

## RESEARCH ARTICLE

# Diet and Physical Activity in Relation to Weight Change among Breast Cancer Patients

Yong Heng Yaw<sup>1</sup>, Zalilah Mohd Shariff<sup>1\*</sup>, Mirnalini Kandiah<sup>2</sup>, Yong Heng Weay<sup>3</sup>, Nurfaizah Saibul<sup>4</sup>, Sarina Sariman<sup>1</sup>, Zailina Hashim<sup>5</sup>

### Abstract

**Background:** This study aimed to provide an overview of lifestyle changes after breast cancer diagnosis and to examine the relationship between dietary and physical activity changes with weight changes in breast cancer patients. Women with breast carcinomas (n=368) were recruited from eight hospitals and four breast cancer support groups in peninsular Malaysia. Dietary and physical activity changes were measured from a year preceding breast cancer diagnosis to study entry. Mean duration since diagnosis was 4.86±3.46 years. Dietary changes showed that majority of the respondents had decreased their intake of high fat foods (18.8-65.5%), added fat foods (28.3-48.9%), low fat foods (46.8-80.7%), red meat (39.7%), pork and poultry (20.1-39.7%) and high sugar foods (42.1-60.9%) but increased their intake of fish (42.7%), fruits and vegetables (62.8%) and whole grains (28.5%). Intake of other food groups remained unchanged. Only a small percentage of the women (22.6%) had increased their physical activity since diagnosis where most of them (16.0%) had increased recreational activities. Age at diagnosis ( $\beta = -0.20, p = 0.001$ ), and change in whole grain ( $\beta = -0.15, p = 0.003$ ) and fish intakes ( $\beta = 0.13, p = 0.013$ ) were associated with weight changes after breast cancer diagnosis. In summary, the majority of the women with breast cancer had changed their diets to a healthier one. However, many did not increase their physical activity levels which could improve their health and lower risk of breast cancer recurrence.

**Keywords:** Changes in dietary intake and physical activity - breast cancer - weight change - Malaysian females

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### Introduction

Dietary change is one of the many possible actions women may take when they have been diagnosed with breast cancer in order to reduce the probability of cancer recurrence and to prevent cancer metastasis (Beagan et al., 2004). Numerous cross sectional studies have reported changes in dietary habits among breast cancer patients after diagnosis (Salminen et al., 2000; Maunsell et al., 2002; Thomson et al., 2002; Patterson et al., 2003; Alfano et al., 2009; Shaharudin et al., 2013). Most common dietary changes reported were decreased high fat foods and increased consumption of fruits and vegetables. In a study of prostate, colon and breast cancer survivors, 45% had increased fruit and vegetable intakes but lower percentage (28.5%) reported lower intake of fat (Patterson et al., 2003). Alfano et al. (2009) showed that 44% of breast cancer survivors decreased fat intake, 42% increased fiber intake, and 43% increased consumption of fruits and vegetables. These studies supported that breast cancer patients were more likely to make healthful dietary changes following a breast cancer diagnosis.

Few epidemiologic studies have described physical activity levels of women diagnosed with breast cancer (Irwin et al., 2003; Irwin et al., 2004) and examined the association between physical activity and cancer survival (Holmes et al., 2005; Pierce et al., 2007; Holick et al., 2008; Irwin et al., 2008). The Health, Eating, Activity and Lifestyle (HEAL) Study (Irwin et al., 2003), a population based prospective cohort study of 1185 breast cancer patients, found that women were significantly less physically active within their first year after diagnosis than a year prior to diagnosis. Obese women reported greater declines in physical activity after cancer diagnosis than lean women. Women decreased their total physical activity by an estimated 2.0 hours per week from the first year pre-diagnosis to the first year after diagnosis. In the same population, Irwin et al., (2004), reported that 50% of the women consisting of mainly lean and overweight women had returned to pre-diagnosis physical activity levels after 3 years. The majority of obese breast cancer survivors did not increase their physical activity levels in the same period.

Weight gain after diagnosis of cancer has been

<sup>2</sup>Department of Food Science and Nutrition, Faculty of Applied Sciences, UCSI University, Cheras, <sup>3</sup>Department of Quality, Health and Safety, Deleum Berhad, Kuala Lumpur, <sup>4</sup>Department of Nutrition and Dietetics, <sup>4</sup>Cancer Resource and Education Center (CARE), <sup>5</sup>Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor, Malaysia  
\*For correspondence: zalilah@medic.upm.edu.my

frequently reported and associated with an adverse effect on recurrence risk and survival (Kroenke et al., 2005). There are multiple risk factors of weight gain in women after being diagnosed with breast cancer, including modifiable (decreased physical activity and increased total caloric intake) and non-modifiable (receiving chemotherapy, reduced rates of metabolism and being or becoming postmenopausal after diagnosis) factors (Demark-Wahnefried et al., 1997; Goodwin et al., 1999; Rock et al., 1999; Demark-Wahnefried et al., 2001). However, these factors have not been extensively studied.

Although the number of newly diagnosed breast cancer cases in Malaysia has declined over time, breast cancer remains the most common cancer in females and also the first most common cancer in the population regardless of sex. In 2003, 3738 new cases of breast cancer were reported to the National Cancer Registry and the number of cases slightly declined to 3525 in 2006 and 3242 in 2007, giving an age-standardized incidence rate (ASR) of 46.2, 39.3 and 29.1 per 100,000 women, respectively. Early diagnosis and better medical treatment have contributed significantly to the increasing number of breast cancer survivors in Malaysia. Concomitantly, it is important to address factors such as weight gain and lifestyle behaviors that could influence quality of life and survival of these cancer survivors. As published information on weight change and its contributing factors among breast cancer survivors in Malaysia is limited (Shaharudin et al., 2013), this study reports on dietary and physical activity changes of women after breast cancer diagnosis and attempts to identify factors that contribute to post-diagnosis weight change.

## Materials and Methods

### Subjects

This study was conducted on 368 women recruited from eight government hospitals and four breast cancer support groups from seven states in Peninsular Malaysia. These states were chosen as they represented the Northern, Central, Southern and the East Coast regions of Peninsular Malaysia. Women were breast cancer patients or survivors attending the outpatient clinics in the selected hospitals for routine medical check-up or members of breast cancer support groups. Data collection was carried out using interviewer-administered questionnaire after patients received information on the study and agreed to participate in the study. The study protocol was approved by The Medical Research Ethics Committee, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia and The Medical Research Ethics Committee, Ministry of Health Malaysia.

### Measurements

The Food Item Questionnaire was used to assess the changes in dietary intake after breast cancer diagnosis. The questionnaire was modified from the Women's Healthy Eating and Living Study Lifestyle Questionnaire (Thomson et al., 2002). It consisted of 8 food domains: high fat foods, added fat foods, low fat foods, meat, fish and eggs, high sugar foods, fruits and vegetables, whole

grains and alcohol. Food items (n=27) under each domain were specifically selected to cover foods commonly available in Malaysia. The respondents were requested to recall whether the food items were consumed before and after breast cancer diagnosis and to report the changes made using a Likert scale (did not consume, stopped, decreased, no change or increased). For food items in low fat foods, fish and eggs, fruits and vegetables, whole grains food domains, each direction of change was rated on 0 to 4, with a score of 0 meant the respondents did not consume the food before and after breast cancer diagnosis and a score of 4 implied the respondents have increased the food consumption after breast cancer diagnosis. Food items in high fat foods, added fat foods, meats, high sugar foods and alcohol food domains were reversely scored. A higher score in each food domain indicated that the respondents had changed to healthier intakes after breast cancer diagnosis.

Respondents were also requested to report any changes in physical activity levels from a year preceding breast cancer diagnosis to study entry by specifying the level of change as "decreased, no change and increased" (Wayne et al., 2004). If respondents reported a decrease or increase in physical activity, then they need to further clarify in which domain (activity at work, travel to and from places and recreational activities) the change has occurred.

Body weight a year preceding breast cancer diagnosis was self-reported (Eng et al., 2005) while present weight was measured by researchers using TANITA weighing scale. A weight change was defined as that occurring from a year preceding diagnosis to study entry.

### Statistical analysis

The SPSS version 20 was used to analyze all the data. Exploratory Data Analysis was carried out to determine the normality and homogeneity of the data. The data was presented descriptively as frequency, percentage, mean, median and standard deviation. Analysis of Variance (ANOVA) was carried out to explore association between weight changes with demographic characteristics and lifestyle changes before and after diagnosis of breast cancer. Stepwise linear regression analysis was then carried out to determine factors contributing to weight changes in respondents. Statistical significance was set at  $p < 0.05$ .

## Results

Table 1 presents the background and weight status of respondents (N=368). More than half (57.1%) were Malay, followed by Chinese (33.2%) and Indian (9.8%). The mean age of diagnosis was  $49 \pm 9.06$  years and the mean years of survival was  $5 \pm 3.46$  years. Most respondents were diagnosed with cancer at Stage I (31.8%) and Stage II (41.0%). Most respondents had undergone surgery (96.4%) and received radiotherapy (79.6%) and chemotherapy (82.9%) treatments. A majority (68.8%) of the respondents did not have a family history of cancer. The mean weights of the subjects a year preceding breast cancer diagnosis and at study entry were  $59.36 \pm 11.62$  kg and  $62.09 \pm 13.04$  kg, respectively. An average weight

**Table 1. Background and Weight Status of Women (N= 368)**

	Mean±SD	Total n(%)
Age (years)	53.57±9.04	
Ethnicity		
Malay		210 (57.1)
Chinese		122 (33.2)
Indian and Punjabi		36 (9.7)
Marital status		
Single		18 (4.9)
Married		304 (82.6)
Divorced/ Widowed		46 (12.5)
Education (years)	8.96±3.91	
Monthly household income (RM)	2022.58±2658.21	
Age at diagnosis (years)	48.53±9.06	
Years of survival (years)	4.86±3.46	
Stage of cancer		
Stage I		117 (31.8)
Stage II		151 (41.0)
Stage III		58 (15.8)
Do not know		42 (11.4)
Treatment		
Lumpectomy		62 (16.8)
Mastectomy		293 (79.6)
Radiotherapy		293 (79.6)
Chemotherapy		305 (82.9)
Hormonal therapy		159 (43.2)
Family history of cancer		
Yes		115 (31.2)
No		253 (68.8)
Weight at study entry (kg)	62.09±13.04	
Weight a year preceding -breast cancer diagnosis (kg)	59.36±11.62	
Weight change from a year preceding -diagnosis to study entry (kg)	3.47±7.53	

gain of 3.47±7.53kg was observed from a year preceding diagnosis to study entry.

Dietary changes such as decreased consumption of high fat foods (18.8-65.5%), added fat foods (28.3-48.9%) and high sugar foods (42.1-60.9%), increased consumption of fruits and vegetables (62.8%) and whole grains (28.5%) were seen in the women after breast cancer diagnosis (Table 2). Most of the women increased fish intake (42.7%) but decreased poultry (39.7%), pork (20.1%) or red meat (39.7%). Low fat foods were avoided (46.8-80.7%) by many of these women. Nearly 42% of the respondents reported that they did not change their overall physical activity level since diagnosis, followed by 35.9% and 22.6% who reported either decreasing or increasing their overall physical activity level since diagnosis (Table 3).

Table 4 and Table 5 show the relationship between dietary and physical activity changes with weight change in women before and after breast cancer diagnosis. Among the independent variables examined, only age at diagnosis, change in whole grain and fish intake were significantly associated with weight change. Women in 20-40 years age group had significantly highest weight gain (4.68±7.03kg) compared to 41-50 years (3.62±9.31kg) and > 51 years age groups (0.91±6.80kg). Women with increased whole grains consumption had the least weight

**Table 2. Consumption of Specific Foods before and after Breast Cancer Diagnosis (N=368)**

	Pre-diagnosis consumption		Change since diagnosis				Mean±SD
	consumption n (%)	Did not consume <sup>i</sup> n (%)	Stopped <sup>ii</sup> n (%)	Decreased <sup>iii</sup> n (%)	No change <sup>iv</sup> n (%)	Increased <sup>v</sup> n (%)	
High fat foods <sup>a</sup> (0-32)							20.07±4.98
Full cream milk <sup>a</sup>	189 (51.8)	167(45.4)	43 (11.7)	83 (22.6)	59 (16.0)	16 (4.3)	2.78±1.29
Cheese <sup>a</sup>	130 (35.6)	234 (63.6)	24 (6.5)	69 (18.8)	38 (10.3)	3 (0.8)	3.22±1.13
Fried foods <sup>a</sup>	351 (96.2)	14 (3.8)	25 (6.8)	241 (65.5)	80 (21.7)	8 (2.2)	1.88±0.72
Pizza <sup>a</sup>	222 (60.8)	140 (38.0)	40 (10.9)	136 (37.0)	45 (12.2)	7 (1.9)	2.71±1.15
Hamburgers <sup>a</sup>	228 (62.5)	136 (37.0)	46 (12.5)	139 (37.8)	42 (11.4)	5 (1.4)	2.72±1.12
Other fast foods <sup>a</sup>	248 (67.9)	116 (31.5)	39 (10.6)	162 (44.0)	47 (12.8)	4 (1.1)	2.59±1.09
Nuts <sup>a</sup>	302 (82.7)	64 (17.4)	28 (7.6)	142 (38.6)	106 (28.8)	28 (7.6)	1.98±1.17
Ice-cream <sup>a</sup>	300 (82.2)	64 (17.4)	38 (10.3)	179 (48.6)	78 (21.2)	9 (2.4)	2.19±1.04
Added fat foods <sup>a</sup> (0-16)							9.82±3.27
Ghee <sup>a</sup>	168 (46.0)	197 (53.5)	25 (6.8)	104 (28.3)	37 (10.1)	5(1.4)	3.01±1.16
Vegetable oil <sup>a</sup>	265 (72.6)	91 (24.7)	10 (2.7)	117 (31.8)	114 (31.2)	36 (9.8)	2.01±1.31
Margarine/shortening <sup>a</sup>	269 (73.7)	96 (26.1)	15 (4.1)	180 (48.9)	73 (19.8)	4 (1.1)	2.34±1.10
Butter <sup>a</sup>	251 (68.8)	114 (31.0)	16 (4.3)	167(45.4)	64 (17.4)	7 (1.9)	2.45±1.15
Low fat foods (0-8)							2.17±1.91
Low fat milk <sup>b</sup>	208 (57.0)	136 (37.0)	36 (9.8)	69 (18.8)	80 (21.7)	47 (12.8)	1.64±1.48
Reduced- fat cheese <sup>b</sup>	86 (23.6)	280 (76.1)	17 (4.6)	39 (10.6)	28 (7.6)	4 (1.1)	0.53±1.03
Meat, fish & eggs <sup>a</sup> (0-20)							13.49±1.80
Red meat <sup>a</sup>	248 (67.9)	117 (31.8)	62 (16.8)	146 (39.7)	37 (10.1)	6(1.6)	2.67±1.08
Pork <sup>a</sup>	118 (32.3)	248 (64.4)	9 (2.4)	74 (20.1)	34 (9.2)	3 (0.8)	3.26±1.12
Poultry <sup>a</sup>	332 (91.0)	32 (8.7)	27 (7.3)	188 (51.1)	108 (29.3)	13 (3.5)	1.88±0.92
Fish <sup>b</sup>	360 (98.6)	4 (1.1)	7 (1.9)	54 (14.7)	146 (39.7)	157 (42.7)	3.21±0.84
Eggs <sup>b</sup>	349 (95.6)	13 (3.5)	21 (5.7)	149 (40.5)	154 (41.8)	31 (8.4)	2.46±0.86
High sugar <sup>a</sup> (0-12)							6.54±1.98
Sugar <sup>a</sup>	333 (91.2)	30 (8.2)	21 (5.7)	224 (60.9)	90 (24.5)	3 (0.8)	1.96±0.81
Candy <sup>a</sup>	251 (68.8)	115 (31.2)	37 (10.1)	155 (42.1)	57 (15.5)	4 (1.1)	2.55±1.12
Cakes/ sweet desert <sup>a</sup>	319 (87.4)	45 (12.2)	21 (5.7)	211 (57.3)	83 (22.6)	8 (2.2)	2.03±0.93
Fruits and vegetables <sup>b</sup> (0-8)							7.14±1.14
Vegetables <sup>b</sup>	362 (99.2)	1(0.3)	2 (0.5)	9 (2.4)	125 (34.0)	231 (62.8)	3.58±0.59
Fruit <sup>b</sup>	360 (98.6)	2 (0.5)	3 (0.8)	14 (3.8)	118 (32.1)	231 (62.8)	3.56±0.66
Whole grains <sup>b</sup> (0-4)	300 (82.2)	93 (25.3)	37 (10.1)	62 (16.8)	71 (19.3)	105 (28.5)	2.16±1.59
Alcohol (wine/ beer) <sup>a</sup> (0-4)	47 (12.9)	318 (86.4)	21(5.7)	13 (3.5)	13 (3.5)	3 (0.8)	3.73±0.76

<sup>i</sup>Did not consume- Did not consume the food before and after diagnosis. <sup>ii</sup>Stopped- Consume before diagnosis and did not consume the food after diagnosis. <sup>iii</sup>Decreased- Consume before diagnosis and decrease the consumption after diagnosis. <sup>iv</sup>No change- The amount of the food consumed remains the same before and after diagnosis. <sup>v</sup>Increased- Consume before diagnosis and increase after diagnosis. <sup>a</sup>0- increased, 1- no change, 2- decreased, 3- stopped, 4- did not consume, <sup>b</sup>0- did not consume, 1-stopped, 2-decreased, 3- no change, 4- increased, A higher score indicates a better direction of change

**Table 3. Self-Reported Change in Physical Activity from a year Preceding Breast Cancer Diagnosis to Study Entry (N=368)**

	Changes in physical activities since diagnosis		
	Increased n (%)	No change n (%)	Decreased n (%)
Activities at work/ domestic	23 (6.3)	257 (69.8)	88 (23.9)
Travel to and from places	14 (3.8)	306 (83.2)	48 (13.0)
Recreational activities	59 (16.0)	233 (63.3)	76 (20.7)
Total physical activity	83 (22.6)	153 (41.6)	132 (35.8)

**Table 4. Weight Change (kg) by Characteristics and Lifestyle Factors**

	n (%)	Weight change (kg) since diagnosis (mean±SD)	F-value	p-value
Age at diagnosis (years)			7.09**a	0.001
20-40	74 (20.1)	4.68±7.03		
41-50	144 (39.1)	3.62±9.31		
>51	150 (40.8)	0.91±6.80		
Change in whole grains intake			2.55**b	0.039
Did not consume	93 (25.3)	3.20±6.70		
Stopped	37 (10.1)	4.16±11.60		
Decreased	62 (16.8)	3.85±7.27		
No change	71 (19.3)	3.43±8.68		
Increased	105 (28.5)	0.68±7.38		
Change in fish intake			2.468***c,d	0.045
Did not consume	4 (1.1)	2.62±8.09		
Stopped	7 (1.9)	-4.04±5.12		
Decreased	54 (14.7)	0.69±5.74		
No change	146 (39.7)	3.19±7.85		
Increased	157 (42.7)	3.30±8.81		

\*\*p<0.05, \*Significant difference between >51 years and 20- 40 and 41- 50 groups, <sup>b</sup>Significant difference between increased and did not consume, stopped, decreased and no change groups, <sup>c</sup>Significant difference between stopped and no change groups, <sup>d</sup>Significant difference between increased and stopped and decreased groups, Non-significant variables [years of education, years of survival, chemotherapy, changes in dietary intake (full cream milk, cheese, fried foods, pizza, hamburgers, other fast foods, nuts, ice-cream, ghee, vegetable oil, margarine/shortening, butter, low fat milk, reduced-fat cheese, red meat, pork, poultry, eggs, sugar, candy, cakes/sweet desert, vegetables, fruits and alcohol) and changes in physical activity (work/ domestic activity and travel related activity)] are not shown in the table.

**Table 5. Stepwise Regression of Factors Related to Weight Changes after Breast Cancer Diagnosis (N=368)**

Variables	Unstandardized coefficients B	Standard error	Standardized coefficients Beta	t	p-value
Final Model <sup>a</sup>					
Age at diagnosis	-0.18	0.05	-0.2	-3.88	0.001
Changes in whole grains intake	-0.78	0.27	-0.15	-2.94	0.003
Changes in fish intake	1.23	0.50	0.13	2.5	0.013

[R=0.27, R2=0.07; F=9.34, p<0.001], <sup>a</sup>Non-significant variables in the model are years of education, years of survival, chemotherapy, changes in dietary intake (high fat foods, low fat foods, meats, sugary foods, fruits and vegetables and alcohol) and changes in physical activity (work/ domestic activity and travel related activity)

gain (0.68±7.38kg) compared to other dietary change groups (3.2-4.2kg). While women who stopped fish intake experienced significant weight loss (-4.04±5.12kg), women in the other dietary change groups gained weight (0.7-3.3kg). The Stepwise Regression Model was then used to further evaluate the combination of independent variables that contribute the most to weight change. Age at diagnosis made the strongest contribution to explain weight change followed by change in whole grain intakes (β= -0.15) and change in fish intake (β= 0.13).

## Discussion

This study revealed that dietary changes are common in women diagnosed with breast cancer. Shaharudin et al. (2013) also reported that breast cancer survivors in Malaysia changed their dietary habits after breast cancer diagnosis and the main dietary changes made were reduced intake of high fat foods and increased intake of fruits and vegetables. Similar to other studies in western countries (Thomson et al., 2002; Patterson et al., 2003; Alfano et al., 2009), we found that the common dietary changes reported by the respondents in this study included decreased consumption of high fat foods, added fat foods, red meat, pork, poultry and high sugar foods and increased consumption of fish, fruits, vegetables and whole grains. Dairy products such as low fat milk and reduced fat cheese were highly avoided by many of the women. Cultural beliefs that high protein foods will cause the cancer to grow and spread could be the reason for this avoidance. The dietary changes made by the respondents are in agreement with the current dietary recommendations for healthy eating to prevent the risk of cancer recurrence by WCRF/AICR (2007).

In contrast to other studies, the present study found that change in physical activity was not significantly associated with weight changes in women after breast cancer diagnosis (Rock et al., 1999; Demark-Wahnefried et al., 2001; Irwin et al., 2005). The non-significant finding could be due to most of the women did not change or increase their physical activities after breast cancer diagnosis. Higher levels of physical activity after a breast cancer diagnosis were associated with a reduced risk of breast cancer mortality (Holmes et al., 2005). The Health, Eating, Activity and Lifestyle (HEAL) study (Irwin et al., 2008) reported that women who participated in any moderate intensity recreational physical activity, such as brisk walking for exercise after diagnosis had an approximately 64% lower risk of mortality than inactive women. Pierce et al. (2007) showed that a combination of eating five servings of fruits/vegetables per day and exercising six days/week for 30 minutes was associated with improved survival in breast cancer survivors. In our study, most women had made healthier changes in their diets but not in their physical activity level. Thus, these women are likely to experience adverse health outcomes in the future, unless positive actions are taken to change to a more physically active lifestyle.

The present study shows consistent findings with other studies (Irwin et al., 2005; Saquib et al., 2007), where younger women at the time of breast cancer diagnosis were more likely to gain more weight compared to older women. The Nurses' Health Study also showed that women who gained weight were slightly younger at the time of diagnosis compared to those who lost or maintained weight after breast cancer diagnosis (Kroenke et al., 2005). In the general population, adult women tend to gain weight until approximately 55 years of age, and then begin to have stable weight and subsequently, lose weight thereafter (Williamson, 1993; Lahmann et al., 2000; Ball et al., 2002). Women are more likely to gain the greatest amount of weight during their childbearing age

(between 25-44 years old) (Siega-Riz et al., 2008). This pattern of weight change is consistent with the findings in the present study, where older women gained less weight compared to younger women, with women in the 20-40 age group gained the greatest amount of weight.

Whole grain foods contain 20-50% of soluble or viscous forms of fibre (Chen and Anderson, 1986, Liu et al., 2000). Grains with high levels of soluble fibre, such as oats, rye and barley, may improve insulin sensitivity by slowing the absorption of macronutrients in the small intestine and prolong gastric emptying time (Hallfrisch and Behall, 2000) and the relatively lower palatability may promote satiety for up to several hours following a meal (Roberts, 2000). The present study found that women who increased the consumption of whole grains gained less weight ( $0.68 \pm 7.38\text{kg}$ ) compared to those who stopped ( $4.16 \pm 11.60\text{kg}$ ) or decreased ( $3.85 \pm 7.27\text{kg}$ ) the consumption of whole grains. These findings were consistent with several studies conducted among the general population, which reported that whole grain intake was inversely correlated with body weight and body fat distribution (Liu et al., 2003; Bazzano et al., 2005; Schulz et al., 2005). Merchant et al. (2009) showed that diets high in energy dense foods but low in whole grain are associated with an increased prevalence of overweight and obesity. Similarly, Koh-Banerjee et al. (2004) reported that increased intake of whole grains over a duration of eight years protected against weight gain among men in the United States.

This study showed that changes in the intake of fish contributed towards weight change among breast cancer patients. Although fish contains lower fat relative to other meats, the methods of food preparation could contribute to fish having higher fat content. Fish are usually eaten raw, boiled or grilled in the Japanese or western cuisines. However, in Malaysia, the common food preparation method for fish is usually deep-fried, grilled with oil or cooked as dishes (e.g. "sambal tumis" or "goreng berlada") (Malaysian Dietary Guidelines, 2010), which use excessive oil and fat. Frying with oil modifies the fatty acid composition of food and increases the energy density (Pokorn et al., 2003). The consumption of fried food may promote obesity through greater fat intake (Astrup et al., 2002) and energy density (Bell et al., 1998). In other words, even if fish intake is high, the choice of cooking method (e.g. frying) and the addition of oil or fat during food preparation could contribute to higher energy intake. Therefore, increasing fish intake may be expected to be associated with an increase in weight among breast cancer survivors in this present study.

In conclusion, this study found that Malaysian breast cancer survivors changed their dietary habits but not their physical activity behaviors. Lifestyle habits especially dietary intake and physical activity are significant determinants of cancer recurrence and survival. The World Cancer Research Fund/ American Institute for Cancer Research 2007 (WCRF/ AICR, 2007) guidelines were developed to serve as the foundation of recommendations provided to population as well as to cancer survivors to reduce their cancer risk and recurrence. These guidelines should be adapted and recommended to suit the needs of

Malaysian breast cancer survivors.

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