

RESEARCH COMMUNICATION

Pattern of Weight Changes in Women with Breast Cancer

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Abstract

This study describes weight changes experienced by Malaysian women with breast cancer. Women with breast cancer (n=368) were recruited from eight hospitals and four breast cancer support groups in Peninsular Malaysia. Current weight was measured and weight at the time of diagnosis and a year preceding diagnosis were based on self-reports. Change in weight was determined from the year preceding breast cancer diagnosis to study entry (time 1), at the time of diagnosis to study entry (time 2) and from a year preceding breast cancer diagnosis to the time of diagnosis (time 3). Current body mass index, at a year preceding diagnosis and at the time of diagnosis were determined. Waist circumference was also measured. The sample comprised 57% Malay, 34% Chinese and 9.8% Indian women. The mean age of the women was 54 ± 9.04 years and over 80% were post-menopausal. Majority of the women were in stage I and stage II breast cancer at the time of diagnosis. The most common treatments received by these women were chemotherapy followed by radiotherapy and mastectomy. Overweight and obesity were prevalent in over 40% of the survivors at all three periods. Significant weight changes were observed during time 1 ($-0.74 \pm 4.78\text{kg}$, $p < 0.001$), time 2 ($2.73 \pm 8.06\text{kg}$, $p < 0.001$) and time 3 ($3.47 \pm 7.53\text{kg}$, $p < 0.001$). At time 1, almost 50% showed no changes in their weight. At time 2, nearly two-thirds had gained weight and at time 3, 69% had gained weight, abdominal obesity was observed in nearly two-thirds of the women at study entry. A significant difference in weight change among age groups was observed in time 2 and time 3. All ethnic groups had significant weight change in time 1 and time 2. Significant weight gain was observed in relation to body mass index prior to diagnosis, at diagnosis and at study entry. However, no significant difference in weight change by educational level, family history of cancer and cancer stages were observed in all 3 periods. In conclusion, significant weight gain was evident in this sample of women after diagnosis of breast cancer and treatment. Women with breast cancer should be encouraged to maintain normal body mass index and waist circumference through appropriate diet and regular physical activity which may help to reduce their risk of recurrence, secondary cancer and metastasis.

Keywords: Weight change - breast cancer - Malaysian women

Asian Pacific J Cancer Prev, 11, 1535-1540

Introduction

Globally, it has been estimated that nearly 25 million persons are lived with cancer (Kamangar et al., 2006) which is one of the top ten leading causes of death worldwide (WHO, 2008). It is ranked second in the developed countries and was among the three leading causes of death in the developing countries (Globocan, 2002; WHO, 2004). On a global basis, breast cancer comprised 23% of all female cancers with an estimation of 1.15 million new cases in 2002 (Parkin et al., 2005). Breast cancer is also the most commonly diagnosed cancer among Malaysian women, which accounted for 16.5% of all cancer cases registered in 2006 (National Cancer Registry, 2006).

People with cancer generally experience weight loss due to the effect of the tumor, treatments, changes in appetite and dietary intake and deterioration of psychological well being. In contrast, the problem of weight gain is a common occurrence in breast cancer patients after diagnosis of the disease (Demark-Wahnefried et al., 1997). The amount of weight change experienced by women after diagnosis of breast cancer varies greatly while in some women weight change is not evident (Rock et al., 1999). Weight gain after breast cancer diagnosis has been associated with adverse effects on recurrences risk and survival (Chlebowski et al., 2002). In addition, overweight and obesity after diagnosis of breast cancer increase the risk for other chronic diseases. Menopausal status (Heideman et al., 2009), adjuvant chemotherapy (Freedman et al., 2004;

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Ingram & Brown, 2004), hyper-phagia and decreased physical activity (Rock, 2003) are some of the factors that have been associated with weight gain in women with breast cancer. This study describes weight changes in women after breast cancer in 3 time periods i.e. a year preceding breast cancer diagnosis, at the time of diagnosis and at study entry. Additionally, the relationship between weight changes and selected social-economic and health characteristics was examined.

Weight gain after diagnosis of cancer has been frequently reported but most data are limited to Western women and many do not describe the changes in weight prior to diagnosis and from pre-diagnosis to study entry. Since there are differences in the epidemiology of breast cancer and obesity between Asian and Western regions, there may also be ethnic differences in the pattern of weight gain after the initiation of breast cancer treatment. However, no data are available on weight changes before and after adjuvant treatment in Malaysian women with breast cancer.

Materials and Methods

Subjects

A retrospective cohort study was conducted on 368 respondents recruited from eight hospitals and four breast cancer support groups in Peninsular Malaysia. Respondents 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. The selection criteria of respondents were women 20-75 years old at the time of cancer diagnosis, had completed treatment for primary and invasive stage I, II or III breast carcinoma, not currently receiving any adjuvant chemotherapy and no evidence of recurrent disease or metastasis since completion of conventional treatment (mastectomy or lumpectomy with axillary lymph node dissection and consequent radiation and/or chemotherapy). The study protocol was approved by the Ethics Committee of Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Prior to data collection in hospitals, ethics approval and permission to conduct the study were obtained from Clinical Research Centre, Ministry of Health Malaysia and The Head of Department of Hospital, respectively. The permission to carry out the study at the breast cancer support groups' centers was obtained from the chairperson of the selected breast cancer support groups. A study information sheet was given to the respondents and informed consent was obtained from all the respondents prior to data collection.

A set of questionnaire was formulated according to the study objectives. The questionnaire was prepared in English and Bahasa Malaysia and was administered through face-to-face interview by trained interviewers. The instruments were pre-tested prior to data collection as to ensure the appropriateness, clarity and interpretation of instruments.

Information on social demographic data (e.g. age, education level, employment status, marital status), reproductive and breast cancer history (e.g. time since diagnosis, menopausal status, type of treatments), family

history of breast and other specific cancers, self-reported weight a year preceding breast cancer were collected.

Anthropometric Measurements

Current weight and height were measured using TANITA digital weighing scale (TANITA Corporation of America, Inc, United States) and SECA body meter (SECA, British Indicators Ltd, United Kingdom), respectively. Respondents were also requested to recall their weight a year preceding breast cancer diagnosis and at the time of diagnosis. BMI for 3 periods of time (a year preceding diagnosis, at the time of diagnosis and at the time of interview) were calculated and classified according to the World Health Organization (WHO, 1995) cut off points: underweight (<18.5kg/m²), normal weight (18.5-24.9kg/m²), overweight (25.0-29.9 kg/m²) and obese (≥30.0kg/m²). Waist circumference was measured using a SECA microtoise tape (SECA, British Indicators Ltd, United Kingdom). Waist circumference >80cm is considered as abdominal obesity and risk for chronic diseases for Asian women (World Health Organization, 1998).

Weight changes were defined as that occurring a year preceding diagnosis to the time of cancer diagnosis (time 1), from the time of cancer diagnosis to study entry (time 2) and from a year preceding diagnosis to study entry (time 3). The changes in weight were then categorized into the following groups: ≥5% weight loss, no weight change (0-5% weight loss or weight gain), ≥5% weight gain. These categories of weight changes were chosen because they are commonly used for weight loss recommendations to reduce risk of obesity and cancer (Doyle et al., 2006). A reduction of 5-10% of body weight is likely to have significant beneficial health effect on those who need to lose weight, even if the ideal weight was not achieved.

Statistical Analysis

The Statistical Package for the Social Sciences for Windows (SPSS for Windows) 16.0 software 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 and health characteristics before and after diagnosis of breast cancer. Statistical significance was set at $p < 0.05$.

Results

The mean age of the respondents (n=368) was 54 ± 9.04 years. The majority (76.9%) were recruited from selected hospitals while the remaining were recruited from the breast cancer support groups. More than half (57.1%) were Malay, followed by Chinese (33.2%) and Indian (9.8%). A majority (82.6%) of the respondents was married. Slightly more than half (51.9%) had completed secondary education and 69.3% were currently unemployed. The mean monthly personal income and monthly household income were $RM636.84 \pm 1306.84$ and $RM2022.58 \pm 2658.21$, respectively. Over 80% of the respondents

were post-menopausal at study entry. The mean duration since diagnosis was 4.86 ± 3.46 years. Slightly less than half (41.0%) of the respondents were diagnosed with stage II, 31.8% were diagnosed with stage I, 15.7% were diagnosed with stage III while the remaining 11.4% of them did not know the stage of their cancer. About 69% of the respondents reported family history of cancer. The type of treatments that the respondents received varied depending on their stage of cancer at the time of diagnosis. Most the

respondents had undergone surgery (mastectomy, 79.6%) and chemotherapy (82.9%).

The weight status of the respondents is described in Table 1. Table 2 reports the distribution of the respondents according to weight change at different time points and weight changes examined according to selected socio-demographic characteristics of the respondents are shown in Table 3. By age groups, there was a mild decline in weight in the 41-50 years group and a reduction of 1kg

Table 1. Weight Status in Women with Breast Cancer (N=368)

Weight information	Total n(%)	Mean \pm SD	
Weight a year preceding diagnosis (kg)		59.36 \pm 11.62	
Weight at time of diagnosis (kg)		58.73 \pm 11.93	NS**
Current weight (kg)		62.09 \pm 13.04	
BMI a year preceding diagnosis (kg/m ²)		24.82 \pm 4.62	
Underweight	21 (5.7)		
Normal	181 (49.2)		
Overweight	122 (33.2)		
Obesity	44 (12.0)		
BMI at time of diagnosis (kg/m ²)		24.55 \pm 4.74	
Underweight	30 (8.2)		
Normal	182 (49.5)		
Overweight	116 (31.5)		
Obesity	40 (10.9)		
Current BMI		25.93 \pm 5.06	
Underweight	20 (5.4)		
Normal	151 (41.0)		
Overweight	138 (37.5)		
Obesity	59 (16.0)		
Weight change from a year preceding diagnosis to the time of diagnosis (kg)		-0.74 \pm 4.78	2.799*
Weight change a year preceding diagnosis to present (kg)		2.73 \pm 8.06	-6.501*
Weight change from the time of diagnosis to present (kg)		3.47 \pm 7.53	-9.048*
Current waist circumference (cm)		84.81 \pm 11.59	
Abdominal obesity (≥ 80)	242 (65.8)		
Normal (< 80)	126 (34.2)		

* p < 0.001; **one-way ANOVA

Table 2. Distribution of Weight Change Before and After Diagnosis

Time period*	Total number gained weight	No weight change	Total number lost weight
Time 1	11 (12.0)	255 (69.3)	69 (18.8)
Time 2	173 (47.0)	114 (31.0)	81 (22.0)
Time 3	182 (49.5)	130 (35.3)	56 (15.2)

* A year preceding breast cancer diagnosis to the time of diagnosis; A year preceding breast cancer diagnosis to study entry; From the time of diagnosis to study entry

Table 3. Weight Changes Before and After Diagnosis by Socio-demographic Characteristics

Characteristics	n (%)	time 1	p-value	Weight changes*		time 3	p-value
				time 2	p-value		
Age group (years)							
20-40	29 (7.9)	0.4 \pm 3.1		3.2 \pm 7.1		2.7 \pm 7.7	
41-50	91 (24.7)	-0.3 \pm 4.9	NS	5.3 \pm 9.5	p < 0.05	5.6 \pm 8.0	p < 0.05
>50	248 (67.4)	-1.0 \pm 4.9		1.7 \pm 7.4		2.8 \pm 7.2	
Ethnic groups							
Malay	210 (57.1)	-0.5 \pm 4.7		3.4 \pm 8.6		3.9 \pm 7.6	
Chinese	122 (33.2)	-1.7 \pm 5.2	p < 0.05	0.9 \pm 6.7	p < 0.05	2.6 \pm 7.5	NS
Indian	36 (9.8)	1.0 \pm 2.6		4.9 \pm 8.1		3.9 \pm 6.9	
Education level							
Secondary and lower	184 (50.0)	-1.2 \pm 5.8	NS	2.4 \pm 8.8	NS	3.6 \pm 8.3	NS
Tertiary and others	184 (50.0)	-0.3 \pm 3.5		3.1 \pm 7.3		3.4 \pm 6.6	

* time 1- A year preceding breast cancer diagnosis to the time of diagnosis; Time 2- A year preceding breast cancer diagnosis to study entry; Time 3- From the time of diagnosis to study entry

Table 4. Association Between Weight Changes and Health Characteristics Before and After Diagnosis of Breast Cancer

Characteristics	n (%)	time 1	p-value	Weight changes*		time 3	p-value
				time 2	p-value		
Family history of cancer							
Yes	115 (31.2)	-0.7 ± 4.7	NS	3.2 ± 8.1	NS	4.0 ± 6.8	NS
No	253 (68.8)	-0.7 ± 4.8		2.5 ± 8.0		3.2 ± 7.8	
Cancer stages							
Stage I	117 (31.8)	-0.6 ± 5.1		3.6 ± 8.0		4.2 ± 8.2	
Stage II	151 (41.0)	-0.6 ± 4.4		2.3 ± 7.8		2.9 ± 6.7	
Stage III	58 (15.8)	-1.3 ± 4.4	NS	2.6 ± 9.3	NS	3.9 ± 8.5	NS
Do not know	42 (11.4)	-1.0 ± 5.8		2.1 ± 7.2		3.0 ± 6.9	
Menopausal status at study entry							
Pre-menopausal	70 (19.0)	0.3 ± 3.7	NS	5.2 ± 7.9	NS	5.0 ± 7.7	p<0.05
Post-menopausal	298 (81.0)	-1.0 ± 5.0		2.1 ± 8.0		3.1 ± 7.5	
BMI pre-diagnosis							
Underweight	21 (5.7)	0.4 ± 2.5		4.8 ± 6.7		4.4 ± 6.3	
Normal	181 (49.2)	-0.4 ± 4.8	NS	4.2 ± 7.4	p<0.05	4.6 ± 7.4	p<0.05
Overweight	122 (33.2)	-1.1 ± 4.4		1.6 ± 8.0		2.7 ± 6.9	
Obese	44 (12.0)	-1.7 ± 6.4		-1.0 ± 9.5		0.6 ± 9.2	
BMI at diagnosis							
Underweight	30 (8.2)	-3.6 ± 4.8		1.9 ± 7.9		5.5 ± 7.1	
Normal	182 (49.5)	-0.9 ± 5.0	p<0.05	3.4 ± 7.3	NS	4.3 ± 7.2	p<0.05
Overweight	116 (31.5)	0.3 ± 4.0		2.6 ± 8.4		2.9 ± 7.3	
Obese	40 (10.9)	1.2 ± 5.0		0.6 ± 10.1		-0.6 ± 8.4	
Current BMI							
Underweight	20 (5.4)	-1.1 ± 3.0		-2.9 ± 5.8		-1.9 ± 6.2	
Normal	151 (41.0)	-1.2 ± 4.0	p<0.05	0.4 ± 6.5	p<0.05	1.6 ± 5.8	p<0.05
Overweight	138 (37.5)	-0.9 ± 5.1		3.4 ± 7.2		4.4 ± 7.4	
Obese	59 (16.0)	1.0 ± 5.8		9.0 ± 10.1		8.0 ± 9.5	
Waist circumference (cm)							
<80 (normal)	242 (65.8)	-1.8 ± 5.3	p<0.05	-0.3 ± 6.9	p<0.05	1.5 ± 7.5	p<0.05
≥80 (abdominal obesity)	126 (34.2)	-0.2 ± 4.4		4.3 ± 8.2		4.5 ± 7.4	

* time 1- A year preceding breast cancer diagnosis to the time of diagnosis; Time 2- A year preceding breast cancer diagnosis to study entry; Time 3- From the time of diagnosis to study entry

in women 50 years and above. However, at time 2, all age groups had gained weight, the highest being 41-50 years (peri-menopausal group). A significant difference in weight change among age groups was observed in time 2. At time 3, again the peri-menopausal group gained significantly more weight than the younger and older age groups. Similar weight gain was seen in the youngest and the oldest age groups at time 3. At time 1, Chinese women experienced the highest reduction in weight (-1.7kg), followed by the Malay group. The Indian women on the other hand had gained a mean weight of 1kg at time 1. At time 2, all ethnic groups had gained weight and the highest weight gain was in the Indian group which was about 4kg. At time 3, a higher weight gain was seen in the Malay and Indian groups in comparison to the Chinese group. Irrespective of the weight gains observed these groups were not significantly different at time 3.

By educational level, women with secondary and lower education experienced a higher weight reduction in comparison to groups with tertiary and vocational education. At time 2, the group with tertiary education gained about 3kg and was higher than the group with secondary and lower education. At time 3, both educational groups had similar weight gain (3.4- 3.6kg). No significant difference in weight change was observed in all 3 periods.

For family history of cancer (with or without), a similar

reduction in weight but not significant, during time 1 was seen (Table 4). At time 2 and time 3, both groups had gained weight but the gain in weight was higher in the group with family history of cancer. However, no significant difference in weight change between those has family history of cancer and without cancer was observed at all the 3 time periods.

Weight changes at time 1, time 2 and time 3 were also considered for cancer stages. Weight loss ranging from -0.6kg in the stage I and Stage II to -1.3kg at stage III was seen at time 1. But, there was no significant difference among the stages. At time 2, weight gain ranging from 2.1kg in the "do not know" group to 3.6kg in the stage 1 group was observed. Again, no significant difference in weight gain was noted among the stages. At time 3, further weight gain was experienced in all stages of cancer with the highest weight gain of 4.2kg in stage I cancer.

For menopausal status, weight loss was experienced by the post-menopausal group while the pre-menopausal group gained some weight at time 1. At time 2, pre-menopausal women had gained about 5kg of weight while post-menopausal women gained less weight. At both times 1 and time 2, the groups were not significantly different. At time 3, both groups had gained weight but the magnitude of change was significantly higher in the pre-menopausal group.

By BMI status a year preceding diagnosis, only the

underweight group had gained a small amount of weight at time 1. The other groups during this time experienced a reduction in weight. At time 2, all groups with the exception of the obese group gained weight ranging from 1.6kg in the overweight group to 4.8kg in the underweight group. All BMI groups were significantly different at time 2. At time 3, all groups had gained weight with the lowest weight gain in the obese group. Weight changes at time 3 were significantly different among BMI groups.

Weight changes by BMI status at diagnosis at time 1 showed that weight gain was experienced by both overweight and obese groups, but the underweight and normal groups showed weight loss ranging from -0.9kg to -3.6kg. All groups were significantly different at time 1. At time 2, weight gain was observed in all BMI groups and the highest weight gain was in the normal BMI group. However, no significant difference among groups was found. At time 3, the obese group had lost weight but all other BMI categories had gained weight, the highest being in the underweight group.

Weight changes according to BMI status at entry were significantly different at all 3 times. At time 1, a reduction in weight was seen in all BMI categories with the exception of the obese group which had gained a mean weight of 1kg. At time 2, the obese group had gained 9kg followed by the overweight group (3.4kg). Weight gain was minimal in the normal BMI category but the underweight category showed a loss of weight of nearly 3kg. At time 3, the underweight group experienced a further loss of weight amounting to about -2kg, while the other categories gained weight ranging from 1.6kg in the normal category to 8kg in the obese group.

Based on waist circumference at study entry, a significant difference in weight change was noted in all 3 times between the normal and abdominally obese groups. At time 1, the normal group had lost nearly 2kg, while the abdominally obese group showed minimal weight loss. At time 2, the abdominally obese group had gained about 4kg, while the normal group showed a further loss in weight, but at time 3, both groups had gained weight with a higher gain observed in the abdominally obese group.

Discussion

In this study, weight changes among women with breast cancer were identified for 3 time periods which were from a year preceding diagnosis to time of diagnosis (time 1), from a year preceding diagnosis to study entry (time 2) and from time of diagnosis to study entry (time 3). Significant weight change was observed prior to and after diagnosis. Women had significantly gained weight both at time 2 and time 3, but had significant weight loss at time 1. Body mass index was highest at study entry. Almost half of the women had gained weight from a year preceding breast cancer diagnosis to study entry and from diagnosis to study entry. Less than 20% of the women in the study had lost weight, while in one-third of them body weight was stable.

Weight gain is a common observation among women with breast cancer. This study supports the existing evidence that women tend to gain weight after breast

cancer diagnosis. Weight gain observed from pre-diagnosis to study entry is somewhat similar to that reported by Caan et al., (2006) (2.4kg), but is lower than that reported in the WHEL study (3.17kg) (Pierce et al., 2002). A significant gain in weight amounting to 3-4kg after diagnosis of breast cancer was observed in this study. A review of literature indicates that women with breast cancer gained between 1- 6 kg during the first year after diagnosis (Irwin et al., 2005; Makari-Judson et al., 2007). Although factors promoting weight gain after breast cancer diagnosis have not been fully established, changes in dietary intake (Rock et al., 2000), reduction in physical activity (Irwin et al., 2003) and metabolic rates (Demark-Wahnefried et al., 2001) have been implicated. There is substantial evidence that weight gain after a diagnosis of breast cancer is more prevalent in women who received chemotherapy as part of their treatment (Demark-Wahnefried et al., 2001). In our study, more than 80% of women had undergone chemotherapy. Weight gain after diagnosis was greater in women treated with chemotherapy (2.5kg in the year after diagnosis) than with surgery and/ or hormonal therapy alone (0.6kg) (Irwin et al., 2005).

Overweight and obesity were prevalent in over 40% of the women prior to and after diagnosis, but more women had moved into the overweight and obese categories at study entry. Overweight status at diagnosis had been associated with a poorer prognosis (Chlebowski et al., 2002). A higher BMI in women after breast cancer diagnosis will increase the risk for recurrence and lower the survival (Chlebowski et al., 2002; Kroenke et al., 2005). Breast cancer survivors who increased their body mass index by 0.5- 2.0 kg/m² had a risk ratio of recurrence of 1.4 and those who gained more than 2.0 kg/m² had a risk ratio of 1.53, where both groups had significantly higher all cause mortality compared to survivors with a stable weight (Kroenke et al., 2005).

Weight and BMI can be used to estimate the prevalence of overweight and obesity; however, they do not detect the distribution of body fat. Waist circumference \geq 80cm in Asian women was used in this study as a criterion for abdominal obesity which is a strong risk factor for developing cardiovascular diseases, cancer and other chronic diseases. Abdominal obesity was found in two-thirds of the respondents (65.8%) at study entry. Most these women were also overweight as found in their BMI status. Therefore, most of the women are likely to experience adverse prognostic effect of abdominal obesity which may lead to a higher risk of developing cardiovascular diseases, diabetes and cancer recurrence (Abrahamson et al., 2006).

Weight changes during the 3 time periods were compared among selected socio-demographic characteristics. Significant changes were observed among the 3 ethnic groups with the Indian and Malay groups having the highest gain in weight in all the 3 time periods. BMI of Indian and Malay women in this study were significantly higher than Chinese women a year preceding diagnosis, at diagnosis and study entry, which may have contributed to the significant weight gain seen in the former groups. Ethnic differences have also been reported in other studies (Rock et al., 1999). Age was

also found to be a significant factor for weight gain. Post-menopausal women who were less than 50 years were significantly more likely than older post-menopausal or pre-menopausal women to report weight gain. A similar observation was also reported by Rock et al. (1999).

There are limitations in this study. First, this is a retrospective study where changes in weight from a year preceding breast cancer diagnosis to study entry were measured based on self-reports. Diet and physical activity were not measured which could explain the changes in weight in this sample of women. Recall bias may also influence the respondent's reports of previous body weight. Some misclassification of body weight status may have occurred due to the self-reported data on body weight. Nevertheless, this is the first study to investigate weight changes prior to and after diagnosis in a sample of Malaysian women diagnosed with breast cancer.

In conclusion, This study further reiterates existing evidence that weight gain is common in Malaysia women with breast cancer. Based on selected socio-demographic characteristics higher weight gain was observed in the middle age adult women prior to after diagnosis of breast cancer and weight gain was the highest in the Indian women. Significant weight gain was observed in relation to body mass index prior to diagnosis, at diagnosis and at study entry, indicating that body mass index may a strong predictor of weight gain particularly if one is already overweight or obese at diagnosis. Weight gain after breast cancer diagnosis is associated with a poorer survival and increases the risk for developing other chronic diseases as well. Although there is limited evidence to show that a plant-based and low fat diet prevents recurrence or prolongs life, a diagnosis of breast cancer provides a teachable moment to motivate women to make lifestyle changes through appropriate diet and regular physical activity which will help to maintain a healthy body weight, and to improve overall quality of life and health status during and after breast cancer treatments.

Acknowledgments

This research was supported by funding from the Fundamental Research Grant Scheme (FRGS). The authors acknowledge the assistance of all hospitals and breast cancer support groups. None have competing or conflicts of interest in the study.

References

Abrahamson PE, Gammon MD, Lund MJ, et al (2006). Recreational physical activity and survival among young women with breast cancer. *Cancer*, **107**, 1777-85.

Caan BJ, Emond JA, Natarajan L, et al (2006). Post-diagnosis weight gain and breast cancer recurrence in women with early stage breast cancer. *Breast Cancer Res Treat*, **99**, 47-57.

Chlebowski RT, Aiello E, McTiernan A (2002). Weight loss in breast cancer patient management. *J Clin Oncol*, **20**, 1128-43.

Demark-Wahnefried W, Rimer BK, Winer EP (1997). Weight gain in women diagnosed with breast cancer. *J Am Diet Assoc*, **97**, 519-26.

Demark-Wahnefried W, Peterson BL, Winer EP, et al (2001). Changes in weight, body composition, and factors influencing energy balance among premenopausal breast cancer patients receiving adjuvant chemotherapy. *J Clin Oncol*, **19**, 2381-9.

Doyle C, Kushi LH, Byers T (2006). Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. *Cancer J Clin*, **56**, 323-53.

Heideman WH, Russell NS, Gundy C, et al (2009). The frequency, magnitude and timing of post-diagnosis body weight gain in Dutch breast cancer survivors. *Eur J Cancer*, **45**, 119-26.

Freedman RJ, Aziz N, Albanes D, et al (2004). Weight and body composition changes during and after adjuvant chemotherapy in women with breast cancer. *J Clin Endocrinol Metab*, **89**, 2248-53.

Ingram & Brown (2004). Patterns of weight and body composition change in premenopausal women with early stage breast cancer. *Cancer Nurs*, **27**, 483-90.

Irwin ML, Crumley D, McTiernan A, et al (2003). Physical activity levels before and after a diagnosis of breast carcinoma: The Health, Eating, Activity, and Lifestyle (HEAL) Study. *Cancer*, **97**, 1746-57.

Irwin ML, McTiernan A, Baumgartner RN, et al (2005). Changes in body fat and weight after breast cancer diagnosis: Influence of demographic, prognostic, and lifestyle factors. *J Clin Oncol*, **23**, 774-82.

Kroenke CH, Chen WY, Rosner B, et al (2005). Weight, weight gain, and survival after breast cancer diagnosis. *J Clin Oncol*, **23**, 1370-8.

Malaysian Cancer Statistics - Data and Figure Peninsular Malaysia (2006). National Cancer Registry. Kuala Lumpur.

Makari-Judson G, Judson CH, Mertens WC (2007). Longitudinal patterns of weight gain after breast cancer diagnosis: Observations beyond the first year. *Breast J*, **13**.

Parkin DM, Bray F, Ferlay J, et al (2005). Global cancer statistics, 2002. *Cancer J Clin*, **55**, 74-108.

Pierce JP, Faerber S, Wright FA, et al (2002). A randomized trial of the effect of a plant-based dietary pattern on additional breast cancer events and survival: the Women's Healthy Eating and Living (WHEL) Study. *Control Clin Trials*, **23**, 728-56.

Rock CL, Flatt SW, Newman V, et al (1999). Factors associated with weight gain in women after diagnosis of breast cancer. *J Am Diet Assoc*, **99**, 1212-21.

Rock CL, McEligot AJ, Flatt SW, et al (2000). Eating pathology and obesity in women at risk for breast cancer recurrence. *Int J Eat Disord*, **27**, 172-9.

Rock CL (2003). Diet and breast cancer: Can dietary factors influence survival? *J Mammary Gland Biol Neoplasia*, **8**, 119-32.

World Health Organization (1995). Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series 854. Geneva: World Health Organization.

World Health Organization (1998). Obesity: Preventing and managing the global epidemic. Report of a WHO Consultation on Obesity. Geneva: World Health Organization.

World Health Organization (2007). World Health Statistics. Geneva: World Health Organization.