-related complications after high-dose chemotherapy. *Blood*, 90(9), 3390-3394.
- Djuric, Z., DiLaura, N. M., Jenkins, I., Darga, L., Jen, C. K., Mood, D., . . . Hryniuk, W. M. (2002). Combining weight-loss counseling with the weight watchers plan for obese breast cancer survivors. *Obes Res*, 10(7), 657-665. doi: 10.1038/oby.2002.89
- Donnelly, J. E., Blair, S. N., Jakicic, J. M., Manore, M. M., Rankin, J. W., & Smith, B. K. (2009). American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc*, 41(2), 459-471. doi: 10.1249/MSS.0b013e3181949333
- Doyle, C., Kushi, L. H., Byers, T., Courneya, K. S., Demark-Wahnefried, W., Grant, B., . . . Gansler, T. (2006). Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. *CA Cancer J Clin*, 56(6), 323-353.
- Duffy, J. This Article Read: 289 Times Word Count: 1166.

- Duijts, S. F., Faber, M. M., Oldenburg, H. S., van Beurden, M., & Aaronson, N. K. (2011). Effectiveness of behavioral techniques and physical exercise on psychosocial functioning and health-related quality of life in breast cancer patients and survivors—a meta-analysis. *Psychooncology, 20*(2), 115-126. doi: 10.1002/pon.1728
- Dyrlund, A. K., & Wininger, S. R. (2006). An Evaluation of Barrier Efficacy and Cognitive Evaluation Theory as Predictors of Exercise Attendance. *Journal of Applied Biobehavioral Research, 11*(3-4), 133-146.
- Eyigor, S., Karapolat, H., Yesil, H., Uslu, R., & Durmaz, B. (2010). Effects of pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients: a randomized controlled study. *Eur J Phys Rehabil Med, 46*(4), 481-487.
- Fayers, P. M. (2001). Interpreting quality of life data: population-based reference data for the EORTC QLQ-C30. *European Journal of Cancer, 37*(11), 1331-1334.
- Fayers, P. M., Aaronson, N. K., Bjordal, K., Grønvold, M., Curran, D., & Bottomley, A. (2001). EORTC QLQ-C30 scoring manual: European Organisation for Research and Treatment of Cancer Brussels.
- Fennell, M. J. V., & Teasdale, J. D. (1987). Cognitive therapy for depression: Individual differences and the process of change. *Cognitive Therapy and Research, 11*(2), 253-271.

- Ferrell, B. R., Grant, M. M., Funk, B. M., Otis-Green, S. A., & Garcia, N. J. (1998). Quality of life in breast cancer survivors: implications for developing support services. *Oncol Nurs Forum*, 25(5), 887-895.
- Fogel, J., Albert, S. M., Schnabel, F., Ditkoff, B. A., & Neugut, A. I. (2002a). Internet use and social support in women with breast cancer. *Health Psychol*, 21(4), 398-404.
- Fogel, J., Albert, S. M., Schnabel, F., Ditkoff, B. A., & Neugut, A. I. (2002b). Use of the Internet by women with breast cancer. *J Med Internet Res*, 4(2), E9. doi: 10.2196/jmir.4.2.e9
- Fogel, J., Albert, S. M., Schnabel, F., Ditkoff, B. A., & Neugut, A. I. (2003). Racial/ethnic differences and potential psychological benefits in use of the internet by women with breast cancer. *Psychooncology*, 12(2), 107-117. doi: 10.1002/pon.617
- Frenzel, J. C., Kee, S. S., Ensor, J. E., Riedel, B. J., & Ruiz, J. R. (2010). Ongoing provision of individual clinician performance data improves practice behavior. *Anesth Analg*, 111(2), 515-519. doi: 10.1213/ANE.0b013e3181dd5899
- Frith, J., Day, C. P., Robinson, L., Elliott, C., Jones, D. E., & Newton, J. L. (2010). Potential strategies to improve uptake of exercise interventions in non-alcoholic fatty liver disease. *J Hepatol*, 52(1), 112-116. doi: 10.1016/j.jhep.2009.10.010
- Ganz, P. A. (2005). Breast cancer, menopause, and long-term survivorship: critical issues for the 21st century. *Am J Med*, 118 Suppl 12B, 136-

141. doi: 10.1016/j.amjmed.2005.09.047

Ganz, P. A., Kwan, L., Stanton, A. L., Krupnick, J. L., Rowland, J. H., Meyerowitz, B. E., . . . Belin, T. R. (2004). Quality of life at the end of primary treatment of breast cancer: first results from the moving beyond cancer randomized trial. *J Natl Cancer Inst, 96*(5), 376-387.

Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). Health Behavior and Health Education. Theory, Research, and Practice (Adapted from Prochaska JA, Redding CA, Evers KE). (4th ed.). San Francisco, CA: John Wiley and Sons, Inc.

Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). *Health Behavior and Health Education. Theory, Research, and Practice*. (4th ed.). San Francisco, CA: John Wiley and Sons, Inc.

Golant, M., Altman, T., & Martin, C. (2003). Managing cancer side effects to improve quality of life: a cancer psychoeducation program. *Cancer Nurs, 26*(1), 37-44; quiz 45-36.

Goodwin, P., Esplen, M. J., Butler, K., Winocur, J., Pritchard, K., Brazel, S., . . . Miller, A. (1998). Multidisciplinary weight management in locoregional breast cancer: results of a phase II study. *Breast Cancer Res Treat, 48*(1), 53-64.

Green, M. J., Peterson, S. K., Baker, M. W., Friedman, L. C., Harper, G. R., Rubinstein, W. S., . . . Mauger, D. T. (2005). Use of an educational computer program before genetic counseling for breast cancer susceptibility: effects on duration and content of counseling sessions.

Genet Med, 7(4), 221-229.

Grosvenor, M., Bulcavage, L., & Chlebowski, R. T. (1989). Symptoms potentially influencing weight loss in a cancer population. Correlations with primary site, nutritional status, and chemotherapy administration. *Cancer*, 63(2), 330-334.

Gustafson, D. H., Hawkins, R. P., Boberg, E. W., McTavish, F., Owens, B., Wise, M., . . . Pingree, S. (2001). CHES: ten years of research and development in consumer health informatics for broad populations, including the underserved. *Stud Health Technol Inform*, 84(Pt 2), 1459-1563.

Harvie, M. N., Howell, A., Thatcher, N., Baildam, A., & Campbell, I. (2005). Energy balance in patients with advanced NSCLC, metastatic melanoma and metastatic breast cancer receiving chemotherapy—a longitudinal study. *Br J Cancer*, 92(4), 673-680. doi: 10.1038/sj.bjc.6602357

Hayes, A. M., & Feldman, G. (2004). Clarifying the construct of mindfulness in the context of emotion regulation and the process of change in therapy. *Clinical Psychology: Science and Practice*, 11(3), 255-262.

Hebert, J. R., Ebbeling, C. B., Olendzki, B. C., Hurley, T. G., Ma, Y., Saal, N., . . . Clemow, L. (2001). Change in women's diet and body mass following intensive intervention for early-stage breast cancer. *J Am Diet Assoc*, 101(4), 421-431. doi: 10.1016/s0002-8223(01)00109-2

- Heller, L., Parker, P. A., Youssef, A., & Miller, M. J. (2008). Interactive digital education aid in breast reconstruction. *Plast Reconstr Surg*, *122*(3), 717-724. doi: 10.1097/PRS.0b013e318180ed06
- Herman, D. R., Ganz, P. A., Petersen, L., & Greendale, G. A. (2005). Obesity and cardiovascular risk factors in younger breast cancer survivors: The Cancer and Menopause Study (CAMS). *Breast Cancer Res Treat*, *93*(1), 13-23. doi: 10.1007/s10549-005-2418-9
- Hewitt, M., Rowland, J. H., & Yancik, R. (2003). Cancer survivors in the United States: age, health, and disability. *J Gerontol A Biol Sci Med Sci*, *58*(1), 82-91.
- Hill-Kayser, C. E., Vachani, C., Hampshire, M. K., Jacobs, L. A., & Metz, J. M. (2009). Utilization of internet-based survivorship care plans by lung cancer survivors. *Clin Lung Cancer*, *10*(5), 347-352. doi: 10.3816/CLC.2009.n.047
- Holmes, M. D., Chen, W. Y., Feskanich, D., Kroenke, C. H., & Colditz, G. A. (2005). Physical activity and survival after breast cancer diagnosis. *JAMA: the journal of the American Medical Association*, *293*(20), 2479.
- Howard, B. V., Manson, J. E., Stefanick, M. L., Beresford, S. A., Frank, G., Jones, B., . . . Prentice, R. (2006). Low-fat dietary pattern and weight change over 7 years: the Women's Health Initiative Dietary Modification Trial. *JAMA*, *295*(1), 39-49. doi: 10.1001/jama.295.1.39
- Huang, S. J., Hung, W. C., Chang, M., & Chang, J. (2009). The effect of an

internet-based, stage-matched message intervention on young Taiwanese women's physical activity. *Journal of health communication, 14*(3), 210-227.

Institute of Medicine. (2002). Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein and Amino Acids (macronutrients). Washington, DC: National Academic Press.

Jakicic, J. M., Clark, K., Coleman, E., Donnelly, J. E., Foreyt, J., Melanson, E., . . . Volpe, S. L. (2001). American College of Sports Medicine position stand. Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc, 33*(12), 2145-2156.

Janis, I. L., & Mann, L. (1977). Decision making: A psychological analysis of conflict, choice, and commitment.

Jemal, A., Bray, F., Center, M. M., Ferlay, J., Ward, E., & Forman, D. (2011). Global cancer statistics. *CA Cancer J Clin, 61*(2), 69-90. doi: 10.3322/caac.20107

Jones, L. W., & Demark-Wahnefried, W. (2006). Diet, exercise, and complementary therapies after primary treatment for cancer. *Lancet Oncol, 7*(12), 1017-1026. doi: 10.1016/s1470-2045(06)70976-7

Jones, L. W., Guill, B., Keir, S. T., Carter, K., Friedman, H. S., Bigner, D. D., & Reardon, D. A. (2007). Exercise interest and preferences among patients diagnosed with primary brain cancer. *Support Care Cancer, 15*(1), 47-55. doi: 10.1007/s00520-006-0096-8

- Jung, K. W., Park, S., Kong, H. J., Won, Y. J., Lee, J. Y., Park, E. C., & Lee, J. S. (2011). Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2008. *Cancer Res Treat*, *43*(1), 1-11. doi: 10.4143/crt.2011.43.1.1
- Karvinen, K. H., Courneya, K. S., Campbell, K. L., Pearcey, R. G., Dundas, G., Capstick, V., & Tonkin, K. S. (2006). Exercise preferences of endometrial cancer survivors: a population-based study. *Cancer Nurs*, *29*(4), 259-265.
- Kelders, S. M., Van Gemert-Pijnen, J. E., Werkman, A., Nijland, N., & Seydel, E. R. (2011). Effectiveness of a Web-based intervention aimed at healthy dietary and physical activity behavior: a randomized controlled trial about users and usage. *J Med Internet Res*, *13*(2), e32. doi: 10.2196/jmir.1624
- Kim, C. J., Hwang, A. R., & Yoo, J. S. (2004). The impact of a stage-matched intervention to promote exercise behavior in participants with type 2 diabetes. *Int J Nurs Stud*, *41*(8), 833-841. doi: 10.1016/j.ijnurstu.2004.03.009
- Kim, C. J., & Kang, D. H. (2006). Utility of a Web-based intervention for individuals with type 2 diabetes: the impact on physical activity levels and glycemic control. *Comput Inform Nurs*, *24*(6), 337-345.
- Kim, S. H., Shin, M. S., Lee, H. S., Lee, E. S., Ro, J. S., Kang, H. S., . . . Kim, C. J. (2011). Randomized Pilot Test of a Simultaneous Stage-Matched Exercise and Diet Intervention for Breast Cancer Survivors.

- Knols, R., Aaronson, N. K., Uebelhart, D., Fransen, J., & Aufdemkampe, G. (2005). Physical exercise in cancer patients during and after medical treatment: a systematic review of randomized and controlled clinical trials. *J Clin Oncol*, 23(16), 3830-3842. doi: 10.1200/jco.2005.02.148
- Koring, M., Richert, J., Parschau, L., Ernsting, A., Lippke, S., & Schwarzer, R. (2011). A combined planning and self-efficacy intervention to promote physical activity: A multiple mediation analysis. *Psychol Health Med*. doi: 10.1080/13548506.2011.608809
- Kristal, A. R., Shattuck, A. L., Bowen, D. J., Sponzo, R. W., & Nixon, D. W. (1997). 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 Epidemiol Biomarkers Prev*, 6(6), 459-467.
- Kroenke, C. H., Fung, T. T., Hu, F. B., & Holmes, M. D. (2005). Dietary patterns and survival after breast cancer diagnosis. *J Clin Oncol*, 23(36), 9295-9303. doi: 10.1200/jco.2005.02.0198
- Laforest, J. (2009). Guide to organizing semi-structured interviews with key informant. Retrieved February, 18, 2010.
- Langstein, H. N., & Norton, J. A. (1991). Mechanisms of cancer cachexia. *Hematol Oncol Clin North Am*, 5(1), 103-123.
- Lee, E. S., Lee, M. K., Kim, S. H., Ro, J. S., Kang, H. S., Kim, S. W., . . . Yun, Y. H. (2011). Health-related quality of life in survivors with breast cancer 1 year after diagnosis compared with the general

- population: a prospective cohort study. *Ann Surg*, 253(1), 101-108.
- Lichtenstein, A. H., Appel, L. J., Brands, M., Carnethon, M., Daniels, S., Franch, H. A., . . . Wylie-Rosett, J. (2006). Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*, 114(1), 82-96. doi: 10.1161/circulationaha.106.176158
- Lippke, S., Wiedemann, A. U., Ziegelmann, J. P., Reuter, T., & Schwarzer, R. (2009). Self-efficacy moderates the mediation of intentions into behavior via plans. *Am J Health Behav*, 33(5), 521-529.
- Litt, M. D., Kleppinger, A., & Judge, J. O. (2002). Initiation and maintenance of exercise behavior in older women: predictors from the social learning model. *Journal of Behavioral Medicine*, 25(1), 83-97.
- Loprinzi, C. L., Athmann, L. M., Kardinal, C. G., O'Fallon, J. R., See, J. A., Bruce, B. K., . . . Rayson, S. (1996). Randomized trial of dietician counseling to try to prevent weight gain associated with breast cancer adjuvant chemotherapy. *Oncology*, 53(3), 228-232.
- Luszczynska, A., Schwarzer, R., Lippke, S., & Mazurkiewicz, M. (2011). Self-efficacy as a moderator of the planning-behaviour relationship in interventions designed to promote physical activity. *Psychol Health*, 26(2), 151-166. doi: 10.1080/08870446.2011.531571
- McBride, C. M., Emmons, K. M., & Lipkus, I. M. (2003). Understanding the potential of teachable moments: the case of smoking cessation.

Health Educ Res, 18(2), 156-170.

- McBride, C. M., Puleo, E., Pollak, K. I., Clipp, E. C., Woolford, S., & Emmons, K. M. (2008). Understanding the role of cancer worry in creating a "teachable moment" for multiple risk factor reduction. *Soc Sci Med*, 66(3), 790-800. doi: 10.1016/j.socscimed.2007.10.014
- McMahon, K., Decker, G., & Ottery, F. D. (1998). Integrating proactive nutritional assessment in clinical practices to prevent complications and cost. *Semin Oncol*, 25(2 Suppl 6), 20-27.
- McNeely, M. L., Campbell, K. L., Rowe, B. H., Klassen, T. P., Mackey, J. R., & Courneya, K. S. (2006). Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *CMAJ*, 175(1), 34-41. doi: 10.1503/cmaj.051073
- McNeely, M. L., Parliament, M., Courneya, K. S., Seikaly, H., Jha, N., Scrimger, R., & Hanson, J. (2004). A pilot study of a randomized controlled trial to evaluate the effects of progressive resistance exercise training on shoulder dysfunction caused by spinal accessory neurapraxia/neurectomy in head and neck cancer survivors. *Head Neck*, 26(6), 518-530. doi: 10.1002/hed.20010
- Mefferd, K., Nichols, J. F., Pakiz, B., & Rock, C. L. (2007). A cognitive behavioral therapy intervention to promote weight loss improves body composition and blood lipid profiles among overweight breast cancer survivors. *Breast Cancer Res Treat*, 104(2), 145-152. doi: 10.1007/s10549-006-9410-x

- Mendoza, T. R., Wang, X. S., Cleeland, C. S., Morrissey, M., Johnson, B. A., Wendt, J. K., & Huber, S. L. (1999). The rapid assessment of fatigue severity in cancer patients. *Cancer*, *85*(5), 1186-1196.
- Meyerhardt, J. A., Heseltine, D., Niedzwiecki, D., Hollis, D., Saltz, L. B., Mayer, R. J., . . . Fuchs, C. S. (2006). Impact of physical activity on cancer recurrence and survival in patients with stage III colon cancer: findings from CALGB 89803. *J Clin Oncol*, *24*(22), 3535-3541. doi: 10.1200/jco.2006.06.0863
- Milan, J. E., & White, A. A. (2010). Impact of a stage-tailored, web-based intervention on folic acid-containing multivitamin use by college women. *Am J Health Promot*, *24*(6), 388-395. doi: 10.4278/ajhp.071231143
- Murray, E., Burns, J., See, T. S., Lai, R., & Nazareth, I. (2005). Interactive Health Communication Applications for people with chronic disease. *Cochrane Database Syst Rev*(4), CD004274. doi: 10.1002/14651858.CD004274.pub4
- Nick Bouras, & Geraldine Holt (Eds.). (2007). *Psychiatric and Behavioural Disorders in Intellectual and Developmental Disabilities*. the United States of America: Cambridge University Press.
- Nitenberg, G., & Raynard, B. (2000). Nutritional support of the cancer patient: issues and dilemmas. *Crit Rev Oncol Hematol*, *34*(3), 137-168.
- Nordevang, E., Callmer, E., Marmur, A., & Holm, L. E. (1992). Dietary

- intervention in breast cancer patients: effects on food choice. *Eur J Clin Nutr*, 46(6), 387-396.
- Oh, K. W., Nam, C. M., Park, J. H., Yoon, J. Y., Shim, J. S., Lee, K. H., & Suh, I. (2003). A Case-Control Study on Dietary Quality and Risk for Coronary Heart Disease in Korean Men. *Korean Journal of Nutrition*, 36(6), 613-621.
- Oh, S. M., Min, K. J., & Park, D. B. (1999). A study on the standardization of the hospital anxiety and depression scale for Koreans: a comparison of normal, depressed and anxious groups. *Journal of Korean Neuropsychiatric Association*, 38(2), 289-296.
- Ohira, T., Schmitz, K. H., Ahmed, R. L., & Yee, D. (2006). Effects of weight training on quality of life in recent breast cancer survivors: the Weight Training for Breast Cancer Survivors (WTBS) study. *Cancer*, 106(9), 2076-2083. doi: 10.1002/cncr.21829
- Ollenschlaeger, G., Konkol, K., Wickramanayake, P. D., Schrappe-Baecher, M., & Mueller, J. M. (1989). Nutrient intake and nitrogen metabolism in cancer patients during oncological chemotherapy. *Am J Clin Nutr*, 50(3), 454-459.
- Owen, J. E., Klapow, J. C., Roth, D. L., Shuster, J. L., Jr., Bellis, J., Meredith, R., & Tucker, D. C. (2005). Randomized pilot of a self-guided internet coping group for women with early-stage breast cancer. *Ann Behav Med*, 30(1), 54-64. doi: 10.1207/s15324796abm3001_7

- Parkin, D. M., Bray, F., Ferlay, J., & Pisani, P. (2005). Global cancer statistics, 2002. *CA Cancer J Clin*, 55(2), 74-108.
- Patterson, R. E., Haines, P. S., & Popkin, B. M. (1994). Diet quality index: capturing a multidimensional behavior. *J Am Diet Assoc*, 94(1), 57-64.
- Peterson, T. R., & Aldana, S. G. (1999). Improving exercise behavior: an application of the stages of change model in a worksite setting. *Am J Health Promot*, 13(4), 229-232, iii.
- Pierce, J. P., Faerber, S., Wright, F. A., Newman, V., Flatt, S. W., Kealey, S., . . . Greenberg, E. R. (1997). Feasibility of a randomized trial of a high-vegetable diet to prevent breast cancer recurrence. *Nutr Cancer*, 28(3), 282-288.
- Pierce, J. P., Newman, V. A., Flatt, S. W., Faerber, S., Rock, C. L., Natarajan, L., . . . Kealey, S. (2004). Telephone counseling intervention increases intakes of micronutrient- and phytochemical-rich vegetables, fruit and fiber in breast cancer survivors. *J Nutr*, 134(2), 452-458.
- Pierce, J. P., Stefanick, M. L., Flatt, S. W., Natarajan, L., Sternfeld, B., Madlensky, L., . . . Rock, C. L. (2007). Greater survival after breast cancer in physically active women with high vegetable-fruit intake regardless of obesity. *J Clin Oncol*, 25(17), 2345-2351. doi: 10.1200/jco.2006.08.6819
- Pignone, M., Harris, R., & Kinsinger, L. (2000). Videotape-based decision

- aid for colon cancer screening. A randomized, controlled trial. *Ann Intern Med*, 133(10), 761-769.
- Pinto, B. M., Frierson, G. M., Rabin, C., Trunzo, J. J., & Marcus, B. H. (2005a). Home-based physical activity intervention for breast cancer patients. *Journal of Clinical Oncology*, 23(15), 3577.
- Pinto, B. M., Frierson, G. M., Rabin, C., Trunzo, J. J., & Marcus, B. H. (2005b). Home-based physical activity intervention for breast cancer patients. *J Clin Oncol*, 23(15), 3577-3587. doi: 10.1200/jco.2005.03.080
- Poddar, K. H., Hosig, K. W., Anderson, E. S., Nickols-Richardson, S. M., & Duncan, S. E. (2010). Web-based nutrition education intervention improves self-efficacy and self-regulation related to increased dairy intake in college students. *J Am Diet Assoc*, 110(11), 1723-1727. doi: 10.1016/j.jada.2010.08.008
- Pollak, K. I., Carbonari, J. P., Diclemente, C. C., Niemann, Y. F., & Mullen, P. D. (1998). Causal relationships of processes of change and decisional balance:: Stage-specific models for smoking. *Addictive behaviors*, 23(4), 437-448.
- Prochaska, J. O. (2001). Treating entire populations for behavior risks for cancer. *Cancer J*, 7(5), 360-368.
- Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*, 51(3), 390-395.

- Prochaska, J. O., Velicer, W. F., Rossi, J. S., Goldstein, M. G., Marcus, B. H., Rakowski, W., . . . Rosenbloom, D. (1994). Stages of change and decisional balance for 12 problem behaviors. *Health psychology, 13*(1), 39.
- Reuter, T., Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2009). Long-term relations between intentions, planning, and exercise: a 3-year longitudinal study after orthopedic rehabilitation. *Rehabilitation psychology, 54*(4), 363.
- Rock, C. L., & Demark-Wahnefried, W. (2002). Nutrition and survival after the diagnosis of breast cancer: a review of the evidence. *J Clin Oncol, 20*(15), 3302-3316.
- Rose, D. P., Connolly, J. M., Chlebowski, R. T., Buzzard, I. M., & Wynder, E. L. (1993). The effects of a low-fat dietary intervention and tamoxifen adjuvant therapy on the serum estrogen and sex hormone-binding globulin concentrations of postmenopausal breast cancer patients. *Breast Cancer Res Treat, 27*(3), 253-262.
- Ruland, C. M., Jeneson, A., Andersen, T., Andersen, R., Slaughter, L., Bente Schjodt, O., & Moore, S. M. (2007). Designing tailored Internet support to assist cancer patients in illness management. *AMIA Annu Symp Proc, 635-639*.
- Savard, J., Simard, S., Blanchet, J., Ivers, H., & Morin, C. M. (2001). Prevalence, clinical characteristics, and risk factors for insomnia in the context of breast cancer. *Sleep, 24*(5), 583-590.

- Schattner, M., & Shike, M. (Eds.). (2006). *Nutrition Support of the Patient with Cancer*. Philadelphia, PA: Lippincott Williams & Wilkins.
- Schmitz, K. H., Holtzman, J., Courneya, K. S., Masse, L. C., Duval, S., & Kane, R. (2005). Controlled physical activity trials in cancer survivors: a systematic review and meta-analysis. *Cancer Epidemiol Biomarkers Prev*, *14*(7), 1588-1595. doi: 10.1158/1055-9965.epi-04-0703
- Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, *20*(2), 143-160.
- Schover, L. R., Yetman, R. J., Tuason, L. J., Meisler, E., Esselstyn, C. B., Hermann, R. E., . . . Dowden, R. V. (1995). Partial mastectomy and breast reconstruction. A comparison of their effects on psychosocial adjustment, body image, and sexuality. *Cancer*, *75*(1), 54-64.
- Segal, R., Evans, W., Johnson, D., Smith, J., Colletta, S., Gayton, J., . . . Reid, R. (2001). Structured exercise improves physical functioning in women with stages I and II breast cancer: results of a randomized controlled trial. *J Clin Oncol*, *19*(3), 657-665.
- Segal, R. J., Reid, R. D., Courneya, K. S., Malone, S. C., Parliament, M. B., Scott, C. G., . . . Wells, G. A. (2003). Resistance exercise in men receiving androgen deprivation therapy for prostate cancer. *J Clin Oncol*, *21*(9), 1653-1659. doi: 10.1200/jco.2003.09.534

- Shapiro, C. L., & Recht, A. (2001). Side effects of adjuvant treatment of breast cancer. *N Engl J Med*, 344(26), 1997-2008. doi: 10.1056/nejm200106283442607
- Simons, A. D., Garfield, S. L., & Murphy, G. E. (1984). The process of change in cognitive therapy and pharmacotherapy for depression: Changes in mood and cognition. *Archives of General Psychiatry*, 41(1), 45.
- Smith, M. R. (2003). Changes in body composition during hormonal therapy for prostate cancer. *Clin Prostate Cancer*, 2(1), 18-21.
- Spruit, M. A., Janssen, P. P., Willemsen, S. C., Hochstenbag, M. M., & Wouters, E. F. (2006). Exercise capacity before and after an 8-week multidisciplinary inpatient rehabilitation program in lung cancer patients: a pilot study. *Lung Cancer*, 52(2), 257-260. doi: 10.1016/j.lungcan.2006.01.003
- Tangney, C. C., Young, J. A., Murtaugh, M. A., Cobleigh, M. A., & Oleske, D. M. (2002). Self-reported dietary habits, overall dietary quality and symptomatology of breast cancer survivors: A cross-sectional examination. *Breast cancer research and treatment*, 71(2), 113-123.
- Taylor, C. L. C., Demoor, C., Smith, M. A., Dunn, A. L., Basen-Engquist, K., Nielsen, I., . . . Gritz, E. R. (2006). Active for Life After Cancer: a randomized trial examining a lifestyle physical activity program for prostate cancer patients. *Psycho-Oncology*, 15(10), 847-862.
- The American College of Sports Medicine. (2007). Aerobic Exercise: Live

Longer, Live Healthier

- Thomas, S., Reading, J., & Shephard, R. J. (1992). Revision of the physical activity readiness questionnaire (PAR-Q). *Canadian Journal of Sport Sciences*.
- Thorsen, L., Skovlund, E., Stromme, S. B., Hornslien, K., Dahl, A. A., & Fossa, S. D. (2005). Effectiveness of physical activity on cardiorespiratory fitness and health-related quality of life in young and middle-aged cancer patients shortly after chemotherapy. *J Clin Oncol*, 23(10), 2378-2388. doi: 10.1200/jco.2005.04.106
- Trabal, J., Leyes, P., Forga, M., & Hervas, S. (2006). Quality of life, dietary intake and nutritional status assessment in hospital admitted cancer patients. *Nutrición Hospitalaria*, 21(4), 505-510.
- Trinh, L., Plotnikoff, R. C., Rhodes, R. E., North, S., & Courneya, K. S. (2011). Associations Between Physical Activity and Quality of Life in a Population-Based Sample of Kidney Cancer Survivors. *Cancer Epidemiol Biomarkers Prev*. doi: 10.1158/1055-9965.epi-10-1319
- Vallance, J. K., Courneya, K. S., Jones, L. W., & Reiman, T. (2006). Exercise preferences among a population-based sample of non-Hodgkin's lymphoma survivors. *Eur J Cancer Care (Engl)*, 15(1), 34-43. doi: 10.1111/j.1365-2354.2005.00617.x
- Vancouver, J. B., & Kendall, L. N. (2006). When self-efficacy negatively relates to motivation and performance in a learning context. *Journal of Applied Psychology*, 91(5), 1146.

- Velicer, W. F., DiClemente, C. C., Prochaska, J. O., & Brandenburg, N. (1985). Decisional balance measure for assessing and predicting smoking status. *J Pers Soc Psychol*, *48*(5), 1279.
- Voskuil, D. W., van Nes, J. G., Junggeburst, J. M., van de Velde, C. J., van Leeuwen, F. E., & de Haes, J. C. (2010). Maintenance of physical activity and body weight in relation to subsequent quality of life in postmenopausal breast cancer patients. *Ann Oncol*, *21*(10), 2094-2101. doi: 10.1093/annonc/mdq151
- Wagner, J., Burg, M., & Sirois, B. (2004). Social support and the transtheoretical model: Relationship of social support to smoking cessation stage, decisional balance, process use, and temptation. *Addictive behaviors*, *29*(5), 1039-1043.
- Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Prescribing exercise as preventive therapy. *CMAJ*, *174*(7), 961-974. doi: 10.1503/cmaj.1040750
- Wayne, S. J., Baumgartner, K., Baumgartner, R. N., Bernstein, L., Bowen, D. J., & Ballard-Barbash, R. (2006). Diet quality is directly associated with quality of life in breast cancer survivors. *Breast cancer research and treatment*, *96*(3), 227-232.
- WHO. Global strategy on diet, physical activity and health, from <http://www.who.int/dietphysicalactivity/en/> (accessed Mar 21, 2012).
- WHO. (2002). International Agency for Research in Cancer handbook of cancer prevention *Weight control and physical activity*. Lyon: IARC.

- Wilson, D. B., Porter, J. S., Parker, G., & Kilpatrick, J. (2005). Anthropometric changes using a walking intervention in African American breast cancer survivors: a pilot study. *Prev Chronic Dis*, 2(2), A16.
- Winett, R. A., Anderson, E. S., Wojcik, J. R., Winett, S. G., & Bowden, T. (2007). Guide to health: nutrition and physical activity outcomes of a group-randomized trial of an Internet-based intervention in churches. *Ann Behav Med*, 33(3), 251-261. doi: 10.1080/08836610701358045
- Wing, R. R., Tate, D. F., Gorin, A. A., Raynor, H. A., & Fava, J. L. (2006). A self-regulation program for maintenance of weight loss. *New England Journal of Medicine*, 355(15), 1563-1571.
- Yun, Y. H., Lee, K. S., Kim, Y. W., Park, S. Y., Lee, E. S., Noh, D. Y., . . . Park, S. (2012). Web-Based Tailored Education Program for Disease-Free Cancer Survivors With Cancer-Related Fatigue: A Randomized Controlled Trial. *J Clin Oncol*. doi: 10.1200/jco.2011.37.2979
- Yun, Y. H., Lee, M. K., You, A., Shin, D., Ko, H., Park, S., . . . Chang, Y. J. (2012). Leadership and Coaching for Health (LEACH) for Disease-free Cancer Survivors: Study Protocol. *Submitted*.
- Yun, Y. H., Park, Y. S., Lee, E. S., Bang, S. M., Heo, D. S., Park, S. Y., . . . West, K. (2004a). Validation of the Korean version of the EORTC QLQ-C30. *Quality of life research*, 13(4), 863-868.
- Yun, Y. H., Park, Y. S., Lee, E. S., Bang, S. M., Heo, D. S., Park, S. Y., . . . West, K. (2004b). Validation of the Korean version of the EORTC

QLQ-C30. *Qual Life Res*, 13(4), 863-868.

Yun, Y. H., Wang, X. S., Lee, J. S., Roh, J. W., Lee, C. G., Lee, W. S., . . .

Cleeland, C. S. (2005). Validation study of the korean version of the
brief fatigue inventory. *J Pain Symptom Manage*, 29(2), 165-172.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression
scale. *Acta Psychiatr Scand*, 67(6), 361-370.

Appendices

Appendix 1. Booklet used in attention control group



Part 1

균형 잡힌 식생활

- 01 균형 잡힌 식사가 왜 중요한가요?
- 02 암환자에게 불균형적인 식사가 어떻게 문제가 될까요?
- 03 균형 잡힌 식사요법을 시작 못할 때는 어떻게 하면 할 수 있을까요?
- 04 균형 잡힌 식사는 어떻게 하나요?
- 05 건강체중 유지에 방해되는 요인들과 이를 극복하는 방법은 무엇일까요?
- 06 나에게 맞는 식사계획은 어떻게 세울까요?
- 07 식사에 대한 암환자의 궁금사항 알아보기
- 08 식사 계획 실천에 도움이 되는 조리 요령 알아보기



Part 2

규칙적인 운동

- 01 암생존자에게 규칙적인 운동이 왜 중요한가요?
- 02 운동을 시작하기가 어려울 때는 어떻게 하면 할 수 있을까요?
- 03 일상 생활에서 신체활동을 늘릴 수 있는 방법은?
- 04 운동을 하려고 할 때 무엇을 고려해야 하나요?
- 05 운동을 할 때 주의해야 할 사항은 어떤 것이 있나요?
- 06 나에게 맞는 운동계획은 어떻게 세우나요?
- 07 운동 실천을 도울 수 있는 요령 알기

건강한 습관,
행복한 삶



Appendix 2. The amount of one serving for food in each food group

| 식품군 | 섭취량 | 1인 1회 분량 |
|----------------|-----|---|
| 곡류 및 전분류 | |  밥 1공기(210g)  국수 1대접(210g)  식빵 2쪽(100g) |
| 고기, 생선, 계란, 콩류 | |  육류1접시(생60g)  닭고기 1조각(생60g)  생선1토막(생50g)  마른콩(20g)  두부2조각(80g)  달걀개(50g) |
| 채소류 | |  콩나물1접시(생70g)  시금치나물 1접시(생70g)  배추김치 1접시(생40g)  오이소박이 1접시(생60g)  버섯 1접시(생30g)  물미역 1접시(생30g) |
| 과일류 | |  사과(중)1/2개 (100g)  귤(중)1개 (100g)  참외(중)1/2개 (200g)  포도1/3개 (100g)  오렌지주스1/2컵 (100g) |
| 우유 및 유제품류 | |  우유 1컵(100g)  치즈 1장(20g)  호상요구르트 1/2컵(110g)  액상요구르트 3/4컵(150g)  아이스크림 1/2컵(100g) |
| 유지, 전과 및 당류 | |  식용유 1작은술 (5g)  버터 1작은술 (5g)  마요네즈 1작은술 (3g)  땅콩 (10g)  설탕 1큰술 (10g) |

| 식품군 | 품목 | 식품명 | 분량(g) | 비고 |
|-------------------------|------|--|-------------------------|----------------|
| 곡류 및 전분류 | 곡류 | 쌀, 보리쌀 쌀밥, 보리밥 | 90 210 | 1공기 |
| | 면류 | 삶은면- 자장면, 칼국수용 건면- 국수용 냉면국수, 메밀국수 당면 | 300 100 100 90 | 1대접 |
| | 떡류 | 흰떡-떡국용 절편 | 130 150 | |
| | 빵류 | 식빵 | 100 | 2쪽 |
| | 씨리얼류 | 콘푸레이크 | 90 | |
| | 감자류 | 감자 고구마 | 330 270 | 중 3개 중 1.5개 |
| | 묵류 | 메밀묵 | 450 | |
| | 견과류 | 밤 | 180 | 큰 것 9개 |
| 고기, 생선, 계란, 콩류 | 육류 | 쇠고기, 돼지고기, 닭고기, 햄 | 60 | |
| | 어패류 | 갈치, 삼치, 꽁치, 고등어, 동태, 가자미, 조기, 넙치, 참치, 참치통조림, 어묵 | 50 | 작은 것 한토막 |
| | | 오징어, 낙지, 새우 미꾸라지, 민물장어 생굴, 조갯살, 꽃게 | 80 | |
| | | 건멸치, 건조기, 건오징어, 명태 | 15 | |
| | 난류 | 계란, 메추리알 | 50 | 계란(중) 1개 |
| | 콩류 | 검정콩, 대두 | 20 | 두부2조각 |
| | | 두부 | 80 | |
| 두유 | | 200 | | |

| 식품군 | 품목 | 식품명 | 분량(g) | 비고 |
|--------------------------------|-----|---|------------|-------------------------------|
| 채소류 | 채소류 | 고구마줄기, 고사리, 풋고추, 근대, 취나물, 아욱, 시금치, 쑥갓, 부추, 들미나리, 무청, 상추, 애호박, 오이, 콩나물, 숙주, 무, 배추, 양배추, 양파 | 70 | 1접시 |
| | | 가지, 당근, 늙은 호박, 토마토 | 60 | |
| | | 나박김치, 오이소박이, 갓김치, 깍두기, 배추김치, 열무김치 | 40 | |
| | | 우엉, 도라지, 파, 파김치 | 25 | |
| | | 마늘 | 10 | |
| | | 토마토주스 | 100 | |
| | 해조류 | 다시마, 미역, 파래(생것) | 30 | 1장 |
| | | 김 | 2 | |
| | 버섯류 | 느타리, 양송이, 팽이, 표고(생것) | 30 | |
| | 과일류 | 과일류 | 딸기, 수박, 참외 | 200 |
| 감, 귤, 바나나, 배, 사과, 복숭아, 오렌지, 포도 | | | 100 | 귤(중)1개, 사과(중) 1/2개, 포도(중) 15알 |
| 주스류 | | 오렌지 주스 | 100 | 1/2컵 |

| 식품군 | 품목 | 식품명 | 분량(g) | 비고 |
|--------------------|-----|--|-------|------|
| 우유 및 유제품 | 우유 | 우유 | 200 | 1컵 |
| | 유제품 | 치즈 | 20 | 1장 |
| | | 떠먹는 요구르트(호상) | 110 | 1/2컵 |
| | | 마시는 야쿠르트(액상) | 150 | 3/4컵 |
| | | 아이스크림 | 100 | 1/2컵 |
| 유지, 견과류 및 당류 | 유지류 | 버터, 마요네즈, 옥수수기름, 참기름, 콩기름, 들기름, 커피프림 | 5 | 1작은술 |
| | | 깨, 깨소금 | 8 | |
| | 견과류 | 땅콩 | 10 | |
| | 당류 | 꿀, 설탕, 당밀/시럽(올리고당), 사탕 | 10 | |

Appendix 3. Consent form

연구과정 설명문

연구제목: 규칙적인 운동과 균형잡힌 식생활 실천을 위한 프로그램의 효과

이 연구는 [암 진단부터 암 생존자관리까지 암환자와 가족의 건강증진 및 삶의 질 향상을 위한 토털케어 프로그램 개발]의 일환으로 이루어지는 연구입니다. 지속적인 건강관리가 필요하고 매우 중요하다는 것은 알면서도 개인적으로 실천하기를 어려워하거나 소홀히 하는 분들이 많습니다. 또한, 시작은 했지만, 계속 유지하기란 쉽지 않습니다. 건강플래닝은 이러한 분들이 주도적이면서도 체계적으로 건강관리를 할 수 있도록 마련된 웹 기반 건강증진 및 삶의 질 향상 프로그램입니다.

이 프로그램은 궁극적으로 암환자들의 삶의 질 향상을 목표로 하며, 일차적인 목적은 암 환자들이 균형잡힌 식생활과 규칙적인 운동의 실천하고 유지할 수 있도록 하는 것입니다. 따라서 이 연구의 목적은 이 프로그램이 그런 효과를 잘 나타내는지 검증하는 것입니다. 귀하는 프로그램을 이용함으로써 암환자에게 필수적인 건강관리 주제인 운동과 식이에 대한 정보를 제공받게 됩니다. 또한, 암환자가 규칙적인 운동과 균형잡힌 식생활에 필요한 건강행위 실천목록을 관리함으로써 자신의 건강을 주도적으로 관리할 수 있습니다.

귀하는 본 연구의 취지를 이해하고 규칙적인 운동과 균형잡힌 식이의 이행을 위한 프로그램에 참여하기를 자발적으로 희망하였습니다. 이 연구를 수

행하는 국립암센터 연구원(이명경, ☎031-920-2194, 2033)이 귀하에게 이 연구에 대해 설명해 줄 것입니다. 이 연구는 자발적으로 참여 의사를 밝히신 분에 한하여 수행 될 것이며, 귀하께서는 참여 의사를 결정하기 전에 본 연구가 왜 수행되는지 그리고 연구의 내용이 무엇과 관련 있는지 이해하는 것이 중요합니다. 다음 내용을 신중히 읽어보신 후 참여 의사를 밝혀 주시길 바랍니다.

1. 이 연구는 왜 실시합니까?

이 연구의 목적은 암환자의 건강증진 및 삶의 질 향상을 위해 규칙적인 운동과 균형잡힌 식생활을 실천하고 지속할 수 있도록 개발된 웹 기반 프로그램과 소책자 형태의 교육자료의 효과를 비교하기 위함입니다.

2. 얼마나 많은 사람들이 참여합니까?

암 진단을 받고 일차적인 치료를 끝마치고 분들 중에서 암 진단을 받은지 2년 이내인 분들 중 운동과 식이에 대한 건강행위 실천이 제대로 되고 있지 않은 분들이나 건강체중을 유지하고 있지 못하는 분들 중 본 연구의 의도를 이해하고 참여하기로 동의한 60명 내외가 참여합니다.

3. 만일 연구에 참여하면 어떤 과정이 진행됩니까?

연구참여는 자발적인 동의에 의해 이루어집니다. 연구참여자로 최종 선정되면 균형잡힌 식생활과 규칙적인 운동을 실천하도록 돕는 웹 건강플래너라고 하는 웹 기반의 프로그램을 사용하는 군과 소책자를 사용하는 군으로 배정받게 됩니다. 두 군중 어느 한 군에 배정될 확률은 50%입니다. 웹 기반 프로그램을 사용하는 군으로 배정받은 경우에는 웹 프로그램 사용과 관련하여 간단한 교육을 제공받게 됩니다. 그리고 이후 총 3개월 동안 웹 기반

프로그램이나 소책자를 이용하게 됩니다. 한 달에 한번씩 총 4번 평가설문 조사에 응답하게 됩니다.

본 프로그램은 연구 목적으로 실시되므로 설문조사 결과는 오직 연구목적 으로만 활용됩니다.

4. 어떤 사람이 본 프로그램에 우선 참여할 수 있습니까?

본 프로그램은 국립암센터 기관고유사업으로 이루어지므로 임상시험을 일 차 목표로 합니다. 때문에 이 프로그램의 효과검증을 위해서는 이 프로그램 이 목표로 하는 규칙적인 운동과 균형잡힌 식생활의 실천이 잘 이루어지지 않거나, 건강체중에 미치지 못하거나 초과하는 분을 우선 대상으로 참여토 록 하고자 합니다.

5. 본 연구에 사용된 웹 기반 프로그램, 소책자 등을 개별적으로 사용할 수 있습니까?

교육 과정을 사용된 웹 기반 프로그램, 소책자 등은 모두 국립암센터에 지 식소유권이 있으며 현재 연구 목적으로 개발되었기 때문에 연구목적 이외 의 개별적으로 사용하는 것은 허용되지 않습니다.

6. 연구참여자의 정보에 대한 비밀보장이 됩니까?

본 연구의 일부로 여러분의 개인기록, 의료기록, 검사결과, 건강정보 등이 수집되게 됩니다. 이러한 정보는 본 연구를 담당하는 책임연구원, 연구담당 직원이 이러한 정보를 사용하며 연구를 수행하기 위하여 본 연구를 감독하 는 정부기관 병원 내 임상시험 심사위원회도 여러분의 정보를 볼 수 있습니 다. 동의서에 여러분이 동의를 한다는 것이 이러한 정보의 사용을 허락한다 는 뜻입니다. 하지만 여러분의 신원을 파악할 수 있는 기록은 비밀로 보장

될 것이며 건강 정보는 여러분의 성명을 가린 채로 제공되기 때문에 자료상으로 여러분이 어디에 사는 누구인지, 어떤 사람인지 알 수 없습니다. 또한 연구의 결과가 출판될 경우에도 여러분의 신상정보는 비밀상태로 유지될 것입니다.

여러분은 언제라도 연구 담당자에게 통보하여 동의를 취소할 수 있습니다. 여러분이 동의하신 것을 철회하면 연구 담당자는 여러분의 의학 정보를 더 이상 사용할 수 없습니다. 하지만 동의 철회와 더불어 연구참여 자격을 상실하며 더 이상 본 연구에서 제공하는 서비스를 받으실 수 없습니다.

본인은 규칙적인 운동과 균형잡힌 식생활 실천을 위한 프로그램의 효과를 검증하는 연구에 참여할 것을 약속합니다.

동의서

연구제목 : 규칙적인 운동과 균형잡힌 식생활 실천을 위한 프로그램의 효과

아래 내용을 읽으시고 내용을 완전히 이해하시면 네모 칸에 표시하여 주십시오.

- 본인은 이 동의서를 읽었고, 내용을 충분히 이해합니다.
- 본인은 연구진으로부터 자세하게 설명을 듣고 궁금한 사항이 있으면 질문하였고 적절한 답변을 들었습니다.
- 본인은 자발적으로 이 연구에 참여합니다.
- 본인은 임상시험 기간 중 언제라도 중도에 임상시험 참여를 거부하거나 중단할 수 있습니다. 또 본인은 이 연구 참여를 중단하더라도 본인에게 어떠한 불이익도 없다는 것을 알고 있습니다.
- 본인은 자유로운 의사에 따라 임상시험 참여를 요청하여 동의서 사본 1부를 수령합니다.

본 교육과정은 국립암센터 임상시험심사위원회 (031-920-0425/0428)의 승인을 받아 이루어집니다.

| | |
|-------------------|----|
| 지원자 성명_서명 | 날짜 |
| 임상시험책임자 또는 대리인_서명 | 날짜 |
| 동의서를 설명한 자_서명 | 날짜 |
| 법적 대리인_서명 | 날짜 |
| 입회인 서명 | 날짜 |

Appendix 4. Follow-up questionnaire

1. 건강 관련 삶의 질 (The EORTC QLQ-C30)

이 설문은 귀하의 건강상태에 대한 질문입니다. 모든 질문에 대한 응답은 귀하 스스로 해주시고, 각 문항에 대하여 귀하와 가장 가깝다고 생각되는 부분에 체크해 주시기 바랍니다.

| * 지난 한 주를 기준으로 답변하여 주십시오. | 전혀 아니다 | 약간 그렇다 | 꽤 그렇다 | 매우 그렇다 |
|---|-----------|-----------|----------|-----------|
| 1. 무거운 쇼핑백이나 가방을 옮길 때처럼 힘을 쓰는 일을 할 때 곤란을 느끼십니까? | 1 | 2 | 3 | 4 |
| 2. 오래 걷는 것이 힘이 드십니까? | 1 | 2 | 3 | 4 |
| 3. 집 밖에서 잠깐 걷는 것이 힘이 드십니까? | 1 | 2 | 3 | 4 |
| 4. 낮 시간 중에 자리(침대)에 눕거나 의자에 기대고 싶습니까? | 1 | 2 | 3 | 4 |
| 5. 식사 도중 혹은 옷을 입는 동안, 세면을 할 때나 화장실을 이용할 때 누군가의 도움이 필요합니까? | 1 | 2 | 3 | 4 |
| 6. 일을 하거나 기타 일상생활을 영위하는데 한계를 느낀 적이 있습니까? | 1 | 2 | 3 | 4 |
| 7. 취미생활이나 여가활동을 하는데 있어 한계를 느낀 적이 있습니까? | 1 | 2 | 3 | 4 |
| 8. 숨이 가쁜 적이 있습니까? | 1 | 2 | 3 | 4 |
| 9. 통증을 느껴 본 적이 있습니까? | 1 | 2 | 3 | 4 |
| 10. 휴식이 필요하다고 생각한 적이 있습니까? | 1 | 2 | 3 | 4 |

| * 지난 한 주를 기준으로 답변하여 주십시오. | | 전혀 아니다 | 약간 그렇다 | 꽤 그렇다 | 매우 그렇다 |
|---------------------------|---|-----------|-----------|----------|-----------|
| 11. | 숙면을 취하는데 곤란을 느낀 적이 있습니까? | 1 | 2 | 3 | 4 |
| 12. | 몸이 허하다고 느낀 적이 있습니까? | 1 | 2 | 3 | 4 |
| 13. | 식욕이 감퇴하셨습니까? | 1 | 2 | 3 | 4 |
| 14. | 속이 메스꺼운 적이 있습니까? | 1 | 2 | 3 | 4 |
| 15. | 구토를 하신 적이 있습니까? | 1 | 2 | 3 | 4 |
| 16. | 변비 증세를 경험한 적이 있습니까? | 1 | 2 | 3 | 4 |
| 17. | 설사를 한 적이 있습니까? | 1 | 2 | 3 | 4 |
| 18. | 피로를 느끼셨습니까? | 1 | 2 | 3 | 4 |
| 19. | 통증으로 인해 일상생활을 영위하는데 지장을 받은 경험이 있습니까? | 1 | 2 | 3 | 4 |
| 20. | 신문을 읽거나 텔레비전을 시청할 때 집중하는 데 곤란을 겪은 경험이 있습니까? | 1 | 2 | 3 | 4 |
| 21. | 긴장감을 느끼셨습니까? | 1 | 2 | 3 | 4 |
| 22. | 걱정에 시달리셨습니까? | 1 | 2 | 3 | 4 |
| 23. | 짜증을 느끼셨습니까? | 1 | 2 | 3 | 4 |
| 24. | 우울함을 느끼셨습니까? | 1 | 2 | 3 | 4 |
| 25. | 기억력 감퇴를 느끼셨습니까? | 1 | 2 | 3 | 4 |
| 26. | 귀하의 건강상태나 의약치료가 귀하의 가정생활에 어떤 곤란을 야기 했습니까? | 1 | 2 | 3 | 4 |
| 27. | 귀하의 건강상태나 의약치료가 귀하의 사회생활에 어떤 곤란을 야기 했습니까? | 1 | 2 | 3 | 4 |
| 28. | 귀하의 건강상태나 의약치료로 인하여 경제적인 어려움을 겪으셨습니까? | 1 | 2 | 3 | 4 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|--------------------|--|
| 3. 지난 24시간동안 당신이 가장 피곤함을 느꼈을 때, 그 정도를 가장 잘 나타내는 숫자에 동그라미를 하십시오. | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 피로가 없음 | | | | | | | | | | 상상할 수 없을 정도의 심한 피로 | |
| 4. 지난 24시간 동안 피로가 당신에게 얼마나 지장을 주었는지 가장 잘 나타내는 숫자에 동그라미를 하십시오. | | | | | | | | | | | |
| 가. 일반적인 활동 | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |
| 나. 기분 | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |
| 다. 일(집안 일을 포함한) | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |
| 라. 대인관계 | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |
| 마. 보행능력 | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |
| 바. 인생을 즐김 | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 지장을 주지 않음 | | | | | | | | | | 완전히 지장을 줌 | |

3. 불안과 우울 (The Hospital Anxiety and Depression Scale)

다음의 귀하의 감정 상태를 보다 잘 이해하기 위한 질문입니다. 아래의 항목을 하나하나 읽어 보시고 지난 일주일 동안 자신이 경험했던 감정과 가장 가까운 답에 체크해 주십시오.

1. 신경이 곤두서거나 '긴장감'이 든다.

- 대부분 그렇다.
- 자주 그렇다.
- 가끔, 종종 그렇다.
- 전혀 그렇지 않다.

2. 늘 즐기던 일들이 여전히 즐겁다.

- 확실히 그렇다.
- 예전만큼은 아니다.
- 조금 그렇다.
- 전혀 그렇지 않다.

3. 뭔가 끔찍한 일이 일어날 것처럼 공포감이 든다.

- 확실히 심하게 든다.
- 공포감이 들지만 그렇게 심하지는 않다.
- 조금 느껴지지만 걱정할 정도는 아니다.
- 전혀 그렇지 못하다.

4. 웃을 수도 있고 어떤 일의 재미있는 면을 볼 수 있다.

- 예전처럼 그렇다.
- 예전만큼 그렇지 못하다.
- 결코 예전 같지 않다.
- 전혀 그렇지 못하다.

5. 걱정스러운 마음이 가득하다.

- 상당히 많은 시간 동안 그러하다.
- 많은 시간 동안 그러하다.
- 자주 그렇지 않다.
- 거의 그런 적이 없다.

6. 명랑한 기분이 든다.

- 전혀 그렇지 않다.
- 자주 그렇지 않다.
- 가끔 그렇다.
- 항상 그렇다.

7. 편히 앉아 긴장을 풀 수 있다.

- 확실히 가능하다.
- 대부분 그렇다.
- 자주 그렇지는 못하다.
- 전혀 불가능하다.

8. 활기가 없는 것처럼 느껴진다.

- 거의 항상 그렇다.
- 상당히 자주 그렇다.
- 가끔 그렇다.
- 전혀 그렇지 않다.

9. 떨리고 두려운 느낌이 든다.

- 전혀 그렇지 않다.
- 가끔 그렇다.
- 자주 그렇다.
- 상당히 자주 그렇다.

10. 나의 외모에 대해 관심이 없어졌다.

- 확실히 그렇다.
- 해야 할만큼 하지 않고 있다.
- 별로 많이 관심을 갖지 않는다.
- 예전만큼 관심을 갖고 있다.

11. 무언가 꼭 하고 있어야 할 정도로 불안해서 가만히 있을 수가 없다.

- 정말 확실히 그렇다.
- 그럴 때가 많다.
- 그렇게 심하지 않다.
- 전혀 그렇지 않다.

12. 어떤 일의 즐거움을 고대한다.

- 예전만큼 고대한다.
- 이전만큼 그렇지는 않다.
- 확실히 이전과는 다르다.
- 전혀 그렇지 못하다.

13. 갑작스럽게 극심한 당황감을 느낀다.

- 상당히 자주 그렇다.
- 자주 그렇다.
- 자주 그렇지는 않다.
- 전혀 그렇지 않다.

14. 좋은 책이나, 라디오, TV 프로그램을 즐길 수 있다.

- 자주 그렇다.
- 가끔 그렇다.
- 자주 그렇지는 못하다.
- 거의 그렇지 못하다.

4. 3일간의 식사정보 기록 (3-Day Dietary Recall)

다음은 귀하가 3일 동안 드신 음식의 종류와 양을 조사하는 설문입니다. 식사일기 작성요령을 잘 읽고, 오늘부터 3일 동안의 식사를 기록해 주세요.

식사일기 작성요령

■ 식이 일기를 쓰는 요령은 다음과 같습니다.

식사일기는 평소 귀하의 영양섭취 상태를 정확히 알아보기 위함입니다.

3일간의 식사일기를 성의껏 기록하여 주십시오.

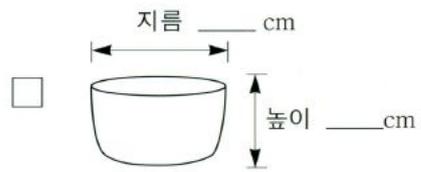
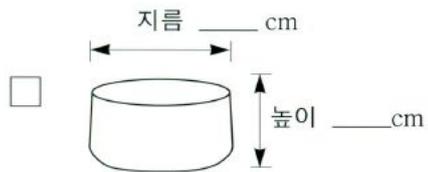
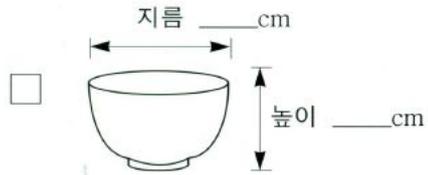
1. 평소 식사 시 사용하시는 밥그릇(공기)과 국그릇(대접)의 모양을 선택하신 후 지름(cm)과 높이(cm)를 자로 측정하여 기록하여 주십시오.

식사일기는 총 3일을 기록합니다. 3일 중 2일은 주중(월~금)에 나머지는 1일은 주말에 기록합니다. 특별한 날(금식, 명절 등)은 포함되지 않도록 합니다.

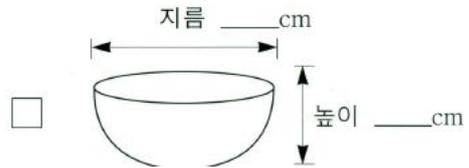
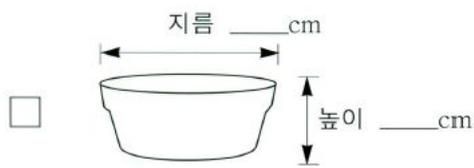
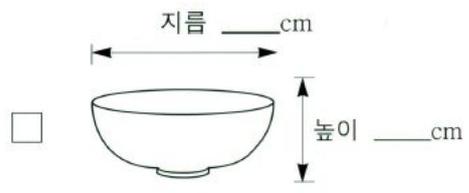
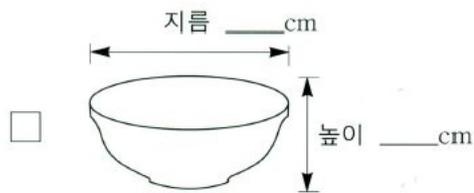
2. 하루 동안 드신 모든 음식(식사와 간식, 음료수)을 빠짐없이 기록합니다. 끼니, 시간, 장소, 음식 명, 조리방법, 재료, 분량을 최대한 정확하고 자세하게 기록하여 주십시오. 정확한 섭취량 계산을 위해 조리 시 사용된 기름 종류나 양념도 기록하여 주시는 것이 좋습니다.
3. 빠짐없이 기록하기 위해서는 음식을 드신 후에 바로 기록하시는 것이 좋습니다.

4. 측정기구(저울, 계량 컵, 계량스푼)가 있다면 사용해 주십시오.
만일 없다면 일반적인 컵, 종이컵, 스푼, 젓가락, 공기, 접시 등으로 표현하여 분량을 알 수 있도록 해 주십시오.
5. 가공식품의 경우 상품명과 회사명, 드신 양을 정확히 기록하여 주십시오.
(예: 농심 육개장 큰 사발 1개, 코카콜라 1캔(250ml), 롯데리아 불고기 버거 1개 등)
6. 외식을 하는 경우 장소 및 상호명을 정확히 기록하여 주십시오.
7. 영양 보충제를 섭취하였다면 기록하여 주십시오.
* 평소 식사시 사용하는 밥그릇(공기)과 국그릇(대접)의 모양을 선택해 주십시오.
그리고 그릇의 지름과 높이를 자로 측정하여 기록해 주십시오.

밥그릇 (공기)



국그릇 (대접)



예 1)

날짜: 2011년 1월 8일 토요일

오늘 영양제를 드셨습니까?

■예(이름: 오스칼, 복용량: 1알) □아니오

| 끼니 | 시간 | 장 소 | 음식명 | 재료명 | 분 량 |
|----|-----|-------|-------|---------------------|----------------------------|
| 식전 | 6시 | 집 | 우유 | 우유(서울우유) | 200ml |
| 아침 | 7시 | 집 | 밥 | 흰쌀밥 | 1공기(210g) |
| | | | 미역국 | 미역, 참기름 | 1그릇 |
| | | | 시금치나물 | 시금치, 파, 마늘, 참기름, 소금 | 종이컵 1컵 (또는 5젓가락) |
| | | | 김계란말이 | 계란, 김, 콩기름 | 1개 1/2장 |
| | | | 김치 | 배추김치 | 1/2접시 |
| 간식 | 10시 | 직장 | 오렌지주스 | 콜드 오렌지주스 | 1팩(240ml) |
| 점심 | 1시 | 구내 식당 | 콩밥 | 흰쌀, 콩 | 밥 1공기, 콩 10알 |
| | | | 아욱국 | 아욱, 된장 | 1그릇 |
| | | | 고등어조림 | 고등어, 무, 고춧가루, 파, 마늘 | 손바닥 크기로 1토막 |
| | | | 오이생채 | 오이, 양파, 고추장 | 1접시(종이컵으로 2/3접시) |
| | | | 김치 | 배추김치 | 1접시 |
| 간식 | 3시 | 직장 | 커피 | 커피 설탕 프림 | 2작은 스푼 2작은 스푼 2작은 스푼 |
| 저녁 | 7시 | 명가원 | 설탕탕 | 설탕탕 | 2/3그릇 |
| | | | 밥 | 흰쌀 | 밥1공기 |
| | | | 깍두기 | 깍두기 | 10개 |
| 간식 | 9시 | 집 | 참외 | | 중간크기 1개 |

1일: 날짜 : 2012년 월 ___ 일 ___ 요일

오늘 영양제를 드셨습니까?

예(이름: 복용량:) 아니오

| 끼니 | 시간 | 장 소 | 음식명 | 재료명 | 분 량 |
|----|----|-----|-----|-----|-----|
| 식전 | | | | | |
| 아침 | | | | | |
| 간식 | | | | | |
| 점심 | | | | | |
| 간식 | | | | | |
| 저녁 | | | | | |
| 간식 | | | | | |

2일: 날짜 : 2012년 월__일__요일

오늘 영양제를 드셨습니까?

예(이름: 복용량:) 아니오

| 끼니 | 시간 | 장 소 | 음식명 | 재료명 | 분 량 |
|----|----|-----|-----|-----|-----|
| 식전 | | | | | |
| 아침 | | | | | |
| 간식 | | | | | |
| 점심 | | | | | |
| 간식 | | | | | |
| 저녁 | | | | | |
| 간식 | | | | | |

3일: 날짜 : 2012년 월__일__요일

오늘 영양제를 드셨습니까?

예(이름: 복용량:) 아니오

| 끼니 | 시간 | 장 소 | 음식명 | 재료명 | 분 량 |
|----|----|-----|-----|-----|-----|
| 식전 | | | | | |
| 아침 | | | | | |
| 간식 | | | | | |
| 점심 | | | | | |
| 간식 | | | | | |
| 저녁 | | | | | |
| 간식 | | | | | |

5. 식사의 질 (Diet Quality Index)

| 3-Day dietary recall | Energy: kcal | |
|------------------------------|---|--|
| DQI | Energy from fat: % | |
| | Energy from saturated fat: % | |
| | Cholesterol: mg/day | |
| | Energy from carbohydrate: % | |
| | Intake of F/V. servings/day | |
| | Protein: (%RDA): | |
| | Calcium: (%RDA): | |
| | Sodium: mg/day | |
| | Total score: | |
| | <input type="checkbox"/> total score: <input type="checkbox"/> Fair(8-10) <input type="checkbox"/> Good(6-7) <input type="checkbox"/> Excellent(0-5) | |
| | cut off point | score |
| Energy from fat: % | ≥ne | <input type="checkbox"/> n |
| | 20< ~ <25 | <input type="checkbox"/> 0 |
| | ≤0< | <input type="checkbox"/> 0 |
| Energy from saturated fat: % | >8 | <input type="checkbox"/> 8 |
| | 6< ~ ≤8 | <input type="checkbox"/> < |
| | ≤< | <input type="checkbox"/> < |
| Cholesterol(mg/day): | >400 | <input type="checkbox"/> 4 |
| | 300< ~ ≤400 | <input type="checkbox"/> 0 |
| | ≤00< | <input type="checkbox"/> 0 |
| Energy from carbohydrate: % | >70 | <input type="checkbox"/> 7 |
| | 65< ~ ≤70 | <input type="checkbox"/> 5 |
| | ≤5< | <input type="checkbox"/> 5 |
| Intake of F/V. serv/d | <4 | <input type="checkbox"/> 4 |
| | 44 ~< 7 | <input type="checkbox"/> 4 |
| | ≥4 | <input type="checkbox"/> 4 |
| Protein: (%RDA): | <75, >150 | <input type="checkbox"/> 7 |
| | 125< ~ ≤150 | <input type="checkbox"/> 2 |
| | 755 ~ ≤125 | <input type="checkbox"/> 5 |
| Calcium: (%RDA): | <75, >150 | <input type="checkbox"/> 7 |
| | 125< ~ ≤150 | <input type="checkbox"/> 2 |
| | 755 ~ ≤125 | <input type="checkbox"/> 5 |
| Sodium(mg/day): | >10000 | <input type="checkbox"/> 1 |
| | 3500< ~ ≤10000 | <input type="checkbox"/> 5 |
| | ≤500< | <input type="checkbox"/> 5 |
| total score | total —— | <input type="checkbox"/> total —— <input type="checkbox"/> total —— <input type="checkbox"/> total —— <input type="checkbox"/> total —— |

6. 운동 측정 (min/week, metabolic equivalents)

귀하가 요즘 하시는 운동의 종류, 운동강도, 1회 운동시간, 주당 횟수, 운동 기간을 적으세요.

| 유산소운동 | 운동강도 | 1회 운동시간 | 주 몇 회 하시나요? | 이 운동을 얼마나 오랜 기간 동안 하셨나요? |
|--|--|---------|-------------|--------------------------|
| <input type="checkbox"/> 걷기 | <input type="checkbox"/> 천천히 <input type="checkbox"/> 보통 <input type="checkbox"/> 빠르게 | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 달리기 | <input type="checkbox"/> 가볍게 <input type="checkbox"/> 보통 <input type="checkbox"/> 빠르게 | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 라켓볼 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 배드민턴 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 스쿼시 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 테니스 | <input type="checkbox"/> 단식 <input type="checkbox"/> 복식 | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 등산 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 스테퍼 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 자전거 | <input type="checkbox"/> 천천히 <input type="checkbox"/> 보통 <input type="checkbox"/> 빠르게 <input type="checkbox"/> 고정식 자전거 (보통) | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 수영 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 에어로빅 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 계단운동 | <input type="checkbox"/> 오르기 <input type="checkbox"/> 내리기 | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 인라인스케이트 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 볼링 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 탁구 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 줄넘기 | <input type="checkbox"/> 천천히 <input type="checkbox"/> 보통 | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 스키/스노우보드 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 골프 | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 기타: | | ()분 | ()회 | ()개월, ()일 |
| <input type="checkbox"/> 특별히 하는 운동이 없음 | | | | |

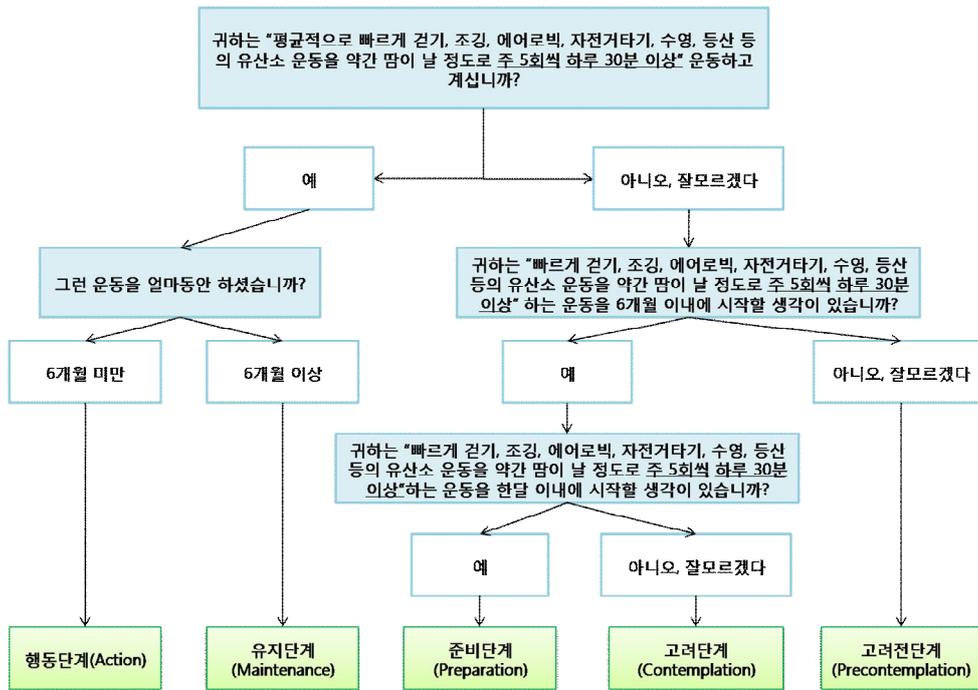
7. 자기효능감 (Domain specific perceived self-efficacy)

다음은 귀하가 건강행위를 실천하는데 어느 정도 자신감을 가지고 있는지를 평가하기 위한 질문입니다. 가장 가까운 답에 체크해 주십시오.

| | 매우 확신함 | 확신함 | 약간 확신함 | 확신하지 못함 | 매우 확신하지 못함 |
|---|-----------|-----|-----------|------------|------------------|
| 귀하는 하루에 중등도 이상의 유산소 운동 을 적어도 30분 이상 주 5회 이상 규칙적으로 할 수 있다고 확신하십니까? | 1 | 2 | 3 | 4 | 5 |
| 여기서 “중등도의 유산소 운동”이란, 집안일이나 직장생활에서 수행하는 일상적인 신체활동이 아니라, 빠르게 걷기, 조깅, 에어로빅, 자전거타기, 수영, 등산 등의 유산소 운동을 약간 땀이 날 정도로 하는 것을 말합니다. | | | | | |
| | 매우 확신함 | 확신함 | 약간 확신함 | 확신하지 못함 | 매우 확신하지 못함 |
| 귀하는 다양한 종류의 채소와 과일 을 하루에 6단위 이상 섭취할 수 있다고 확신하십니까? | 1 | 2 | 3 | 4 | 5 |
| 여기서 채소와 과일 1단위 는 이중 어느 하나와 같은 양입니다: 삶거나 데친야채(예, 콩나물무침, 시금치나물): 1/2컵 생야채(예, 쌈야채, 양상추, 오이, 당근): 1컵 과일통조림(예, 복숭아통조림): 1/2컵 건조과일(예, 건포도, 건조바나나): 1/4컵 100% 과일주스: 3/4컵 | | | | | |
| | 매우 확신함 | 확신함 | 약간 확신함 | 확신하지 못함 | 매우 확신하지 못함 |
| 귀하는 건강체중을 유지할 수 있다고 확신 하십니까? | 1 | 2 | 3 | 4 | 5 |
| 여기서 건강체중이란 체중(kg)을 키의 제곱(단위:m ²)으로 나눈 값인 체질량 지수를 18.5이상 23미만으로 유지하는 것 을 말합니다. 귀하는 키 165cm, 몸무게 60kg으로, 체질량 지수가 $60 \div (1.65 \times 1.65) = 22.0$ 이 되어 “18.5 이상 23미만”에 포함되므로 “건강체중”입니다. | | | | | |

8. 변화단계 (Stage of Change; Motivational Readiness) 측정

1) 운동 변화단계



2) 식이변화단계

채소와 과일 1단위는 이중 어느 하나와 같은 양입니다:

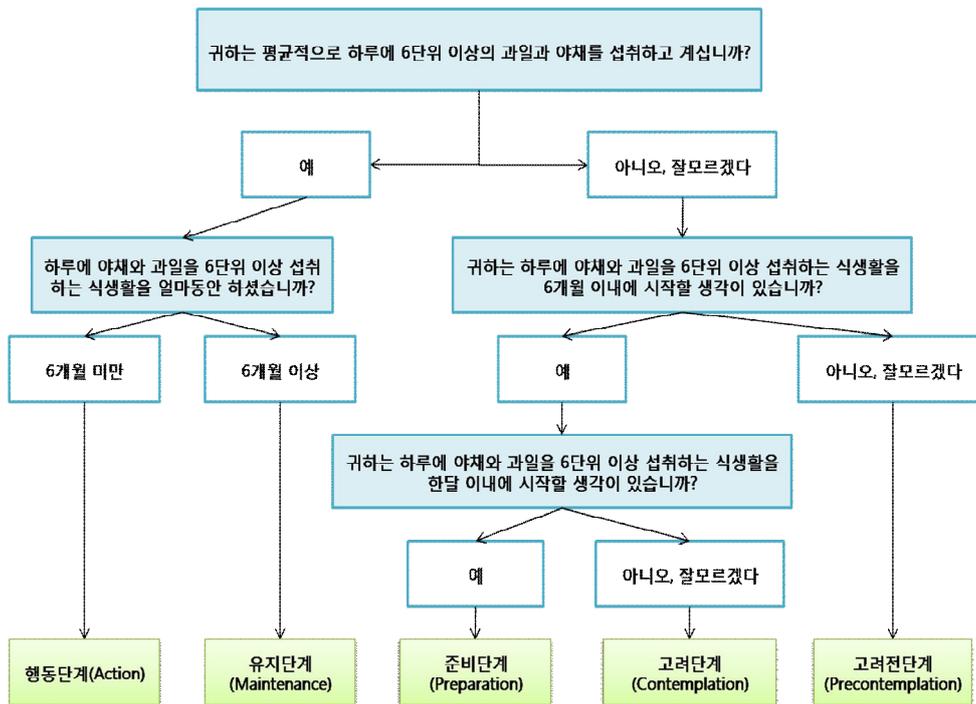
삶거나 데친 야채 (예, 콩나물무침, 시금치나물): 1/2컵

생야채 (예, 쌈야채, 양상추, 오이, 당근): 1컵

과일통조림 (예, 복숭아통조림): 1/2컵

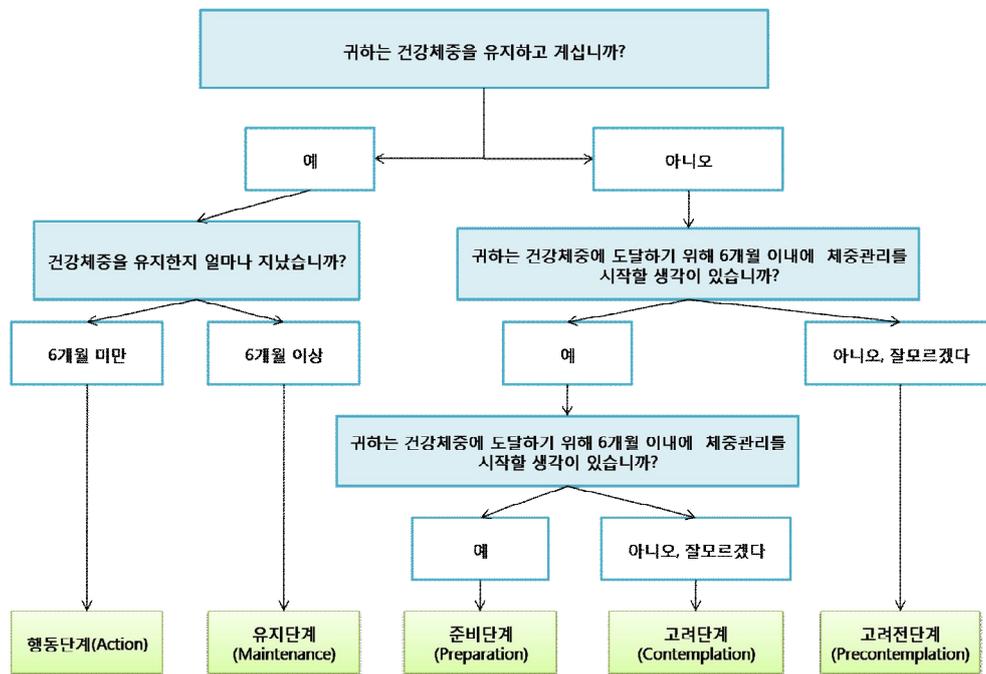
건조과일 (예, 건포도, 건조바나나): 1/4컵

100% 과일주스: 3/4컵]



3) 건강체중 변화 단계

건강체중이란 체중(kg)을 키의 제곱(단위:m²)으로 나눈 값인 체질량 지수를 18.5이상 23미만으로 유지하는 것을 말합니다.
 귀하는 키 165cm, 몸무게 60kg으로, 체질량 지수가 $60 \div (1.65 \times 1.65) = 22.0$ 이 되어 “18.5 이상 23미만”에 포함되므로 “건강체중”입니다.



국문초록

본 연구의 목표는 웹 기반 운동과 식이 자가관리 프로그램을 개발하고 이 프로그램이 유방암 환자의 운동과 식이 행위를 향상시키는데 효과가 있는지를 검증하는 것이었다. 일차 치료를 끝낸지 12개월 이내의 0-III기의 59명의 유방암 환자를 4개의 종합병원으로부터 모집하였다. 59명의 참여자는 범이론모형 기반의 교육과 행위계획, 그리고 실천한 건강행위에 대한 자동 피드백을 제공하는 것을 특징으로 하는 12주의 웹 기반 운동과 식이 자가관리프로그램을 이용하는 실험군 혹은 운동과 식이 행위 증진을 위한 내용으로 구성된 소책자를 이용하는 대조군에 무작위로 배정되었다. 웹 기반 조사 방법을 통해 변화단계, 지각된 자기효능감, 목표 수준으로 이행하는 건강행위의 수 (운동, 식이, 건강체중), 식이 섭취, 중등도 강도의 운동의 양, 체질량지수, 건강관련 삶의 질, 불안과 우울을 중재 시작 전, 중재 시작 후 4주, 8주, 그리고 12주에 측정하였다. 실험군 29명 (96.7%)과 대조군 28명 (96.6%)이 12주간의 중재 과정을 완료하였다. 중재 전 동질성 검증에서 두 그룹은 인구사회학적 특성과 임상적 특성에서 유의한 차이를 보이지 않았다. 웹 기반 운동과 식이 자가관리 프로그램을 이용한 실험군은 대조군에 비해 목표수준으로 실천하는 건강행위의 수 ($p=.002$), 매주 실천하는 중등도 이상 운동의 양 ($p<.0001$), 하루에 섭취하는 야채와 과일의 양 ($p=.025$), 그리고 전반적인 식사의 질 ($p=.001$)이 유의하게 향상되었다. 웹 기반 운동과 식이 자가관리 프로그램을 이용한 실험군은 대조군에 비해 삶의 질 영역 중 신체적 기능과 ($p=.016$) 식욕부진에서 ($p=.024$) 유의한 향상을 보였으며, 피로가 ($p=.002$) 감소하였다. 결론적으로, 운동과 식이 행위 변화를 위해 범이론모형의 전략인 맞춤형 동기부여와 행위계획을 적용한 웹 기반 프로그램은 유방암 환자에서 운동과 식이 건강행위 실천에 효과적이었다.

주요어 : 웹, 행위계획, 운동, 식이, 자가관리프로그램, 무작위배정임상시험
학 번 : 2009-30119