RESEARCH ARTICLE

Obesity, Diet and Physical Inactivity and Risk of Breast Cancer in Thai Women

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Abstract

To evaluate the relationship between obesity, diet, physical activity and breast cancer in Thai women, we conducted a case control study with 1,130 cases and 1,142 controls. Informed consent was obtained from all participants and a structured questionnaire was performed by trained interviewers to collect information on demographic and anthropometric data, reproductive and medical history, residential history, physical activity and occupation as well as dietary habits. A significant positive association with an increased risk of breast cancer was observed in women body mass index (BMI) of ≥25 mg/m^2 (OR=1.33, 95%CI 1.07-1.65), the risk being higher in postmenopausal women (OR=1.67, 95%CI 1.24-2.25). In addition, underweight BMI at ages 10 and 20 years showed an inverse association in all women (OR=0.70, 95%CI 0.56-0.88 and OR=0.74, 95%CI 0.59-0.93, respectively) and in those with a premenopausal status (OR=0.69, 95%CI 0.51-0.93 and OR=0.76, 95%CI 0.56-0.99, respectively). Regular exercise was associated with a decreased risk of breast cancer (OR=0.78, 95%CI 0.68-0.98). Interestingly, analysis by type of activity revealed significant protective effects for women who reported the highest levels of walking for shopping (OR=0.58, 95%CI 0.38-0.88). High consumption of vegetables and fruit were associated with a decreased risk of breast cancer, while high consumption of animal fat showed an increased risk in postmenopausal women. In conclusion, our results indicate that obesity and high consumption of animal fat are associated with breast cancer risk, particularly in postmenopausal women, while recreational physical activity has protective effects. It seems that primary prevention of breast cancer should be promoted in an integrated manner. Effective strategies need to be identified to engage women in healthy lifestyles.

Keywords: Breast cancer - diet - obesity - physical activity - case control study

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Introduction

Breast cancer is the most common cancer among Thai women. There are evidences that the occurrence of breast cancer will continuously increase in Thailand. Although the association of overweight and obesity with postmenopausal breast cancer in Caucasians is well established, however, there is a few data among Asian women.

As living standard improve, obesity is becoming epidemic conditions not only in developed countries, but also in less developed countries. The international Agency for Research on Cancer (IARC) estimates that 25% of cancer worldwide are caused by overweight or obesity and a sedentary lifestyle (Vainio et al., 2002). The current trend of increasing numbers of adults and children who are overweight or obese and report low levels of physical activity make understanding the association of these lifestyle patterns with cancer as a pressing healthcare issue. These lifestyle patterns may increase cancer risk by several mechanisms including increased estrogens and testosterone leading to increased risk of breast and endometrial cancers; hyperinsulinemia and insulin resistance leading to increased risk of colon, breast, and pancreatic cancers; and increased inflammation and depressed immune function leading to several cancers (McTiernan et al., 1998). Data from the national health examination survey also showed the increasing rates of obesity in Thai population (Aekplakorn et al., 2009).

To elaborate on public health recommendation, further clarification of the association between obesity, diet, physical activity and breast cancer in Thai women is needed. We therefore analyzed data from a recently conducted case control study.

Materials and Methods

Ethical approval

This project was approved by the ethics committee of the National Cancer Institute. Informed consent was

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obtained from all participants before enrollment to the study.

Study participants

Cases were all new incident breast cancer patients histologically diagnosed at the National Cancer Institute in Bangkok during the period of May 2002 - March 2004 and August 2005-August 2006, with a participation rate of 99.6% (1126/1130). Controls were randomly selected from healthy women who visited patients admitted to the same hospitals for diseases other than breast or ovarian cancer. Control subjects were recruited during the same study period as the case ascertainment with a participate of 98.4% (1135/1142).

Data collection and statistical analysis

A structured questionnaire was used to obtained information on demographic background, socioeconomic status, reproductive and medical history, residential history, physical activity and occupation as well as dietary habits. Anthropometric measurement body height (cm) and weight (kg) were collected at the time of diagnosis. Estimated BMI at age 10 and 20 years were obtained by using BMI visual graph. Physical activity and food consumption were categorized into quartiles for analyses based on the distribution of each value among control subjects. Odd ratios (ORs) and 95% confidence intervals (CIs) were estimated by unconditional logistic regression analysis adjusted for potential confounders. Physical activity was assessed using 20 questions designed to measure both leisure time and work activities. These questions aimed to quantity time (hours and minutes) spent in bed (sleeping and resting), performing household activities (cooking and cleaning) and discretionary activities (eg. gardening, walking, bicycling and exercise). A specific metabolic equivalent (MET) abstracted from the Compendium of Physical activity was assigned to each activity according to its reported intensity (Ainsworth et al., 2011). A MET is defined as a ratio of the metabolic rate associated with a specific activity to the resting metabolic rate. The variables estimated for the analyses were expressed in MET-hours/week, calculated as the mean number of hours per week.The retrospective dietary intake of the study participants was estimated using a semi-quantitative food frequency questionnaire where cases and controls were asked to report the frequency (how often) and portion size for each food item consumed during of 12-month prior breast cancer diagnosis for cases and prior being interviewed for controls. The usual food intakes derived from the FFQ were calculated by multiplying the frequency of consumption with the daily portion size for each food group. All analyses were performed in SPSS for window (version 16.0). All tests were two-sided, with the significance level of 0.05.

Results

Characteristics of the study population were compared by case-control status, as shown in Table 1. The mean age of controls (43.7±11.6 years) was significantly lower (p<0.01) than that of breast cancer patients (47.0±10.4 years). Pregnancy, menopausal status, breast feeding, involuntary tobacco smoking, family history of breast cancer, and education were different between cases and controls. However, for tobacco smoking and alcohol

Table 1. Selected Characteristics of Study Population

Characteristics		Cases	Controls	p value
Age	≤40	326 (34.9±4.2)	451 (32.1±6.0)	0.001
	41-55	575 (47.9±4.0)	523 (48.0±4.2)	
	>55	229 (62.1±5.5)	168 (61.4±4.7)	
		1130 (47.0±10.4)	1142 (43.7±11.6)	
Pregnancy	No	249 (22.4%)	294 (26.6%)	0.023
	Yes	860 (77.6%)	810 (73.4%)	
Breast feeding	No	98 (12.0%)	67 (8.6%)	0.032
	Yes	719 (88.0%)	708 (91.4%)	
Manupausal status				
Premenopausal		643 (57.0%)	749 (65.7%)	0.001
Prostmenopausal		484 (43.0%)	390 (34.3%)	
Tobacco smoking				
	No	1089 (96.9%)	1111 (97.5%)	0.448
	Yes	35 (3.1%)	29 (2.5%)	
Involuntary smoking				
	No	961 (88.3%)	1032 (92.5%)	0.001
	Yes	128 (11.7%)	84 (7.5%)	
Alcohol	No	1056 (93.4%)	1061 (93.0%)	0.619
	Yes	74 (6.6%)	81 (7.0%)	
Family history of breast cancer				
	No	1080 (95.7%)	1116 (98.4%)	0.001
	Yes	49 (4.3%)	18 (1.6%)	
Education	12	777 (68.9%)	601 (52.7%)	0.001
(Years)	>12	351 (31.1%)	540 (47.3%)	

Table 2. Association between Obesity - Selected Indices and Risk of Breast Cancer

Measurement		All			Premenopausal			Postmenopausal		
		Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)
Body Mass Index	18.5-24.9	612	712	1	362	450	1	248	259	1
(kg/m^2)	<18.5	71	95	1.19(0.72-1.97)	44	80	1.01(0.53-1.93)	27	15	1.94(0.98-3.85)
	≥25	434	329	1.33(1.07-1.65)	230	214	1.08 (0.81-1.43)	203	115	1.67(1.24-2.25)
Waist circumference	<80	564	664	1	363	472	1	199	190	1
(cm)	≥80	537	464	1.07(0.86-1.32)	265	268	0.99(0.75-1.30)	271	195	1.18(0.89-1.57)
Hip circumference	<100	659	758	1	401	526	1	256	230	1
(cm)	≥100	405	345	1.18(0.95-1.47)	208	199	1.22(0.91-1.63)	196	146	1.12(0.84-1.50)
Waist-Hip Ratio	<0.85	680	719	1	417	501	1	261	216	1
	≥0.85	405	390	0.89(0.72-1.11)	201	229	0.87(0.65-1.15)	203	161	0.96(0.72-1.27)
BMI at age 10 years	Normal	420	334	1	226	194	1	192	138	1
	Underweight	639	749	0.70(0.56-0.88)	378	508	0.69(0.51-0.93)	260	240	0.80(0.60-1.07)
	Overweight	52	56	0.87(0.51-1.48)	30	45	0.68(0.35-1.33)	22	11	1.50(0.67-3.36)
BMI at age 20 years	Normal	724	671	1	400	420	1	322	250	1
	Underweight	291	387	0.74(0.59-0.93)	181	272	0.76(0.56-0.99)	109	115	0.74(0.54-1.02)
	Overweight	97	80	1.20(0.81-1.78)	53	54	1.22(0.73-2.03)	44	24	1.32(0.77-2.26)

Table 3. Association between Physical Activities and Risk of Breast Cancer

Characteristic		All			Premenopausal			Postmenopausal		
		Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)
Regular exercise	No	798	658	1	431	395	1	365	260	1
	Yes	325	476	0.78(0.62-0.98)	208	348	0.76(0.57-0.99)	116	128	0.71(0.52-0.98)
Home activities	Q1 (< 420)	294	288	1	140	141	1	153	146	1
(METs-Min/Week)	Q2 (421-655)	284	282	0.96(0.71-1.29)	154	189	0.74(0.48-1.14)	130	93	1.27(0.89-1.83)
	Q3 (666-1020)	291	286	1.05(0.78-1.41)	176	211	0.81(0.53-1.22)	113	75	1.36(0.93-1.99)
	Q4 (>1021)	260	283	1.00(0.74-1.36)	173	206	0.85(0.56-1.29)	87	75	1.06(0.71-1.57)
Walk for shopping	Q1 (<55)	375	312	1	180	181	1	194	130	1
(METs-Min/Week)	Q2 (55-138)	431	389	1.1(0.86-1.42)	252	244	1.19(0.84-1.67)	178	145	0.93(0.68-1.29)
	Q3 (139-276)	241	284	0.88(0.66-1.17)	159	199	0.93(0.64-1.36)	82	84	0.73(0.49-1.09)
	Q4 (>276)	82	154	0.58(0.38-0.88)	52	123	0.57(0.34-0.95)	29	30	0.80(0.44-1.45)

Table 4. Association between Dietary Consumption and Risk of Breast Cancer

Dietary consumption		All			Premenopausal			Postmenopausal		
		Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)	Cases	Controls	OR* (95%CI)
Cooked vegetable	Q1 (<76)	269	279	1	136	152	1	132	126	1
(gram/week)	Q2 (76-340)	480	430	1.14(0.87-1.49)	275	301	0.91(0.63-1.31)	205	129	1.49(1.06-2.09)
	Q3 (341-680)	159	135	1.31(0.91-1.88)	103	106	1.03(0.65-1.63)	54	28	1.77(0.99-3.03)
	Q4 (>680)	134	216	0.63(0.45-0.88)	69	134	0.53(0.33-0.85)	65	82	0.68(0.44-1.05)
Fresh vegetable	Q1 (<113)	350	321	1	174	177	1	176	143	1
(gram/week)	Q2 (113-340)	388	361	0.89(0.68-1.16)	229	252	0.85(0.59-1.23)	158	109	1.09(0.78-1.53)
	Q3 (341-680)	155	146	0.88(0.63-1.24)	97	113	0.74(0.47-1.14)	56	33	1.32(0.79-2.18)
	Q4 (>680)	151	220	0.55(0.40-0.76)	77	135	0.49(0.31-0.78)	74	84	0.63(0.42-0.95)
Fruit (gram/week)	Q1 (<113)	300	296	1	163	187	1	136	109	1
	Q2 (113-340)	301	272	1.21(0.91-1.62)	159	167	1.36(0.92-2.03)	141	104	1.17(0.81-1.70)
	Q3 (341-1361)	338	285	1.38(1.04-1.83)	198	202	1.44(0.98-2.09)	139	83	1.37(0.94-2.02)
	Q4 (>1361)	117	209	0.57(0.40-0.81)	70	136	0.63(0.40-0.99)	47	72	0.56(0.35-0.89)
Fish	Q1 (<76)	240	272	1	137	166	1	102	105	1
(gram/week)	Q2 (76-227)	341	311	1.16(0.86-1.57)	193	213	1.07(0.72-1.59)	147	98	1.44(0.98-2.13)
	Q3 (228-340)	301	294	1.09(0.81-1.46)	162	189	1.06(0.71-1.58)	138	104	1.21(0.82-1.80)
	Q4 (>340)	195	206	0.90(0.65-1.24)	112	128	0.99(0.64-1.53)	83	78	1.00(0.65-1.53)
Pork	Q1 (<28)	256	271	1	134	145	1	212	125	1
(gram/week)	Q2 (28-113)	404	376	1.12(0.85-1.47)	201	243	0.92(0.63-1.33)	202	132	1.55(1.10-2.20)
	Q3 (114-227)	140	162	1.09(0.77-1.54)	74	103	0.82(0.51-1.32)	64	59	1.16(0.74-1.81)
	Q4 (>227)	246	247	1.18(0.86-1.63)	182	204	0.98(0.65-1.46)	65	43	1.54(1.09-2.49)
Chicken	Q1 (<57)	298	331	1	157	177	1	140	153	1
(gram/week)	Q2 (57-113)	252	247	1.22(0.91-1.64)	130	152	1.02(0.68-1.53)	122	94	1.53(1.06-2.21)
	Q3 (114-340)	387	367	1.37(1.05-1.78)	224	267	1.09(0.77-1.55)	161	100	1.70(1.20-2.41)
	Q4 (>340)	117	122	1.26(0.85-1.86)	81	93	1.18(0.72-1.94)	36	29	1.54(0.89-2.69)

consumption, no significant differences were found. As presented in Table 2, cases had higher BMI than control, OR=1.33, 95%CI 1.07-1.65. When the results were stratified by menopausal status, the association between BMI and breast cancer risk showed stronger effect for postmenopausal women (OR=1.67, 95%CI 1.24-2.25), but no association was observed among premenopausal women. Underweight of BMI at age 10 and 20 years showed an inverse association in all women (OR=0.70, 95%CI 0.56-0.88 and OR=0.74, 95%CI 0.59-0.93, respectively) and in premenopausal status (OR=0.69, 95%CI 0.51-0.93 and OR=0.76, 95%CI 0.56-0.99). There were no different between waist circumstance, hip circumference or waist to hip ratio between cases and control. Data of habitual physical activity are presented in Table 3. Women who had regular exercise during young adulthood were at significantly lowered OR in all women, as well as in premenopausal and postmenopausal women (OR=0.78, 95% 0.62-0.98; OR=0.76, 95%CI 0.57-0.99; OR=0.71, 95% 0.52-0.98, respectively). In addition, analyses by type of activity revealed significant protective effects for women who reported the highest quartile of walking for shopping in all and premenopausal women (OR=0.58, 95%CI 0.38-0.88 and OR=0.57, 95%CI 0.34-0.95, respectively). Household activity had no association with breast cancer risk. Table 4 shows the common dietary habits of the study participants. We observed a decreased risk of breast cancer with the highest quartile of vegetable and fruit consumption in all women group. Consumption of fish show no association with breast cancer risk. In postmenopausal women, an increased risk of breast cancer was observed among women who reported the highest quartile of eating pork (OR=1.54, 95%CI 1.09-2.49). A similar findings were observed for high consumption of chicken, OR=1.53 (95%CI 1.06-2.21) for quartile 2 and OR= 1.70 (95%CI 1.20-2.41) for quartile 3.

Discussion

Our results indicated that obesity, diet and physical inactivity may play an important role in the etiology of breast cancer. Usually, BMI is used to evaluate generalized obesity, whereas WHR or WC are used to evaluate central obesity. Many studies have concluded that obesity may increase risk of breast cancer in postmenopausal women, but no association has been identified for premenopausal women (van den Brandt et al., 2000; Deng et al., 2001; La Vecchia et al., 2011). Our results support this finding, we found that BMI was significant associated with breast cancer (OR=1.33, 95%CI 1.07-1.65), and the risk was higher in post-menopausal status (OR=1.67, 95%CI 1.24-2.25). The association between breast cancer and central obesity is inconsistent. Some studies have indicated that central obesity is a risk factor for breast cancer (Friedenreich, 2001), whereas others have found no association (Sonnenschein et al., 1999). In this study, we found no difference between breast cancer cases and control groups for WC, HC or WHR.

Assessing physical activity in epidemiologic studies is difficult because of the complex nature of lifestyle exposure, the lack of available gold standards to validate exposure assessments, and the need to rely on self-reports. The use of different methods of assessment may explain the heterogeneity of the results observed across previous studies of physical activity and breast cancer (Ainsworth et al., 1998). Our results show that women who had regular exercise during young adulthood were at lower risk of breast cancer. Interestingly, analyses by type of activity revealed significant protective effects for women who reported the highest quartile of walking for shopping in premenopausal women (OR=0.57, 95%CI 0.34-0.95).

Various mechanisms of physical activity have been associated with several cancers, such as alterations in sex hormones and insulin growth factors, alterations in free radical generation, factors affecting body fat distribution, and direct effects on cancer (Shephard et al., 1995; Stein et al., 2004; Inoue et al., 2008; van Gils et al., 2009; Velthius et al., 2009). Exercise may act as an immune modulator that induces changes in the activity of macrophages, natural killer cells, lymphokine-activated killer cells, neutrophils, and regulating cytokines (Shephard et al., 1995). The effects of physical activity on age at menarche, menstrual cycle function, and level of endogenous sex steroid hormone levels in girls and young women are often cited as potential mechanisms for reduced breast cancer risk (Bernstein et al., 1994). Exercise may cause minor shifts in the hormonal milieu of premenopausal women (Bullen et al., 1984; Keizer et al., 1987), but exercise of significant frequency and intensity is needed to induce menstrual dysfunction sufficient to result in significantly decreased exposure to sex-steroid hormones (Bullen et al., 1985).

Fruits and vegetables are common sources of many nutritional compounds, such as dietary fiber, vitamins, minerals, and other bioactive compounds (phytochemicals), that may reduce the occurrence of breast cancer (Michels et al., 2007). However, the bioavailability of these compounds in fruits and vegetables is variable and their ultimate health effects are uncertain (World Cancer Research Fund International, 2007). In our study, we found that high intake of vegetables and fruits were associated with a decreased risk of breast cancer. The associations of dietary factors with breast cancer did not vary by menopausal status. Other studies, mostly conducted in Asian populations, have found the same protective effect (Malin et al., 2003; Gaudet et al., 2004; Shannon et al., 2005; Do et al., 2007; Aune et al., 2009; Zhang et al., 2009). A meta-analysis of 23 studies also concluded that vegetable intake reduced breast cancer risk by 20% to 25% (Gaudet et al., 2004). However, a pooled analysis of eight prospective studies conducted largely in Western populations did not find any protective effect for fruit or vegetable consumption (Smith-Warner et al., 2001). Regarding meat intake, we found that pork and chicken intake was positively associated with breast cancer among postmenopausal women. However, previously published studies on the association between breast cancer and meat intake have been inconsistent and suggested a null association (Missmer et al., 2002; Talor et al., 2007; Kobat et al., 2009; Pala et al., 2009). It was recently suggested by a review article (Ferguson, 2010) that the increase in risk associated with meat intake may not be a function of meat per se, but may reflect high intake of fat and/or be attributable to the carcinogens generated through various cooking and processing methods. Meat cooked at a high temperature may contain mammary-specific carcinogens, such as heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs) (Knize et al., 1999; Balogh et al., 2000).

Our study has some potential limitations. The retrospective assessment of diet and physical activity may have an inherent measurement error. Although the average serving sizes were estimated, we did not ask about specific portion size. Another limitation is a possible recall bias. Reporting on the basis of histories may be biased because of the patients having knowledge of their diseases.

In conclusion, our results indicate that many nutritional factors, physical activity and obesity may play an important role in the etiology of breast cancer. Preventive strategies aimed at improving nutrition and energy imbalance may have a powerful effects on a series of pathologic conditions that may represent a source of incidence of breast cancer in Thai women.

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