



## Association Between Recent Changes in Breast Cancer Incidence and Food Intake among Japanese Women

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DOI: 10.31080/ASNH.2023.07.1211

Received: February 15, 2023

Published: February 25, 2023

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### Abstract

Age-specific incidence rates of breast cancer among Japanese women recently increased in a bimodal distribution pattern with two peaks in the premenopausal and postmenopausal groups. The recent incidence rates among premenopausal women in Japan appear to have exceeded those in the United States. Focusing on diet in Japan during 2005 through 2015, changes in the incidence rates of breast cancer, different from those of colon cancer which is originally regarded to be increased by westernized lifestyle factors, negatively correlated with the intake of fruits, vegetables, algae, or fish and shellfish, whereas those positively correlated with the meat intake. The continuing increase in breast cancer incidence among Japanese women was associated with the recent change in food intake from the Japanese diet to the Western-like diet, especially among premenopausal women. From the relevant literature, the changes in food intake among Japanese women are inferred to possibly link with an increase in inflammation and estrogen levels.

**Keywords:** Breast Cancer; Food Intake; Japanese Diet; Western-Like Diet; Inflammation; Estrogen

### Introduction

As we reported before [1], age-specific incidence rates of breast cancer among Japanese women recently increased in a bimodal distribution pattern with two peaks in the premenopausal and postmenopausal groups. The recent incidence rates among premenopausal women in Japan appear to have exceeded those in the United States [2], while the age-specific incidence rates back in 1980 were entirely low in a bell-shaped pattern [3]. These indicate some modifiable or westernized lifestyle factors to develop breast cancer.

Regarding lifestyle factors, the present study focuses on a recent trend of diet among Japanese women. Recent diet in Japan seems to be gradually changing from the typical Japanese diet to the Western-like diet [4]. Association between recent changes in

diet and breast cancer incidence is assessed, comparing a recent trend in colon cancer incidence which is originally regarded to be increased by westernized lifestyle factors [5,6].

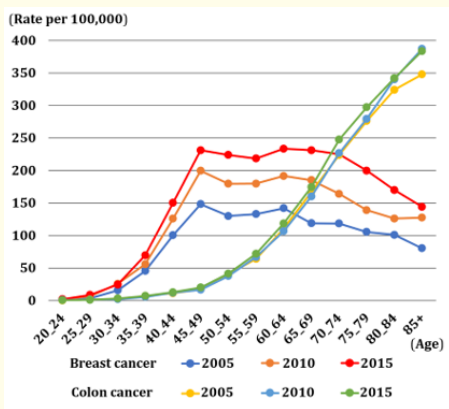
### Methods

Age-specific incidence rates (per 100,000 population in 5-year age groups) of breast and colon cancers among Japanese women in 2005 through 2015 were obtained from national data published by Cancer Information Services, National Cancer Center, Japan ([http://gdb.ganjoho.jp/graph\\_db/](http://gdb.ganjoho.jp/graph_db/)). Annual changes in food intake among Japanese women stratified by age (10-year age groups) from 2001 through 2019 were obtained from national data published by National Institute of Health and Nutrition, Ministry of Health, Labour and Welfare, Japan ([https://www.mhlw.go.jp/bunya/kenkou/kenkou\\_eiyou\\_chousa.html](https://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyou_chousa.html)).

After the age-specific incidence rates of breast cancer were recalculated from per 100,000 population in each 5-year age group to per 100,000 population in each 10-year age group, correlations between annual changes in breast cancer incidence and food intake during 2005 through 2015 were assessed in the age groups of 30-39, 40-49, 50-59 and 60-69 years. The linear correlations using 11 pair data (n = 11) were assessed by Pearson's correlation coefficients. All tests were two-tailed, and statistical significance was set at  $p < 0.05$ .

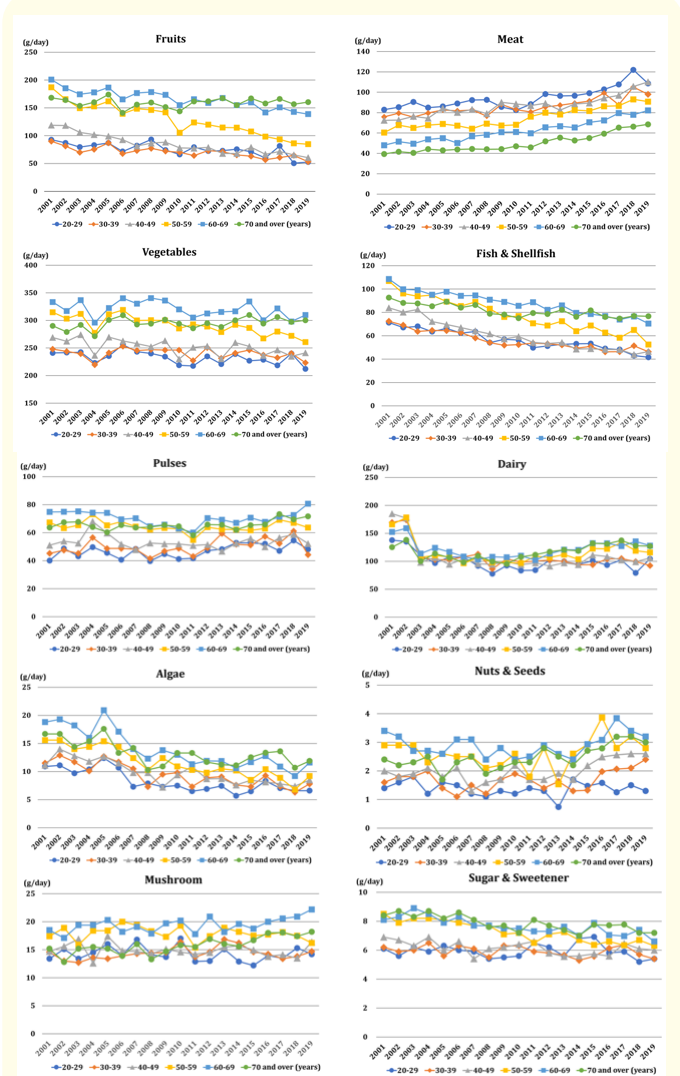
**Results**

Figure 1 shows the age-specific incidence rates of breast cancer and colon cancer among Japanese women stratified by 5-year age groups in 2005, 2010 and 2015. The age-specific incidence rates of breast cancer clearly increased during the 10-year period in a bimodal distribution pattern with two peaks in the age groups of 45 to 49 and 60 to 64 years or in the premenopausal and postmenopausal groups. In contrast, the age-specific incidence rates of colon cancer increased with age like common age-related cancers, and the incidence rates slightly increased from 2005 to 2015.



**Figure 1:** Age-specific incidence rates of breast cancer and colon cancer among Japanese women in 2005, 2010 and 2015.

Figure 2 shows annual changes in food intake among Japanese women stratified by 10-year age groups from 2001 to 2019. The recent annual changes in fruit intake seemed to be a representative pattern for a recent trend of food intake among Japanese women. The fruit intake during 2001 through 2019 in the age groups of 20 to 29, 30 to 39 and 40 to 49 years was lower than in the older age groups of 50 to 59, 60 to 69 and 70 years and over, and the fruit intake in all the age groups clearly decreased during the period. The fruit intake in the age group of 50 to 59 years became close to that in the younger age groups in the end of the period. The similar trend was seen for vegetables, algae, fish and shellfish and sugar and sweetener. The intake of pulses, mushroom, nuts and seeds or sugar and sweetener was lower in the younger age groups but did not decrease during the period. In contrast to the fruit intake, the



**Figure 2:** Annual changes in food intake among Japanese women stratified by age from 2001 to 2019.

meat intake during 2001 through 2019 in the age groups of 20 to 29, 30 to 39 and 40 to 49 years was higher than in the older age groups of 50 to 59, 60 to 69 and 70 years and over, and the meat intake in all the age groups clearly increased during the period.

As shown in table 1, the breast cancer incidence rate significantly and negatively correlated with the fruit intake during 2005 through 2015 in the age groups of 30 to 39 ( $r = -0.674$ ), 40 to 49 ( $r = -0.786$ ), 50 to 59 ( $r = -0.863$ ) and 60 to 69 years ( $r = -0.802$ ), the vegetable intake in the age group of 50 to 59 years ( $r = -0.868$ ), the algae intake in the age groups of 30 to 39 ( $r = -0.824$ ), 50 to 59 ( $r = -0.922$ ) and 60 to 69 years ( $r = -0.800$ ), the fish and shellfish intake in the age groups of 30 to 39 ( $r = -0.873$ ), 40 to 49 ( $r = -0.927$ ), 50 to 59 ( $r = -0.885$ ) and 60 to 69 years ( $r = -0.932$ ), or the sugar and sweetener intake in the age group of 50 to 59 years ( $r = -0.910$ ). On the other hand, the breast cancer incidence rate significantly and positively correlated with the meat intake in the age groups of 50 to 59 ( $r = 0.819$ ) and 60 to 69 years ( $r = 0.847$ ).

Age	30-39	40-49	50-59	60-69
Fruits	r = -0.674 <sup>a</sup>	r = -0.786 <sup>b</sup>	r = -0.863 <sup>c</sup>	r = -0.802 <sup>b</sup>
Vegetables	r = -0.240	r = -0.476	r = -0.868 <sup>c</sup>	r = -0.374
Pulses	r = -0.230	r = -0.228	r = -0.595	r = -0.233
Algae	r = -0.824 <sup>b</sup>	r = -0.602	r = -0.922 <sup>c</sup>	r = -0.800 <sup>b</sup>
Mushroom	r = 0.473	r = -0.373	r = -0.462	r = -0.141
Meat	r = 0.491	r = 0.558	r = 0.819 <sup>b</sup>	r = 0.849 <sup>c</sup>
Fish and Shellfish	r = -0.873 <sup>c</sup>	r = -0.927 <sup>c</sup>	r = -0.885 <sup>c</sup>	r = -0.932 <sup>c</sup>
Dairy	r = -0.381	r = 0.332	r = 0.598	r = 0.585
Nuts and Seeds	r = 0.234	r = 0.381	r = -0.040	r = -0.163
Sugar and Sweetener	r = 0.300	r = 0.204	r = -0.910 <sup>c</sup>	r = -0.438

**Table 1:** Correlation coefficients between annual changes in breast cancer incidence and food intake among Japanese women stratified by age during 2005 through 2015.

<sup>a</sup>p < 0.05, <sup>b</sup>p < 0.01, <sup>c</sup>p < 0.001.

**Discussion**

Although westernized lifestyle factors were regarded to increase the incidence of both breast and colon cancers among Japanese women [5,6], the increase in breast cancer incidence continued, but that in colon cancer was stagnant during the period studied. The increase in breast cancer incidence was found to inversely correlate with annual changes in the intake of fruits, algae, and fish and shellfish in almost all the age groups. Algae and fish are included in components of the Japanese diet index score [7], and fresh vegetables and fruits are included in components of the traditional Japanese pattern [8]. The meat intake was increased in contrast to the fish and shellfish intake in all the age groups, and it tended to positively correlate with the breast cancer incidence.

Castro-Espin., *et al.* have reported that the inflammatory potential of diet was associated with the risk of breast cancer incidence especially among premenopausal women in the European Investigation into Cancer and Nutrition (EPIC) study [9]. They describe that a more anti-inflammatory diet is characterized by high consumption of legumes, vegetables and fruits, whereas a more pro-inflammatory diet is characterized by high consumption of meat and meat products, foods rich in fats and oils, and sugar and confectionery. In Japan, it has been reported that the dietary inflammation index score increased with the increase in cereal, meat, fat, and oil intake, whereas the dietary inflammation index score decreased with the increase in potato, bean, nut and seed, vegetable, fruit, mushroom, seaweed, seafood, and milk intake [10].

Clinical and experimental studies have demonstrated that estrogen is involved in each phase of the carcinogenesis through complex mechanisms for breast cancer [11]. Endogenous estrogen lev-

els have been suggested to be a risk factor for breast cancer [12,13]. The Western dietary pattern, which represents higher intakes of red and processed meats, refined grains, sweets and desserts, was associated with a higher estradiol level among postmenopausal women in the Nurses’ Health Study (NHS) [14]. A systematic review and meta-analysis of observational studies demonstrated that an increased risk of postmenopausal breast cancer associated with the Western or Western-like dietary pattern with high loadings of foods including red and/or processed meats, high-fat dairy products, potatoes, and sweets, which was selected as a representative unhealthy dietary pattern [15]. Adhering to a healthy diet qualified by the Alternative Healthy Eating Index was demonstrated to be inversely associated with premenopausal estrogen concentrations [13]. Interestingly, seaweed (algae), a typical food of the Japanese diet, has been demonstrated to decrease endogenous estrogen levels [16].

**Conclusion**

The present study demonstrated that the continuing increase in breast cancer incidence among Japanese women was associated with recent changes in food intake from the Japanese diet to the Western-like diet, especially among premenopausal women. From the relevant literature, the changes in food intake among Japanese women are inferred to possibly link with an increase in inflammation and estrogen levels.

**Conflicts of Interest**

The author has indicated no potential conflicts of interest

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