Comparisons of food intake between breast cancer patients and controls in Korean women

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Abstract

The purpose of this study was to compare food intakes between Korean breast cancer patients and a healthy control group. We compared the intake of nutrients of 117 food items between Korean breast cancer patients (n=97) and age matched healthy controls (n=97). Nutrient intake was estimated using a quantitative food frequency questionnaire. The mean caloric intake of breast cancer patients and healthy controls was not significantly different. Breast cancer patients consumed significantly less fat and antioxidant nutrients such as vitamin A, retinol, β-carotene, vitamin C and vitamin E when compared to the control subjects. Among the food items, the intake of eggs (p<0.01), legumes (p<0.05), vegetables (p<0.05), seasonings (p<0.001), and oils and fats (p<0.01) in breast cancer patients was significantly lower than that in the controls. These results suggest that Korean breast cancer patients consumed less amount of soy and vegetables, which are rich source of antioxidant nutrients and phytosterols. Thus, dietary guidance to increase intake of these foods may be beneficial in the prevention of breast cancer.

Key Words: Breast cancer, fat, antioxidant vitamin, vegetable, soy

Introduction

Although the incidence of female breast cancer in most Asian countries is much lower than that in Western countries (Hirose et al., 2007), there has been a marked increase in recent years. Each year, it is estimated that one million women are newly diagnosed with breast cancer (Stewart & Kleihues, 2003). The incidence have been shown to be rising in Asian countries due to changes in lifestyle. In Korea, the incidence of breast cancer has doubled between 1987 and 2002 (Ministry of Health and Welfare, 2002).

Much of the international variation is due to differences in established genetic risk factors but diet might also contribute to risk and provide a potentially modifiable target for prevention. Recent efforts have focused on identifying dietary risk modulators. Both fat and fatty acids (Jakovljevi et al., 2002; Smith-Waner et al., 2001; Velie et al., 2000) have been shown to confer an increased risk, while fruits and vegetables (Gandini et al., 2001; Hanf & Gonder, 2005; Olsen et al., 2003) and phytoestrogens (Dai et al., 2002; Horn-Ross et al., 2001; Mc-Michael-Phillips et al., 1998; Ziegler, 2004) afford a protective effect against breast cancer. Comparison studies of the food intake in breast cancer patients in Korean women are relatively rare. Therefore, we compared food intakes between Korean breast cancer patients and their age-matched controls.

Subjects and Methods

Subjects

The cases included 97 women with diagnosed breast cancer, and the age-matched controls included 97 women who were clinically healthy. Case subjects were collected women with histologically newly confirmed diagnosis of breast cancer at the inpatient or outpatient clinic of Yeouido St. Mary’s Hospital, Seoul, Korea. The patients were chosen for the study after having a preliminary evaluation consisting of a brief medical history, smoking and alcohol habits and physical examinations. Patients with any history of liver diseases, diabetes mellitus, respiratory disorders and cardiovascular diseases were not included in the study. Controls were frequency matched by age and included outpatients in the department of general surgery at the same hospital during the same time period. Exclusion criteria for controls were those with known malignant, hormonal, gynaecological or endocrine diseases. All cases and controls were interviewed by a trained dietitian. The questionnaire included general information (age, sex and marital status), age at menarche, and pregnancy history.

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A questionnaire was coded and analyzed for nutrient intake by selecting the amounts of foods consumed. The food frequency showed food models and photographs of the standard serving size, a serving size, and a 1.5 serving size. The interviewer asked '3 per day', '3~4 per week', '5~6 per week', '1 per day', '2 per day', '1 per month', '2~3 per month', '1 per week', '2 per week', '3~4 per week', '5~6 per week', '1 per day', '2 per day', '3 per day'. The portion sizes were set as follows: a 0.5 serving week', '3~4 per week', '5~6 per week', '1 per day', '2 per day', '1 per month', '2~3 per month', '1 per week', '2 per week', '3~4 per week', '5~6 per week', '1 per day', '2 per day', '3 per day'. The portion sizes were set as follows: a 0.5 serving.

### Table 1. Descriptive characteristics of patients with breast cancer and age-matched controls

|                      | Cancer (n=97) | Control (n=97) | p value |
|----------------------|--------------|---------------|---------|
| Age (y)              | 49.64 ± 9.35 | 49.79 ± 9.25  | N.S.²   |
| Weight (kg)          | 58.85 ± 7.56 | 57.74 ± 7.40  | N.S.    |
| Height (cm)          | 157.49 ± 5.25| 158.64 ± 5.03 | N.S.    |
| BMI² (kg/m²)         | 23.68 ± 2.99 | 22.97 ± 3.04  | N.S.    |
| Age at menarche (y)  | 14.60 ± 7.79 | 15.44 ± 1.90  | p<0.01  |
| Parity (n)           | 2.52 ± 2.88  | 2.34 ± 1.02   | N.S.    |
| Age first term birth (y) | 25.45 ± 5.26 | 25.80 ± 2.97  | N.S.    |

¹ values are mean ± SD; ² not significant

### Table 2. Daily intake of energy and nutrients assessed by the quantitative food frequency questionnaire

|                      | Cancer (n=97) | Control (n=97) | p value |
|----------------------|--------------|---------------|---------|
| Energy (kcal)        | 1773.76 ± 528.98 | 1847.85 ± 557.63 | N.S.¹ |
| Carbohydrate (g)     | 297.35 ± 81.01 | 296.21 ± 84.38 | N.S.    |
| Protein (g)          | 68.13 ± 23.80 | 75.76 ± 26.41 | p<0.05  |
| Animal protein (g)   | 25.91 ± 14.53 | 28.30 ± 16.41 | N.S.    |
| Plant protein (g)    | 42.21 ± 12.83 | 47.45 ± 47.45 | p<0.01  |
| Fat (g)              | 35.60 ± 18.82 | 42.85 ± 21.01 | p<0.01  |
| Animal fat (g)       | 20.36 ± 12.35 | 23.10 ± 13.90 | N.S.    |
| Plant fat (g)        | 15.24 ± 8.53  | 19.74 ± 9.30  | p<0.01  |

¹ values are mean ± SD; ² not significant

### Table 3. Mean daily fatty acids intake of patients with breast cancer and their age-matched controls

|                      | Cancer (n=97) | Control (n=97) | p value |
|----------------------|--------------|---------------|---------|
| Total fatty acids (g) | 18.08 ± 11.69| 21.95 ± 13.61 | p<0.05  |
| SFA³ (g)             | 7.00 ± 4.82  | 8.17 ± 5.69   | N.S.²   |
| MUFA⁴ (g)            | 6.90 ± 4.79  | 8.25 ± 5.38   | N.S.    |
| PUFA⁵ (g)            | 4.17 ± 2.49  | 5.52 ± 3.04   | p<0.001 |
| ω-3 fatty acids (g)  | 0.45 ± 0.26  | 0.56 ± 0.30   | p<0.01  |
| ω-6 fatty acids (g)  | 3.70 ± 2.29  | 4.83 ± 2.81   | p<0.01  |

³ values are mean ± SD; ² not significant

### Table 4. Daily vitamin intake assessed by the quantitative food frequency questionnaire

|                      | Cancer (n=97) | Control (n=97) | p value |
|----------------------|--------------|---------------|---------|
| Total vitamin A (μg R.E) | 759.85 ± 505.42| 976.43 ± 502.78 | p<0.01  |
| Retinol (μg)          | 90.42 ± 71.39| 123.30 ± 89.17| p<0.01  |
| Carotenole (μg)       | 3780.60 ± 2625.75| 4906.54 ± 2602.23| p<0.01  |
| Vitamin C (μg)        | 144.61 ± 68.67| 166.81 ± 73.52| p<0.05  |
| Vitamin E (mg a-TE)   | 6.90 ± 3.45  | 9.24 ± 4.40   | p<0.001 |

¹ values are mean ± SD.

### Estimation of nutrient intake

We used an interviewer-administered quantitative food frequency questionnaire to estimate nutrient intake during the 2 year before the diagnosis for cases and before the interview for controls. The questionnaire included a list of 117 food items. Selection criteria were 1) most frequently consumed food items, 2) food items consumed in greatest amounts and 3) major food items supplying each nutrient, especially antioxidant vitamins.

The selection was based on the Korean National Health and Nutrition Survey Report Ministry of Health and Welfare. Selected food items were categorized according to food groups and subdivided by food preparation methods, nutrient content and portion sizes. Categories and numbers of food items in each category were cereals and starches-15, soups-7, meats-12, egg-2 fish and other seafoods-12, legumes-4, milk and dairy products-5, vegetables-28 fruits-12 seasonings-3, oils-4, hot beverages and soft drink-10 and snacks-3. Subjects were asked to state the average frequency of consumption of each food item according to the categories of frequency, ‘never or less than once per month’, ‘1 per month’, ‘2~3 per month’, ‘1 per week’, ‘2 per week’, ‘3~4 per week’, ‘5~6 per week’, ‘1 per day’, ‘2 per day’, ‘3 per day’. The portion sizes were set as follows: a 0.5 serving size, a serving size, and a 1.5 serving size. The interviewer showed food models and photographs of the standard serving size, and asked the subjects to refer to those portions when selecting the amounts of foods consumed. The food frequency questionnaire was coded and analyzed for nutrient intake by a computer aided nutrient analysis program for professionals (CAN-Pro, APAC Intelligence, Seoul, Korea).

### Statistical analysis

All data were analyzed through the SAS (Version 8.1) statistical package. The results are given as mean ± SD values. The significance of the mean difference between the two groups was assessed by the Student’s t-test.

### Results

#### Demographic characteristics

The demographic characteristics of breast cancer patients and their age-matched controls were similar (Table 1). Statistical analysis showed no significant differences between breast cancer patients and the control group in age, anthropometric variables, parity, or age at first full-term birth. However, the mean age at menarche was significantly younger in the patient group (p<0.01).

#### Nutrient intake of study subjects

Daily nutrient intake is shown in Table 2. The mean energy intake of breast cancer patients was not significantly different than that of the control subjects. However, the intake of total protein and fat was significantly lower among breast cancer patients (p<0.05). Breast cancer patients consumed significantly less polyunsaturated fatty acids (p<0.001), ω-3 fatty acids (p<0.001) and ω-6 fatty acids (p<0.01) compared to the controls.
Table 5. Food intakes in controls and patients with breast cancer (unit: g)

| Food          | Cancer (n=97) | Control (n=97) | p value |
|---------------|---------------|----------------|---------|
| Cooked rice   | 131.75 ± 124.64 | 64.99 ± 84.47    | <0.001  |
| Mixed rice    | 62.14 ± 109.26 | 71.51 ± 96.57    | N.S.    |
| Cooked rice with soybean | 61.64 ± 107.98 | 87.42 ± 106.16 | N.S.    |
| Bi-bim-bap    | 12.28 ± 39.14  | 20.73 ± 36.57    | N.S.    |
| Bread         | 16.78 ± 23.97  | 29.69 ± 35.80    | p < 0.01|
| Whole grain bread & Dduk | 0.58 ± 3.25   | 3.59 ± 20.71     | N.S.    |
| Noodle        | 26.11 ± 36.06  | 42.75 ± 52.31    | p < 0.05|
| Noodle with black bean paste | 8.18 ± 20.70   | 10.99 ± 21.03    | N.S.    |
| Naengmyun     | 2.17 ± 3.78    | 0.00 ± 4.36      | N.S.    |
| Noodle bean soup | 1.41 ± 3.58   | 1.53 ± 6.60      | N.S.    |
| Rye-myon      | 11.59 ± 24.64  | 11.07 ± 20.13    | N.S.    |
| Kimchi pot stew | 36.93 ± 47.03 | 30.96 ± 42.10    | N.S.    |
| Soybean paste stew | 48.02 ± 49.06 | 45.78 ± 50.27    | N.S.    |
| Fish stew     | 10.09 ± 40.58  | 12.83 ± 24.76    | N.S.    |
| Clear beef stew | 12.72 ± 30.50 | 11.37 ± 19.16    | N.S.    |
| Soybean paste stew | 18.97 ± 20.81 | 17.21 ± 19.27    | N.S.    |
| Bean sprout soup | 9.84 ± 16.68  | 9.34 ± 16.63     | N.S.    |
| Seaweed soup  | 4.65 ± 6.78    | 4.88 ± 5.28      | N.S.    |
| Pressed boiled pork | 1.05 ± 2.23  | 1.94 ± 3.81      | N.S.    |
| Ham           | 0.87 ± 3.10    | 1.12 ± 3.03      | N.S.    |
| Grilled beef rib | 5.82 ± 16.95  | 6.43 ± 10.59     | N.S.    |
| Beef          | 4.81 ± 5.78    | 6.87 ± 9.57      | N.S.    |
| Soy sauce glazed beef | 0.60 ± 2.66  | 1.03 ± 2.11      | N.S.    |
| Small intestine | 1.72 ± 5.18  | 1.54 ± 5.28      | N.S.    |
| Chicken stew with ginseng | 11.27 ± 15.26 | 10.13 ± 14.39    | N.S.    |
| Deep fried chicken | 5.74 ± 13.47 | 2.07 ± 3.35      | p < 0.05|
| Chicken breast | 0.52 ± 1.87   | 0.96 ± 1.95      | N.S.    |
| Fried egg     | 7.02 ± 12.34   | 13.93 ± 15.36    | p < 0.001|
| Steamed egg   | 2.52 ± 7.57    | 2.77 ± 12.86     | N.S.    |
| Flourder      | 0.59 ± 1.83    | 0.86 ± 2.27      | N.S.    |
| Yellow croaker | 3.28 ± 6.66    | 3.26 ± 5.80      | N.S.    |
| Mackerel      | 2.50 ± 3.26    | 3.16 ± 3.51      | N.S.    |
| Spanish mackerel | 1.15 ± 2.08  | 1.39 ± 2.70      | N.S.    |
| Hair tail     | 1.00 ± 1.85    | 1.78 ± 2.55      | p < 0.05|
| Fish cakes    | 1.17 ± 5.27    | 4.64 ± 5.28      | p < 0.001|
| Anchovy       | 4.88 ± 6.67    | 3.99 ± 3.89      | N.S.    |
| Squid         | 1.56 ± 2.31    | 2.21 ± 3.23      | N.S.    |
| Shellfish     | 1.23 ± 2.92    | 1.02 ± 1.87      | N.S.    |
| Salted fish pickle | 2.00 ± 3.81  | 1.82 ± 6.29      | N.S.    |
| Seaweed salad | 11.74 ± 27.58  | 15.68 ± 25.32    | N.S.    |
| Baked fish    | 0.28 ± 0.28    | 0.35 ± 0.46      | N.S.    |
| Sea weed      | 2.67 ± 5.34    | 2.90 ± 5.75      | N.S.    |
| Bean curd     | 6.76 ± 7.23    | 10.22 ± 10.10    | p < 0.01|
| Soy milk      | 15.94 ± 49.17  | 30.45 ± 60.67    | N.S.    |
| Soy sauce glazed black soybean | 15.94 ± 49.17 | 30.45 ± 60.67 | N.S.    |
| Sesame oil    | 0.21 ± 0.63    | 0.77 ± 1.73      | p < 0.01|
| Mayonnaise    | 0.45 ± 1.34    | 0.65 ± 1.37      | N.S.    |
| Butter        | 0.21 ± 0.99    | 0.15 ± 0.62      | N.S.    |
| Peanuts       | 0.84 ± 1.88    | 1.71 ± 6.32      | p < 0.05|
| Snack         | 2.77 ± 6.88    | 4.03 ± 8.24      | N.S.    |
| Cracker       | 1.53 ± 4.37    | 2.47 ± 5.13      | N.S.    |
| Chocolate     | 1.28 ± 4.53    | 0.97 ± 3.25      | N.S.    |
| Coffee        | 39.73 ± 103.29 | 8.14 ± 36.79     | p < 0.01|
| Coffee with sugar | 11.41 ± 48.05 | 7.71 ± 40.79     | N.S.    |
| Coffee with sugar and cream | 114.18 ± 148.14 | 100.12 ± 123.86 | N.S.    |
| Orange juice  | 23.36 ± 41.90  | 47.46 ± 65.53    | p < 0.01|
| Grape juice   | 6.79 ± 22.09   | 15.15 ± 24.84    | p < 0.01|
| Tomato juice  | 6.34 ± 19.90   | 16.54 ± 32.94    | p < 0.01|
| Green tea     | 0.49 ± 0.79    | 0.71 ± 1.08      | N.S.    |
| Black tea     | 0.03 ± 0.15    | 0.05 ± 0.25      | N.S.    |
| Cola          | 5.98 ± 17.54   | 8.26 ± 18.07     | N.S.    |
| Watermelon    | 21.99 ± 18.73  | 17.40 ± 21.65    | N.S.    |
| Persimmon     | 7.31 ± 0.03    | 5.02 ± 7.72      | N.S.    |
| Strawberry    | 17.74 ± 19.61  | 15.15 ± 18.82    | N.S.    |
| Rape          | 9.44 ± 11.35   | 11.45 ± 12.43    | N.S.    |
| Korean melon  | 11.35 ± 16.63  | 7.06 ± 8.90      | p < 0.05|
| Plum          | 5.27 ± 12.43   | 4.12 ± 7.08      | N.S.    |

1) values are mean ± SD.
2) **not significant**

The association between major antioxidant vitamin intake and the risk of breast cancer is presented in Table 4. The patient group consumed significantly less vitamin A (p < 0.01), retinol (p < 0.01), carotene (p < 0.01), vitamin C (p < 0.05) and vitamin E.
nutritional factors. It has been argued that over-nutrition, in early body size and fat percentage, has been attributed, in part, to countries (Yoo et al., 2006). This, coupled with the increase in body size and fat percentage, has been attributed, in part, to nutritional factors. It has been argued that over-nutrition, in early life, causes rapid growth resulting in early menarche and in turn an increased risk of breast cancer (Law, 2000). There is evidence from cohort studies, after control for body sizes and energy intakes, that higher consumptions of grains, nuts, and legumes are associated with later menarche whereas higher consumptions of meat are associated with earlier menarche (Law, 2000).

Earlier findings from international comparisons and case-control studies suggested a positive association between a Western-style diet and breast cancer risk (Zaridze et al., 1991). However, a large scale prospective cohort of 8 years has failed to prove that breast cancer risk is reduced by a low-fat diet (Prentice et al., 2006). Results from the present study showed a lower total fat intake in the control subjects and no difference was found in total caloric intake. In our study, means of fat intake of the breast cancer patients and the controls were 8.6% and 10.1% of total energy intakes, respectively. And which is much a smaller quantity than the study population of other nations, especially European and Western countries. In a recent study carried out in the United States (Velie et al., 2000), means of daily intake of total fat was 35.0% of total energy, which is almost three times higher than those of our study population. The level of energy from fat is relatively low in Korean patients compared to their Western counterparts, and fat consumption may not be an independent risk factor at this level. Venkatraman et al. (2000) suggested that lipids are mediators of the immune system and that they may modulate its immune-regulatory effects. That study has shown that a low-fat/high-carbohydrate diet may increase inflammatory and decrease antiinflammatory immune factors, and depresses antioxidants. An association between the specific type of dietary fat consumed or the \omega _3/\omega _6 fatty acids ratio and breast cancer risk should also be considered.

In the current study, the breast cancer patient group consumed significantly less major antioxidant vitamins including vitamin A, retinol, carotene, vitamin C and vitamin E compared to the control group. And they consumed significantly lower quantities of onion, garlic, green pepper, sweet pepper, kale, cucumber, seasoned bean sprouts, sesame leaf, zucchini, radish, mushroom, crown daisy in the vegetable category, red pepper paste, bean paste, spicy bean paste in the seasonings category, and orange juice, grape juice, tomato juice in the beverages category compared to controls.

Among the food items from each group, the intake of eggs (p<0.01), legumes (p<0.05), vegetables (p<0.05), seasonings (p<0.001), and oils and fats (p<0.01) in the breast cancer patients was significantly lower than those of the controls (Figure 1).

**Discussion**

This study compared with in food intakes between Korean breast cancer patients and their age-matched controls. The demographic characteristics of breast cancer patients and their age-matched controls were similar. However the age at menarche was younger in breast cancer patients, implying that earlier exposure to hormones may be a key determinant in these subjects. A younger age at menarche is associated with a higher risk of breast cancer and increases lifetime exposure to estrogens. There has been a decrease in the average age of menarche in Western countries (Yoo et al., 2006). This, coupled with the increase in body size and fat percentage, has been attributed, in part, to nutritional factors. It has been argued that over-nutrition, in early
DNA from oxidative damage (Rock et al., 2000). In addition, each has other chemopreventive properties (Rock et al., 2000). Carotenoids found in orange vegetables and fruits, may inhibit cell proliferation and inhibit cellular growth via conversion into retinols (Borek, 2004). A pooled analysis of 12 early case-control studies found that women in the highest fifth percentile of β-carotene consumption had a 19% reduction in breast cancer incidence compared to other postmenopausal women (Howe et al., 1990). A meta-analysis of literature from 1982 to 1997 found a similar result (Gandini et al., 2001).

In addition to its antioxidant potential, vitamin C is also crucial for immune function (Rock et al., 2000). A meta-analysis of case-control studies found a 37% reduction in breast cancer risk among postmenopausal women in the highest fifth percentile of consumption of vitamin C (Willett, 2001). In animal models, vitamin E has been found to inhibit tumors and reduce cell proliferation (Rock et al., 2000). However, available epidemiologic data do not support this effect (Willett, 2001).

In our study, breast cancer patients consumed lower quantities of red pepper paste, bean paste and spicy bean paste. Pepper is also a major source of flavonols, which may have a protective effect on breast cancer risk in laboratory and animal studies (Ackland et al., 2005; Zhong et al., 2003).

Among the food items from each group, the intake of legumes in breast cancer patients was significantly lower than those of the controls. Adlercreutz (2002) reported breast cancer rates in Asian women consuming soy-containing diets have been noted in breast cancer patients was significantly lower than those of the controls. However, that breast cancer patients consumed lesser amounts of legumes and vegetables, which are rich sources of antioxidant nutrients and phytosterols than those of the controls. Thus, dietary guidance to increase legume and vegetable intake may be beneficial in the prevention of breast cancer.

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