

Age-specific incidence rates of breast cancer among Japanese women increasing in a conspicuous bimodal distribution pattern

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Abstract

Breast cancer incidence rates are increasing in East and Southeast Asia, along with the westernisation of reproductive and lifestyle patterns. Such westernisation is thought to be involved in the cumulative exposure of breast tissue to both endogenous and exogenous oestrogen. Immigrant studies among Asian American women indicate that risk factors for breast cancer can be modified. When breast cancer incidence rates were compared with those of corpus uteri and colon among Japanese women in 2005, 2010 and 2015, it is of note that age-specific incidence rates of breast cancer in 5-year age groups clearly increased during the 10-year period in a bimodal distribution pattern, with two peaks in the 45–49 and 60–64 years age groups. From the relevant literature, it is inferred that the low prevalence of obesity and the intake of soy products or isoflavones among Japanese women may contribute to the bimodal distribution pattern by suppressing the extent of increase in breast cancer incidence rates among Japanese postmenopausal women. With regard to dietary habits relating to obesity, it has been globally reported that the intake of high-calorie foods is associated with the incidence of oestrogen receptor-positive breast cancer in both pre- and postmenopausal women, while high-carbohydrate or -milk intake that can enhance the secretion of insulin or insulin-like growth factor I is associated with that of oestrogen receptor-negative breast cancer mostly in postmenopausal women. Studies are needed to clarify the aetiology or modifiable factors behind the bimodal incidence rates of breast cancer among Japanese women.

Keywords

Breast cancer, age-specific incidence, obesity, dietary habits, menopausal status

Introduction

Breast cancer has been reported to be the most frequently diagnosed cancer in the vast majority of countries (154/185), with an estimated 2.1 million cases in 2018. The incidence rates of breast cancer are generally high in North America and Western Europe, and low in most of Africa and Asia.¹ The age-specific incidence rates in Asian countries differ from those in Western countries. The Breast Cancer Working Group described that while the incidence of age-specific breast cancer increased with age in Western countries, it showed a bell-shaped pattern in Japan and Korea, with a peak in the 40–50 years age group and a flatter pattern after the peak in Singapore and the Philippines, using estimates of the worldwide cancer incidence for the year 2002.² The Working Group anticipated that the age-specific incidence patterns in Asian and Western countries would approach those seen in Singapore. Oestrogen is thought to play an important role in

the development of breast cancer.³ Breast cancer incidence rates are increasing in East and Southeast Asia, along with the westernisation of reproductive and lifestyle patterns which can be involved in the cumulative exposure of breast tissue to both endogenous and exogenous oestrogen.^{4,5}

In this short communication, we demonstrate that the age-specific incidence rates of breast cancer among Japanese women are increasing in a conspicuous bimodal distribution pattern, with two peaks in pre- and postmenopausal age groups.

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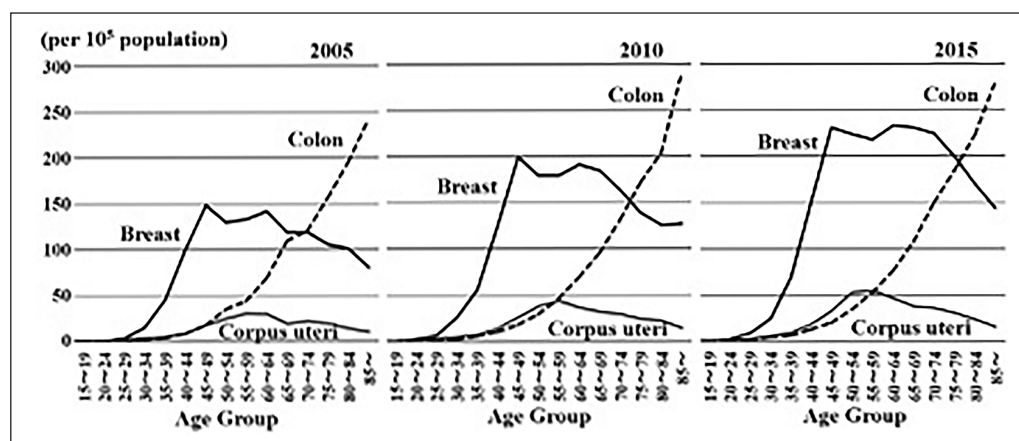


Figure 1. Age-specific cancer incidence rates (per 100,000 population) of the breast, corpus uteri and colon among Japanese women in 5-year age groups in 2005, 2010 and 2015, respectively, using national estimates from Cancer Information Services, National Cancer Centre, Japan.

The aetiology behind the bimodal incidence rates of breast cancer is speculated by the relevant literature in association with modifiable factors, including dietary habits.

Results and discussion

Figure 1 shows that age-specific cancer incidence rates (per 100,000 population) of the breast, corpus uteri and colon among Japanese women in 2005, 2010 and 2015, respectively, using national estimates from Cancer Information Services, National Cancer Centre, Japan. It is of note that the age-specific incidence rates for breast cancer in 5-year age groups clearly increase during the 10-year period in a bimodal distribution pattern, with two peaks in the 45–49 and 60–64 years age groups. The cancer incidence of corpus uteri, which is also thought to be affected by oestrogen,⁶ was lower than that of breast cancer, but it still increased during the same period in a bell-shaped pattern, with a single peak in the 55–59 years age group. By contrast, the increase with age of the incidence of colon cancer, which was somewhat similar to that of breast cancer in Western countries, reduced 2015, as had been predicted by the Research Group for Population-based Cancer Registration in Japan.⁷ The three distinct patterns of age-specific cancer incidence rates among Japanese women are intriguing to presume the aetiology for breast cancer in relation to the westernisation of reproductive and lifestyle patterns. Modifiable risk factors for breast cancer, including pregnancy history, use of hormone replacement therapy and obesity assessed by body mass index (BMI), are also indicated by the increased incidence of breast cancer among immigrant Asian American women.⁴

From the two-component mixture models, it is inferred that bimodal age-specific distributions of breast cancer incidence vary with the proportional composition of pre- and postmenopausal components, regardless of molecular characteristics.⁸ A study examining breast cancer incidence during the period 1978–1997 in the USA and Japan⁹ showed that Caucasians and African Americans had a bimodal (early- and late-onset) breast cancer population and that Japanese in Osaka Prefecture had only an early-onset breast cancer population. Age-specific breast cancer incidence rates among Japanese Americans in Hawaii were high but resembled those

among native Japanese in Osaka in the earliest calendar period (1978–1982), and increased up to those among Caucasians and African Americans, especially among postmenopausal women, for subsequent calendar periods. The authors speculated that the difference in breast cancer incidence rates between Americans and Japanese was partially ascribed to a much lower prevalence of obesity in Japan than in the USA and to screening mammography that was not implemented until 2000 in Japan. It was of interest that the age-specific breast cancer incidence rates among Japanese Americans in Hawaii during 1978–1982 appeared to be a bimodal distribution pattern in the semi-log graph. As it was considered that the prevalence of overweight and obese people was very low in Japan,¹⁰ we examined the associations of obesity with the bimodal distribution pattern with the conspicuous two peaks among Japanese women shown in the present study.

In Figure 2, the age-specific incidence rates of breast cancer are shown when regrouped by a 10-year period instead of a 5-year period in order to be in accordance with the age-specific prevalence rates of obesity (BMI ≥ 25 kg/m²) among Japanese women without pregnancy or lactation reported by National Institute of Health and Nutrition, Japan. It is first recognised that the conspicuous two peaks of the age-specific distribution of breast cancer incidence have been hidden when regrouped by the 10-year period. Referring to previous epidemiological cancer studies, the age-specific prevalence rates of obesity 10 years before the year when the breast cancer incidence rates were obtained are used for comparison. Both the breast cancer incidence rates and the obesity prevalence rates appear to be in parallel among whole age groups. However, the obesity prevalence rates of the 30–39 years age group only increases from 1995 to 2005 in parallel to the increase in the breast cancer incidence in the 40–49 years age group. The obesity prevalence appears to decrease after 40 years of age, which may contribute to the reason why breast cancer incidence rates among Japanese postmenopausal women did not increase up to those among Japanese American postmenopausal women described above. The obesity prevalence rates in the 60–69 years age group were 31.0% in 1995, 31.0% in 2000 and 29.1% in 2005. In 2015, the age-specific prevalence rates of obesity increased to 11.1% (BMI ≥ 30 kg/m², 2.6%) at 20–29 years of age and decreased

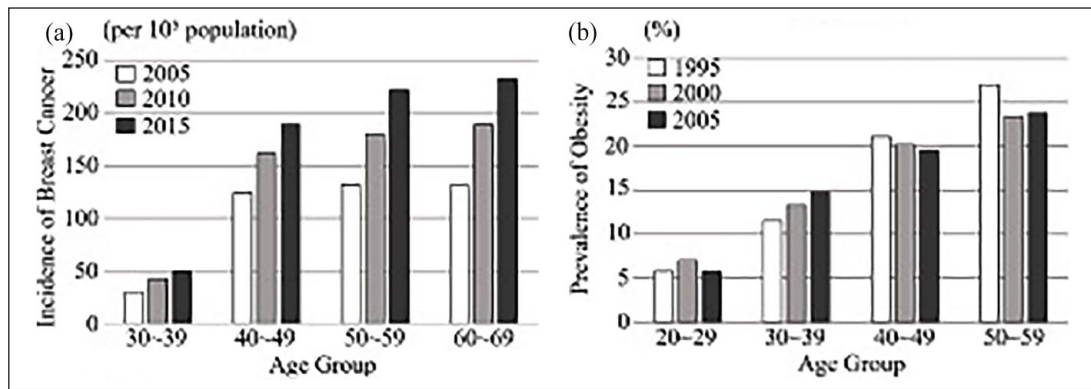


Figure 2. Comparison of (a) the age-specific incidence rates (per 100,000 population) of breast cancer among Japanese women in 10-year age groups with (b) the age-specific prevalence rates (%) of obesity (body mass index ≥ 25) 10 years before the year when the breast cancer incidence rates were obtained. National data obtained separately from National Cancer Centre and from the National Institutes of Health and Nutrition.

Table 1. Associations between breast cancer incidence and dietary habits, stratified by menopausal status and, if assessed, oestrogen-receptor (OR) expression status.

Authors and year of publication	Country	Study	Premenopausal		Postmenopausal		Breast cancer risks in association with dietary habits	Ref. no.
			OR (+)	OR (-)	OR (+)	OR (-)		
Marzbani et al. 2019	Iran	Case control		●	Not assessed		Consumption of soft drinks, industrial juices, sweets and fried foods; inadequate consumption of vegetables	11
Kim et al. 2017	Korea	Cohort		●		●	Consumption of grilled meat Irregular eating habits	12
McCann et al. 2017	USA	Case control	●	●	●	●	High milk intake Negative association with sweet dairy intake	13
Shin et al. 2016	Japan	Cohort			●		Westernised dietary pattern: high intake of meat, processed meat, bread, dairy products, coffee, soft drinks, tea, sauces and alcohol	14
De Cicco et al. 2019 (Review)	Italy	Cohort				●	Negative association with intake of fruits and vegetables	15
	Europe	Cohort	●		●		High total and saturated fat intake Negative association with low-fat dairy intake	
	USA+Europe	Cohort		●			High glycaemic load and carbohydrate intake but not body mass index	
	USA+Europe	Prospective				●	Negative association with intake of soy products or isoflavones	
	Asia	Case control				●		

●: description of breast cancer risks is applicable (a blank means not applicable).

to 6.4% (0.7%) at 30–39 years of age, 18.8% (4.5%) at 40–49 years of age, 20.6% (4.6%) at 50–59 years of age and 21.7% (2.4%) at 60–69 years of age. It is worth noting whether these changes in obesity prevalence will lead to a decline in the incidence of breast cancer.

To speculate further on the aetiology or modifiable factors behind the bimodal incidence rates of breast cancer among Japanese women, recent representative reports on associations between breast cancer incidence and dietary habits are listed in Table 1, stratified by menopausal status and, if assessed, oestrogen-receptor (OR) expression status. It has been globally

reported that the intake of high-calorie foods, probably relating to obesity, is associated with the incidence of OR-positive breast cancer in both pre- and postmenopausal women, while high-carbohydrate or -milk intake that can enhance the secretion of insulin or insulin-like growth factor 1 is associated with that of OR-negative breast cancer, mostly in postmenopausal women.^{11–15} In a review article,¹⁵ it was described that a healthy dietary pattern to reduce breast cancer risk is characterised by the high intake of unrefined cereals, vegetables, fruit, nuts and olive oil, and a moderate or low consumption of saturated fatty acids and red meat. It is of interest that inhibitory effects of soy

products or isoflavones on breast cancer incidence have been observed only in Asian postmenopausal women. Such effects may also be contributable to suppressing the extent of increase in breast cancer incidence rates among Japanese menopausal women, leading to the bimodal distribution of age-specific breast cancer incidence rates.

Conclusions

The age-specific incidence rates of breast cancer among Japanese women clearly increased from 2000 to 2015 in a bimodal distribution pattern, with the conspicuous two peaks. From the relevant literature, it is inferred that the low prevalence of obesity and intake of soy products or isoflavones among Japanese women may contribute to the bimodal distribution pattern by suppressing the extent of increase in breast cancer incidence rates among Japanese postmenopausal women. With regard to dietary habits relating to obesity, it has been globally reported that high-calorie foods are associated with OR-positive breast cancer in both pre- and postmenopausal women, while high-carbohydrate or -milk intake that can enhance the secretion of insulin or insulin-like growth factor I is associated with OR-negative breast cancer, mostly in postmenopausal women. Studies are needed to clarify the aetiology or modifiable factors behind the bimodal incidence rates of breast cancer among Japanese women.

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None.

Authors' contributions

All authors searched the relevant literature, especially on dietary habits (N.T. and K.M.) and body mass index (R.U.). Y.A. designed the study and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

Availability of data and materials

Figure 1 was drawn, based on the open data from the website below (in English) of Cancer Information Services, National Cancer Centre, Japan (http://gdb.ganjoho.jp/graph_db/index?changeLang=Submit). Figure 2 was drawn, based on the open data from the website below (in English) of the National Institutes of Health and Nutrition, Japan (Physical Status Questionnaire, National Health and Nutritional Survey; <https://www.nibiohn.go.jp/eiken/kenkounippon21/en/eiyouchousa/index.html>).

Conflict of interest

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Ethical approval

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Informed consent

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