Associations between Health Behaviors and Health-Related Quality of Life among Breast Cancer Survivors

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Purpose: To examine the levels of physical activity (PA) and diet quality, socio-demographic and clinical correlates, and identify associations with health-related quality of life (HRQOL) among breast cancer survivors. **Methods:** The study used a cross-sectional study design. A total of 74 breast cancer survivors who had completed their primary cancer therapy were recruited from a comprehensive cancer center in Korea. Measurements used included the International Physical Activity Questionnaire, the Diet Quality Index, and the EORTC QLQ-C30. **Results:** Only twenty-six women (35.1%) met the American Cancer Society criteria of weekly PA, while most participants (93.2%) displayed good or excellent diet quality. Those less likely to meet the PA criteria were older women, women who had a lower economic level, and women not receiving anti-hormone therapy. However, there was no significant factor associated with diet quality. Women who met the criteria for PA displayed significantly better global QOL than women who did not meet the criteria. No significant differences were found in HRQOL between women who did and did not meet the diet quality criteria. **Conclusion:** Nurses should be aware of breast cancer survivors who are older and who have a low economic status when assessing and screening the level of PA to improve HRQOL.

Key Words: *Physical Activity, Diet, Breast Neoplasms, Quality of Life*

INTRODUCTION

Breast cancer is the second most prevalent cancer among women in Korea and the incidence rate has increased continuously since the late 1990s. With increased early detection and effective treatment, the number of breast cancer survivors is growing significantly. Despite this encouraging projection, cancer survivors are at an increased risk for recurrence, secondary cancers, functional decline, and deterioration of quality of life (QOL).[1,2] Attenuating secondary health problems of cancer survivors has become important. One area receiving increased attention is the post-diagnosis health behavior of cancer survivors.[3] Studies have examined the prevalence of lifestyle behaviors among cancer survivors[3,4] and their positive influence on health-related QOL (HRQOL)[5-7] and on cancer recurrence and survival.[8,9]

Physical activity (PA) and diet are two lifestyle behaviors shown to significantly influence the HRQOL and prognosis of cancer survivors.[10] Among breast cancer survivors, in particular, PA and diet behavior are positively associated with HRQOL, as well as recurrence and survival.[6-9,11] PA is linked to increased functional capacity, improved mood, decreased nausea, increased immune function, decreased fatigue, improved health perceptions, or improved HRQOL.[12] Recently, diet quality was significantly associated with physical and mental functioning among cancer survivors.[6,7]

The American Cancer Society (ACS) recommends 30 min of moderately intense exercise at least 5 days each week and consumption of five servings of fruits and vegetables each day (5-A-Day) for cancer survivors, with the aim of minimizing recurrence or secondary cancer.[13] But, a plethora of studies, including population-based studies from the United States and Australia have shown that up to 70% of cancer survivors do not achieve the PA recommendation and 48% to 74% are not meeting the 5-A-Day recommendation.[3,4] Therefore, although a cancer diagnosis has been referred to as a possible "teachable moment" where survivors are likely to be motivated to make lifestyle changes to improve health outcomes,[1] few are actually making these changes.

Behavior change is less likely to be undertaken and maintained by men, and by those who are less educated, over age 65, or urban dwellers.[1,14,15] Additional studies are needed to assess the factors associated with lifestyle changes in cancer survivors. To date, most studies regarding health behaviors and survivorship reflects Western populations, with scant knowledge of other races and ethnic groups. As for Korean cancer survivors, only one study examined the levels of PA and diet behaviors. Min et al. (2008)[16] reported that 89.3% of breast cancer survivors were involved in regular exercise, most typically walking exercise (55.0%). Among them, 60.4% were doing exercise more than three times per week. In this study, 89.3% of breast cancer survivors reported that they had changed their diet behavior and the most preferred diets were bean-based diet (20.5%) and plant-based diet (16.4%). However, they did not use a valid instrument for the evaluation of diet quality. Although Korean breast cancer survivors showed a positive health behavior pattern, little is known about the levels of PA and diet behavior based on a public guideline or valid instrument.

1. Purpose of the study

The purposes of the study were (1) to explore the current status of PA and diet quality, (2) to examine factors associated with PA and diet quality, and (3) to identify associations between these health behaviors and HRQOL among Korean breast cancer survivors who had completed their cancer treatment.

METHODS

1. Study design

The study had a cross-sectional study design, and was a secondary analysis of screening data collected as part of a randomized controlled pilot study that tested the effectiveness of the Simultaneous Stage-matched Exercise and Diet (SSED) Trial in Korea.[17]

2. Participants

Participants in the present study were disease-free breast cancer survivors who underwent screening and baseline interviews for the SSED trial. The eligibility criteria of this trial were age ≥ 20 yr, stage 0-III breast cancer, completion of primary treatment except for anti-hormone therapy. Participants were excluded if they had progressive disease or additional primary tumors or were being treated for cancer; any condition that precluded unsupervised exercise; contraindications for exercise; or any

condition that could interfere with a high vegetable and fruit diet (e.g., kidney failure or chronic warfarin use).

3. Study procedures

Breast cancer survivors were identified within 2 yr of diagnosis by case ascertainment (i.e., woman diagnosed with stage 0-III breast cancer) from a comprehensive cancer center, Goyang, Korea. They were mailed an invitation to participate in the study by the principal investigator and the patient's oncologist or surgeon, who used hospital records to identify potentially eligible patients according to diagnosis, time since diagnosis, and treatment criteria. Survivors who provided signed informed consent and were considered eligible based on the screening (n = 74) underwent a survey in the hospital. All measures reported herein were completed before the intervention.

4. Outcome measurements

PA. PA was assessed using the International Physical Activity Questionnaire (IPAQ). The IPAQ assessed moderate and vigorous PA in four life domains: job-related work done outside the home, house and yard work, recreation, and transportation.[18] We used only the recreation domain for analyses in this study because we had to examine PA from routine exercise. PA was measured in a frequency-by-duration format on a per week basis. Total time spent in PA during the past 7 days was obtained by multiplying the number of days the activity was done by the amount of time spent in each activity and then summed according to the intensity of the PA. Data collected with the IPAQ can be reported as a continuous measure. It also can be computed by weighting each type of activity by its energy requirements, defined in metabolic equivalent tasks (MET), to yield a score in MET-min according to the IPAQ guidelines. In this study, the data were converted to MET-hours per week for PA. A reliability and validity study previously carried out in 14 centers in 12 countries reported acceptable measurement properties of IPAQ for monitoring population-level PA among 18 to 65-yr-old adults in diverse settings.[18]

Diet quality. Diet behavior was initially assessed using a 3-day diet recall, with participants being asked to record all food and beverages consumed for 3 non-consecutive days (2 weekdays and 1 weekend day). All nutrient intake data were calculated using the Korean Nutrition Society computer-aided nutritional analysis program (CAN Pro 3.0) and were scored according to the recommended Korean dietary allowance.[19] This dietary measure is considered the most accurate for mean macronutri-

ent content and is appropriate for use in studies where subjects may consume a wide variety of foods. Diet quality was assessed using the Diet quality Index (DQI)[20] from the 3-day diet recall data. This instrument was originally constructed for the U.S. population[20] and was later modified for the Korean population.[21] The modification involved not only the translation of the original instrument, but also incorporation of Korean dietary guidelines.[22,23] The revised DQI consists of eight nutrient components of diet: energy from fat (%), energy from saturated fatty acid (SFA) (%), cholesterol (mg/day), energy from carbohydrates (%), intake of vegetables and fruits (servings/day), protein (% recommended daily allowance, RDA), calcium (% RDA), and sodium (g/day). The fruits and vegetables group included all fruits, vegetables, juices, dried fruits, and mixed foods that contained fruits or vegetables, but excluded desserts such as apple pies.[20] Each of the eight components had a score ranging from 0-2. Scores were summed across eight categories, resulting in a range of scores from 0-16, with low scores indicating better diet quality. Diet quality scores were also categorized as excellent (0-5), good (6-7), fair (8-10), or poor (11-16).[7] In addition, we analyzed a diet quality according to the categories from Oh et al.'s study[21] (i.e., < 20% of energy from fat; < 300 mg/day intake of cholesterol; and more than 7 servings/day of vegetables and fruits). These three nutritional indicators present a better diet quality in Korean population.

HRQOL. HRQOL was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 items (EORTC QLQ-C30)[24] after obtaining written permission from the EORTC group. This instrument is a 30-item cancer-specific questionnaire integrating system for assessing the HRQOL of cancer patients. The questionnaire incorporates five functioning scales (physical, role, cognitive, emotional, and social), three symptom scales (fatigue, pain, and nausea and vomiting), a global health and QOL scale, and several single items for the assessment of additional symptoms commonly reported by cancer patients. In this study, we used only five functioning scales and a global QOL. The EORTC QLQ-C30 was scored according to the EORTC scoring manual[25] and the data was linearly transformed to yield scores from 0-100; a higher score represented a higher level of functioning. The Korean versions of the EORTC QLQ-C30 have been validated.[26] The Cronbach's α for subscales from the EORTC QLQ-C30 ranged from .708 to .769 in this study.

5. Statistical analyses

Descriptive statistics were conducted for all demographic, medical

characteristics, and outcome variables. Chi-square test or Fisher's exact test were used to identify the associations between general characteristics and both health behaviors. Criteria for PA were defined as PA of more than 10 MET hours/week, consistent with the ACS guideline (i.e., engaging in 30 or more min per day of at least moderate PA at least 5 days each week and we decided moderate intensity to be 4 MET hours/week)[13] and meeting criteria for diet quality as DQI scores ≤ 5 (i.e., excellent quality). To assess the difference in QOL outcomes between the health behavior groups (i.e., meeting criteria or not), general linear model using analysis of covariate analysis (ANCOVA) was used after adjusting for demographic and medical variables, which were previously found to be related to HRQOL. A two-sided $p < .05$ indicated statistical significance. Data were analyzed using the Statistical Package for Social Science (SPSS version 16.0).

6. Ethical considerations

The study was approved by the Institutional Review Board of the participating institution (No: NCCNCS-07-084). Permission and written consent have been obtained from all participants and they were given information about the aim of the study.

RESULTS

1. Characteristics of the participants

Participant's ages ranged from 26-69 yr (47.4 ± 8.7 yr, mean ± standard deviation, here and hereafter). All participants were women. The majority was married (84.6%) and had more than a high school education (78.5%). The average of time since diagnosis was 13.6 ± 5.9 months (range 3.3-23.7 months). Most participants (87.8%) had received breast-conserving surgery, and the majority received chemotherapy (78.1%) or radiation therapy (76.6%). There were some missing data due to data for screening. Detailed demographic and medical information for the participants is presented in Table 1.

2. PA and diet quality

Descriptive statistics for PA and diet quality are presented in Table 2. For PA, 47.3% of participants were doing regular moderate intensity of PA and participants had an average of 9.3 ± 15.2 MET hours per week. Only twenty-six women (35.1%) currently met the criteria of weekly PA. Reviewing the average weekly duration and frequency of moderate and vigorous recreational PA, women were performing moderate activity

Table 1. Characteristics of the Participants   (N=74)

Characteristic	n	%	Mean (SD)
Age (yr)			47.4 (8.7)
<50	49	66.2	
≥50	25	33.8	
Marital status (n=65)			
Married	55	84.6	
Divorced/widowed/single	10	15.4	
Education level (n=65)			
<High school graduation	14	21.5	
≥High school graduation	51	78.5	
Job (n=65)			
Yes	19	29.2	
No	46	70.8	
Monthly income (won) (n=64)			
<2,000,000	24	37.5	
≥2,000,000	40	62.5	
Religious affiliation (n=64)			
Yes	17	26.6	
No	47	73.4	
Menopause (n=65)			
Yes	46	70.8	
No	19	29.2	
Comorbid condition (n=60)			
Yes	29	48.3	
No	31	51.7	
Time since diagnosis (months) (n=73)			13.6 (5.9)
<12	30	41.1	
≥12	43	58.9	
Stage (n=72)			
0-I	30	41.6	
II	31	43.1	
III	11	15.3	
Type of surgery			
Mastectomy	9	12.2	
Breast-conserving surgery	65	87.8	
Experience of chemotherapy (n=64)			
Yes	50	78.1	
No	14	21.9	
Experience of radiation therapy (n=64)			
Yes	49	76.6	
No	15	23.4	
Current anti-hormone therapy (n=62)			
Yes	44	71.0	
No	18	29.0	

Table 2. Physical Activity and Diet Quality of the Participants   (N=74)

Behavior characteristics	Mean	SD
Physical activity		
Vigorous activity frequency (times/week)	0.5	1.3
Vigorous activity duration (min)	13.2	40.8
Moderate activity frequency (times/week)	1.8	2.3
Moderate activity duration (min)	26.4	37.8
MET h/week for vigorous and moderate physical activity	9.3	15.2
Diet quality		
Energy from fat (%)	22.1	5.6
Energy from saturated fat (%)	3.4	1.9
Cholesterol (mg/day)	254.7	122.4
Energy from carbohydrate (%)	60.5	9.7
Intake of fruit and vegetable (servings/day)	11.0	4.5
Protein (% RDA)	126.8	33.1
Calcium (% RDA)	92.9	48.3
Sodium (g/d)	4.3	1.4
DQI total score (range: 0-16)	4.6	1.8

Behavior group	n	%
Physical activity		
Regular moderate PA	35	47.3
Regular vigorous PA	13	17.6
<10 MET h/week	48	64.9
≥10 MET h/week	26	35.1
Diet quality		
<20% of energy from fat	23	31.5
<300 mg/day intake of cholesterol	47	64.4
≥7 servings/day intake of fruit and vegetable	62	84.9
DQI classification		
Excellent (0-5)	49	66.2
Good (6-7)	20	27.0
Fair (8-10)	5	6.8
Poor (11-16)	0	0.0

DQI=diet quality index; h=hours; MET=metabolic equivalent task; RDA= recommended daily allowance.

more often (mean time per session=26.4 min; mean times per week=1.8 times), followed by vigorous activity (mean time per session=13.2 min; mean times per week=0.5 times).

The ACS guideline for diet and nutrition recommends a healthy diet with an emphasis on plant sources (e.g., eating five or more servings each day of a variety of vegetables and fruits, and reducing consumption of processed and red meats).[13] Therefore, we assessed consumption of vegetables and fruits, percentage of energy from fat, and intake of cholesterol per day. According to Korean guidelines,[19] women had to be within the acceptable daily macronutrient distribution ranges for adults as follows; <20% of energy from fat; <300 mg/day intake of cholesterol; and more than 7 servings/day of vegetables and fruits. In terms of three nutritional indicators, 31.5%, 64.4%, and 84.9% of participants met the guideline for fat, cholesterol, and vegetables/fruits, respectively. The mean scores of DQI were 4.6 (SD=1.8) and almost all of the women (93.2%) were categorized as having good or excellent diet quality. No one displayed poor diet quality.

3. Associations between demographic and medical characteristics and health behaviors

Some socio-demographic and medical factors were associated with PA. Older women ($p = .043$) and women who had a lower economic level ($p = .021$) were less likely to meet the PA criteria. In addition, women who were receiving anti-hormone therapy were more likely to meet the PA criteria ($p = .009$). No significant factor was associated with diet quality (Table 3).

4. Associations between health behaviors and HRQOL

Women who met the PA criteria showed significantly better global QOL ($p = .029$) than women who had not met the criteria after controlling for age, marital status, education level, job, religion, monthly income, menopause status, disease stage, and comorbidity. Although the statistical significance was borderline, those meeting the criteria displayed better social functioning ($p = .059$). Women who met the PA criteria had higher scores for physical, role, emotional, and cognitive functioning than women who did not meet the PA criteria, although there was no statistical significance. No significant differences were found in any HRQOL outcome between those who did or did not meet the criteria for diet quality (Table 4).

DISCUSSION

The present study examined current PA and diet behaviors, factors related to them, and association with HRQOL among Korean female breast cancer survivors. The level of PA in Korean breast cancer survivors tends to be relatively low and similar to Western populations, whereas diet quality tends to be better. With regard to relationships between health behaviors and HRQOL, evidence of PA was partially supported, however, that of diet quality was not supported.

Approximately one-third (35.1%) of the participants met the PA recommendations of the ACS. These findings are consistent with a previous study that reported that 37.1% of breast cancer survivors,[27] 32%-40% of gynecological cancer survivors,[11] and 29.6% of mixed cancer survivors[3] engage in routine exercise after treatment that meets the ACS. Mosher et al. (2009)[6] reported that the mean time of moderate-to-vigorous exercise of 43.9 min per week, a value similar to that found presently (39.6 min). The previous and present findings indicate a lack of awareness of increasing PA among cancer survivors.

On the other hand, the diet behavior of our sample population showed favorable findings. Eighty-five percent of the women met the Korean recommendation of seven servings of fruits and vegetables per day. This finding differs from findings in Western countries, where the 5-A-DAY recommendation was met in < 30% of cancer survivors.[11,14,15] Regarding diet quality, our participants also showed more positive results compared with two recent Western studies. The mean value of diet quality score was better (indicated by lower score) for our sample than in an earlier study[7] using the same instrument of DQI (4.6 versus 6.7, respectively). Surprisingly, almost all participants (93.2%) were classified as having excellent or good diet quality, in contrast to the 63.8% value reported in Western participants.[7] Furthermore, there was no poor diet quality group in our study, while 11.3% of Western participants exhibited poor diet quality.[7] Another study[6] that assessed diet quality among older long-term cancer survivors using the Health Eating Index (HEI05) reported only 7% of the participants had HEI05 scores > 80, indicative of good eating habits relative to national guidelines. The data could reflect characteristics of the Korean diet, which was originally plant-based. Most Koreans still eat two or more kinds of vegetable dishes at each meal, use salt or hot pepper rather than oil or butter, and do not eat meat frequently. The diet is relatively low-fat and vegetable-enriched as compared to the typical Western diet. A second explanation is a selection bias; since the participants were recruited from women enrolled in a lifestyle intervention and consented to participate, there was already an interest in health issues.

With regard to factors associated with the two lifestyle behaviors (PA and diet), only PA showed significant findings. Older women were less likely to exercise than younger women, consistent with previous findings.[15] Other comorbid conditions may be obstacles for regular PA for older women. Interestingly, the finding that economic status was a significant factor associated with meeting the PA criteria was unique to the present study. Thus, health care providers in Asian cultures should consider that breast cancer survivors with a lower economic status may be a target population for education or intervention for improving PA.

In the present study, women receiving anti-hormone therapy were more likely to meet the PA criteria. This finding, which was also unique, may have reflected side-effects of anti-hormone therapy, which can impair physical functioning.[28] Therefore, women who are being treated currently with anti-hormone therapy may need to increase their PA in order to overcome the physical burden. Also, it is possible that they received information concerning the importance of PA for prevention of osteoporosis from their health care providers. Particularly, aromatase

Table 3. Associations Between Socio-demographic and Medical Characteristics and Health Behaviors

Variables	Meeting criteria for physical activity			Meeting criteria or diet behavior		
	Yes (n=26)	No (n=48)	p	Yes (n=49)	No (n=25)	p
	n (%)			n (%)		
Age (yr)			.043			.604
<50	21 (42.9)	28 (57.1)		31 (63.3)	18 (63.7)	
≥50	5 (20.0)	20 (80.0)		18 (72.0)	7 (28.0)	
Marital status			.483			.461
Married	23 (41.8)	32 (58.2)		6 (60.0)	4 (40.0)	
Divorced/widowed/never married	3 (30.0)	7 (70.0)		40 (72.7)	15 (27.3)	
Education level			.480			.999
<High school graduation	5 (35.7)	9 (64.3)		10 (71.4)	4 (28.6)	
≥High school graduation	21 (41.2)	30 (58.8)		36 (70.6)	15 (29.4)	
Job			.824			.389
Yes	8 (42.1)	11 (57.9)		12 (63.2)	7 (36.8)	
No	18 (39.1)	28 (60.9)		34 (73.9)	12 (26.1)	
Monthly income ($)			.021			.778
<2,000	5 (20.8)	19 (79.2)		18 (75.0)	69 (25.0)	
≥2,000	20 (50.0)	20 (50.0)		28 (70.0)	12 (30.0)	
Religious affiliation			.529			.552
Yes	8 (47.1)	9 (52.9)		34 (72.3)	13 (27.7)	
No	18 (38.3)	29 (61.7)		11 (64.7)	6 (35.3)	
Menopause			.824			.550
Yes	18 (39.1)	28 (60.9)		31 (67.4)	15 (32.6)	
No	8 (42.1)	11 (57.9)		15 (78.9)	4 (21.1)	
Comorbid condition			.951			.321
Yes	11 (37.9)	18 (62.1)		8 (57.1)	6 (42.9)	
No	12 (38.7)	19 (61.3)		37 (74.0)	13 (26.0)	
Time since diagnosis (months)			.876			.387
<12	11 (36.7)	19 (63.3)		18 (60.0)	12 (40.0)	
≥12	15 (34.9)	28 (65.1)		30 (69.8)	13 (30.2)	
Stage			.934			.310
0-I	11 (36.7)	19 (63.3)		18 (60.0)	12 (40.0)	
II-III	15 (35.7)	27 (64.3)		30 (71.4)	12 (28.6)	
Type of surgery			.320			.476
Mastectomy	2 (22.2)	7 (77.8)		5 (55.6)	4 (44.4)	
Breast-conserving surgery	24 (92.3)	41 (85.4)		44 (67.7)	21 (32.3)	
Experience of chemotherapy			.459			.321
Yes	21 (42.0)	29 (58.0)		37 (74.0)	13 (26.0)	
No	5 (35.7)	9 (64.3)		8 (57.1)	6 (42.9)	
Experience of radiotherapy			.057			.753
Yes	23 (46.9)	26 (53.1)		35 (71.4)	14 (28.6)	
No	3 (20.0)	12 (80.0)		10 (66.7)	5 (33.3)	
Current anti-hormone therapy			.009			.782
Yes	23 (52.3)	21 (47.7)		30 (71.4)	12 (28.6)	
No	3 (16.7)	15 (83.3)		15 (68.2)	7 (31.8)	

inhibitors can cause a critical reduce of bone mineral density.

On the other hand, we did not find significant associations between diet behaviors and socio-demographic or clinical characteristics, which was not consistent with previous studies.[6,7] Older age, higher educational level, comorbidities, and lower body mass index were significant factors associated with better diet quality in cancer survivors in other studies.[6,7] Further research is needed to explore new findings in this area.

PA has been positively associated with HRQOL, and plays a significant role to improve HRQOL among cancer survivors.[5,6,11,14,29] Consistent with previous research,[27] presently women who met the criteria for

Table 4. Least Squares Means (SE)* for HRQOL by the Health Behavior Groups

Variables	Meeting criteria for PA			Meeting criteria for diet quality		
	Yes	No	p	Yes	No	p
EORTC QLQ-C30 (0-100)						
Physical functioning	76.2 (2.5)	73.6 (2.1)	.440	74.2 (1.9)	75.7 (3.1)	.674
Role functioning	83.9 (5.0)	72.3 (4.1)	.202	76.7 (3.8)	73.7 (6.2)	.693
Emotional functioning	72.2 (4.1)	67.0 (3.3)	.340	67.6 (3.1)	72.7 (5.0)	.396
Cognitive functioning	82.9 (3.8)	75.5 (3.1)	.151	78.4 (2.9)	78.7 (4.7)	.967
Social functioning	84.1 (5.2)	70.7 (4.3)	.059	74.4 (4.0)	80.0 (6.5)	.479
Global QOL/health status	68.8 (4.1)	56.7 (3.3)	.029	60.2 (3.2)	64.8 (5.1)	.467

EORTC QLQ-C30=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30; HRQOL=health-related quality of life; PA=physical activity; SE=standard error.
*Adjusted for age, marital status, education level, job, religion, monthly income, menopause status, disease stage, comorbidity.

PA showed better global QOL compared with those who did not. This finding suggests that PA is a key lifestyle behavior to improve global QOL in cancer survivors. However, there was no significant difference in other subscales such as physical, emotional, or social functioning between those who did/did not meet the PA criteria. Associations between PA and mental QOL outcomes have been equivocal,[29,30] but, contrary to the present study, a significant association between PA and physical functioning has been demonstrated consistently among cancer survivors.[6,29,30] This discrepancy may have arisen because of the small sample size and/or may relate to the instrument of PA. IPAQ is composed of four domains, and queries PA in the aspects of job-related activity, house and yard work activity, transportation activity, and recreation. Participants may be confused because of repeated similar questions (e.g., walking time in workplace, for transportation, or for recreation). Therefore, MET for recreational PA that was presently calculated might be overestimated. An unexpected finding that was contrary to our hypothesis was the lack of significant differences in any HRQOL subscales between meeting and not meeting the criteria for diet quality. This is inconsistent with previous studies reporting significant associations between poor diet quality and lower physical or mental functioning, and depression.[6,7] One possible explanation for the difference is selection bias. Presently, scores of diet quality were seriously skewed towards better quality. Thus it was difficult to discern an association between diet quality and HRQOL. Further replicative studies involving more participants are needed.

Several limitations of this study should be noted. First, the cancer survivors knew they were being recruited into a lifestyle intervention study. This may have caused a selection bias that attracted cancer survivors who were more likely meeting the lifestyle behavior recommendations. Second, there could be a social desirability bias (e.g., responding in a way that exaggerates positive health behaviors and minimizes negative be-

haviors). This should be considered in interpreting the study results. Third, DQI was not validated in people with cancer in Korea. There is a need to perform a validation study of Korean version of DQI among cancer survivors. Fourth, causal relations between PA, diet, and HRQOL could not be established in the current cross-sectional study. Longitudinal research would extend the current findings. Finally, the small sample size makes it difficult to detect significant relationships.

CONCLUSION

The present study provides important new information about Korean cancer survivors' health behaviors after cancer treatment and sheds light on the correlates of positive health behaviors (i.e., meeting criteria of PA and diet quality) and associations with HRQOL. Among Korean breast cancer survivors, the level of PA was not optimal, while diet quality was very good. PA was associated with age, economic status, and not receiving anti-hormone therapy, however, there was no factor associated with diet quality. In addition, PA was associated with better HRQOL, whereas there was no association between diet quality and HRQOL. Therefore, health care providers caring for breast cancer survivors in Korea should focus on assessment of the level of PA, screening sedentary women, and developing programs to improve PA more than diet-related issues. Cancer survivors are now living longer and represent a rapidly growing population. Therefore, nurses should monitor cancer survivors' health behaviors and develop health education programs to promote health behaviors for cancer survivors. Specifically, for Korean breast cancer survivors, nurses should be aware of women who are older and who have a lower economic status in assessing and screening for PA to improve HRQOL.

REFERENCES

1. Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM. Riding the crest of the teachable moment: Promoting long-term health after the diagnosis of cancer. J Clin Oncol 2005;23:5814-30.

2. Hewitt M, Greenfield S, Stovall EL. Institute of Medicine and National Research Council: From patient to cancer survivors: Lost in transition. 1st ed. Washington DC:National Academies Press;2005.

3. Bellizzi KM, Rowland JH, Jeffery DD, McNeel T. Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. J Clin Oncol 2005;23:8884-93.

4. Eakin EG, Youlden DR, Baade PD, Lawler SP, Reeves MM, Heyworth JS, et al. Health behaviors of cancer survivors: Data from an Australian population-based survey. Cancer Causes Control 2007;18:881-94.

5. Fitzgerald B. Review: Regular exercise improves quality of life and physical fitness in women with breast cancer. Evid Based Nurs 2007:10:12.

6. Mosher CE, Sloane R, Morey MC, Snyder DC, Cohen HJ, Miller PE, et al. Associations between lifestyle factors and quality of life among older long-term breast, prostate, and colorectal cancer survivors. Cancer 2009; 115:4001-9.

7. Wayne SJ, Baumgartner K, Baumgartner RN, Bernstein L, Bowen DJ, Ballard-Barbash R. Diet quality is directly associated with quality of life in breast cancer survivors. Breast Cancer Res Treat 2006;96:227-32.

8. Holmes MD, Chen WY, Feskanich D, Kroenke CH, Colditz GA. Physical activity and survival after breast cancer diagnosis. JAMA 2005;293: 2479-86.

9. Pierce JP, Stefanick ML, Flatt SW, Natarajan L, Sternfeld B, Madlensky L, et al. Greater survival after breast cancer in physically active women with high vegetable-fruit intake regardless of obesity. J Clin Oncol 2007;25: 2345-51.

10. Demark-Wahnefried W, Jones LW. Promoting a healthy lifestyle among cancer survivors. Hematol Oncol Clin North Am 2008;22:319-42.

11. Beesley VL, Eakin EG, Janda M, Battistutta D. Gynecological cancer survivors' health behaviors and their associations with quality of life. Cancer Causes Control 2008;19:775-82.

12. Alfano CM, Rowland JH. Recovery issues in cancer survivorship: A new challenge for supportive care. Cancer J 2006;12:432-43.

13. Doyle C, Kushi LH, Byers T, Courneya KS, Demark-Wahnefried W, Grant B, et al. Nutrition and physical activity during and after cancer treatment: An American Cancer Society guide for informed choices. CA Cancer J Clin 2006;56:323-53.

14. Blanchard CM, Stein KD, Baker F, Dent MF, Denniston MM, Courneya KS, et al. Association between current lifestyle behaviors and health-related quality of life in breast, colorectal, and prostate cancer survivors. Psychol Health 2004;19:1-13.

15. Mayer DK, Terrin NC, Menon U, Kreps GL, McCance K, Parsons SK, et al. Health behaviors in cancer survivors. Oncol Nurs Forum 2007;34: 643-51.

16. Min HS, Park SY, Lim JS, Park MO, Won HJ, Kim JI. A study on behaviors for preventing recurrence and quality of life in breast cancer survivors. I Korean Acad Nurs 2008;38:187-94.

17. Kim SH, Shin MS, Lee HS, Lee ES, Ro JS, Kang HS, et al. Randomized pilot test of a simultaneous stage-matched exercise and diet interventions for breast cancer survivors. Oncol Nurs Forum 2011;38:E97-E106.

18. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-95.

19. Korean Nutrition Society. Using DRIs for Korean dietary standard. Available at: http://www.kns.or.kr [accessed on 9 July, 2007].

20. Patterson RE, Haines PS, Popkin BM. Diet quality index: Capturing a multidimensional behavior. J Am Diet Assoc 1994;94:57-64.

21. Oh KW, Nam CM, Park JW, Yoon JY, Sim JS, Lee KH. A case control study on diet quality and risk for coronary heart disease in Korean men. J Korean Nutr Soc 2003;36:613-21.

22. Korean Nutrition Society. Recommended dietary allowances for Koreans. 6th ed. Seoul:Korean Nutrition Society;1995.

23. Korean Society of Lipidology & Atherosclerosis. Guidelines for treatment of hyperlipidemia. 1st ed. Seoul:Korean Society of Lipidology & Atherosclerosis;1996.

24. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. The European organization for research and treatment of cancer QLQ-C30: Quality-of-life instrument for use in international clinical trials in oncology. J Natl Cancer Inst 1993;85:365-76.

25. Fayers PM, Aaronson N, Bjordal K, Groenvold M, Curran D, Bottomley A. The EORTC QLQ-C30 scoring manual. 3rd ed. Brussels: European Organization for Research and Treatment of Cancer;2001.

26. Yun YH, Park YS, Lee ES, Bang SM, Heo DS, Park SY, et al. Validation of the Korean version of the EORTC QLQ-C30. Qual Life Res 2004;13: 863-8.

27. Blanchard CM, Courneya KS, Stein K. 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 2008;26:2198-204.

28. Boehm DU, Lebrecht A, Eckhardt T, Albrich S, Schmidt M, Siggelkow W, et al. Quality of life and adjuvant tamoxifen treatment in breast cancer patients. Euro J Cancer Care 2009;18:500-6.

29. Courneya KS, Mackey JR, Bell GJ, Jones LW, Field CJ, Fairey AS. Randomized controlled trial of exercise training in postmenopausal breast cancer survivors: Cardiopulmonary and quality of life outcomes. J Clin Oncol 2003;21:1660-8.

30. Ohira T, Schmitz KH, Ahmed RL, Yee D. Effects of weight training on quality of life in recent breast cancer survivors: The weight training for breast cancer survivors (WTBS) study. Cancer 2006;106:2076-83.