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Diet and breast cancer

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Abstract
Breast cancer is the most common malignancy among women. We conducted an analysis to investigate the impact of diet on breast cancer. Well-balanced diet is a mandatory part of a healthy lifestyle, and consequently, it is very important in prevention of breast cancer. High intake of fruits and vegetables, proper BMI and low intake of alcohol and fried food rich in saturated fatty acids are common known to be anti-cancer prevention. Soy food, black pepper and turmeric are suggested to inhibit cancer's proliferation. Dietitians and oncologists should educate their patients about healthy lifestyle patterns.

Keywords: Diet; breast cancer; lifestyle; cancer; dietary patterns

Introduction
Breast cancer is the most common malignancy among women.[1] Because of the expression of hormone receptors it could be divided into two main groups – estrogen/progesterone receptor positive (ER+/PR+) or negative (ER-/PR-). [2] Human growth factor (HER-2) receptor is also a factor which is used to describe the disease as HER2 positive or negative (Table 1). [3]

Table 1.
Groups of breast cancer

	ER	PR	HER-2	Ki-67
Luminal A	+	+	-	<20%
Luminal B	+	+/-	-	>20%
HER-2 enriched	-	-	+	>20%
Triple negative	-	-	-	>20%

Because of the screening which provides early diagnosis, the effective treatment like surgery, chemotherapy, immunotherapy and hormonotherapy which depends on the molecular subtype could be introduced. [4] Healthy lifestyle is an important part of the treatment process as well as the prevention of the primary disease or the recurrence. Several studies have investigate the impact of food (meat, vegetables, spices, soya, alcohol) on breast cancer. The aim of the our analysis is to investigate the impact of diet on breast cancer prevention and survival.

Methods

The article is based on literature review using information from PubMed and GoogleScholar published before November 2021. We included meta-analysis, systematic reviews and research studies. The search terms were "diet and breast cancer". Furthermore, we combined the keywords "breast cancer" and individual products like "soy", "alcohol", "spices", "meat" as well as special diets like "vegan", "vegetarian".

BMI and breast cancer

Munsell et al who conducted a meta-analysis of 89 epidemiologic reports published in English during 1980–2012, concluded that the risk of ER/PR+ breast cancer is 20-40% higher in obese women. [5] Obesity is associated with lower levels of circulating estrogen levels in premenopausal women in contrast to postmenopausal women where this condition causes elevation of estrogen levels because of conversion of androgenic precursors to estrogens in adipose tissue [6,7] In the meta-analysis conducted by Althuis et al. [8] it could be concluded that ER/PR+ breast cancers could be etiologically distinct diseases and higher BMI could be associated with higher occurrence of those tumors. Moreover reduction of fat intake and weight loss led to lower incidence of deaths caused by breast cancer. [9, 10, 11] Western dietary pattern is discussed to be another factor affecting breast cancer occurrence. It increased the risk of breast cancer by 14% as well as the prudent dietary pattern reduced risk of breast cancer by 18%. [12] Another study confirmed those findings showing that westernized dietary pattern was associated with a 32% increase of breast cancer occurrence. [13]

Fruits and vegetables

Fruits and vegetables are rich in polyphenols and fiber which are suggested to have an important role in the prevention of cancerogenesis, particularly in postmenopausal women. [14, 15, 16] The study conducted by Penniecook- Sawyers et al. [17] showed that vegetarian diet did not protect from breast cancer. However, cancer occurrence among vegans was low but it was not statistically significant. On the other hand plant-based diet patterns have a protective effect on mortality from cardiovascular diseases like ischemic heart disorders and total cancer morbidity. [18] Moreover another metanalysis showed that diet rich in vegetables as well as lower fat and meat intake could protect from breast cancer. [19] Mediterranean diet which is a dietary pattern rich in vegetables, fruits, fish and olive oil was associated with decreased risk of the breast cancer [20, 21, 22]

Soy food and breast cancer

Estrogens which are produced in ovaries are supposed to be one of the main factors affecting breast cancer's development. [23] It is suggested that hormones may be an important part of ER+/PR+ carcinogenesis more than ER-/PR-. [24]

It is thought that some products are forbidden among patients with breast cancer, f.e. soy food, turmeric or milk because of the phytoestrogens. Phytoestrogens are substances which are functionally as well as structurally similar to estrogen. [25]

Soya is used to produce tofu, soy milk or soy chops, is rich in the isoflavones which are supposed to have a protective role in breast cancer prevention. [26] Isoflavones has been

showed to have anti-angiogenic, anti-oxidant effect as well as tyrosine kinase inhibition. Several epidemiological studied have been conducted in Asia due to high intake of soy food in this area. The higher soy-based food intake was associated with lower risk of pre-menopausal breast cancer as well as both pre- and post-menopausal breast cancer. [27, 28] Adolescent exposure to soy based food is suggested to have a protective role against breast cancer developing. [29] Chi et al. [30] in their meta a analysis showed that soy food intake reduced mortality and recurrence. The positive effect of soy food on breast cancer development has been confirmed in the study conducted by Trock et al. [31] and Zhang et al. [32] who concluded that soy intake could be inversely associated with cancer risk.

On the other hand, genistein which is a form of isoflavones promoted the proliferation of cancer cells and tumor growth in mice having deficient immune system [33] Furthermore, genistin which is glycoside of genistein could also enhance mammary estrogen-dependent tumors' growth. In addition, in vivo study showed no tumor's growth stimulation after use of soy flour but it should be considered that there was no tumor's size regression in comparison to tumors where genistein and estrogen has been eliminated. [34]

Meat and fastfood

Described above soy food is sometimes used as a replacement for meat in vegan and vegetarian diet. It has been discussed if meat has impact on breast cancer development. Anderson et al. conducted a cohort study and meta-analysis and concluded that consumption of processed meat could be associated with higher risk of breast cancer development. [35] Nevertheless, read meat consumption was not associated with higher breast cancer's risk. On the other hand, in another study the association between read meat consumption and breast cancer has been confirmed. [36, 37] Furthermore, poultry consumption was inversely associated with breast cancer risk and it has been suggested that breast cancer risk may be reduced by subitizing red meat by poultry.[36] Another factors which increase the risk of breast cancer are fried food, sweets and soft drinks. [38]

Spices

Turmeric is a spice which is a rich source of curcumin. Many studies provides that curcumin may have anti-oxidant and anti-cancer effect. It is suggested that curcumin modulates cancer proliferation, angiogenesis and signaling pathways. [39, 40, 41] In addition, black pepper which consists of piperine sensitized HER2+ breast cancer to paclitaxel which is commonly used in chemotherapy. Furthermore, this substance inhibited proliferation and enhanced tumor's apoptosis. It is suggested that piperine could be used in a prevention as well as treatment of HER2+ breast cancer. [42]

Alcohol

Alcohol consumption is associated with higher breast cancer occurrence. Consumption of one additional unit (10g) of ethanol increases risk of cancer by 12-20%. [43] Additionally, alcohol intake was associated with higher ER+/PR+, ER+/PR- as well as ER- cancers but correlation between alcohol and ER+ tumors was stronger. [44] Different types of alcoholic beverages also could have different effect on breast cancer development. Red wine is thought to be a source of polyphenols, antioxidants, anti-inflammatory substances and to have a protective effect on cardiovascular system. Another study suggests that resveratrol may inhibit aromatase, enzyme which is responsible for conversion of androgens into estrogens and neutralize reactive oxygen species. [45, 46]

Post-diagnostic diet

Breast cancer therapy options are still developing and getting more effective. Because of that fact, the life expectancy of breast cancer survivors may be longer. Holmes et al. [47] conducted a study including 6348 women with breast cancer stage I-III diagnosis. They hypothesized that the protein and amino acid intake is associated with better survival. They concluded that there was an inverse association between energy-adjusted intake of protein and recurrence of the breast cancer and the associated did not differ in tumors expressing insulin receptor.
According to another study, women with higher vegetables consumption had better overall survival after breast cancer diagnosis. [48] Fruit consumption was not associated with breast cancer mortality as well as all-cause mortality. High fruit juice consumption was associated with worse mortality caused by the breast cancer as well as all-cause. Higher vegetable consumption after the diagnosis (especially containing high vitamin C levels and green leafy) is suggested to improve overall survival. It is suggested that intake of vitamin C supplement may reduce mortality caused by the breast cancer. [49] On the other hand, another study did not prove those findings and showed no association between vitamin C supplements and survival. [50] Further investigations should be conducted to investigate those relations. What is more, anti-inflammatory diet may reduce mortality caused by cardiovascular diseases among women diagnosed with breast cancer but there was no significant association between this dietetic pattern and breast cancer-related mortality. [51, 52] On the other hand, another study showed that long-term anti-inflammatory diet may improve survival among women after breast cancer diagnosis. [53] To sum up, low-fat diet with high quality products and avoiding overweight may be recommended for breast cancer survivors, while western dietary pattern and processed food would not be beneficial for them. [54, 55, 56, 57]

Conclusions

Well-balanced diet which is a mandatory part of a healthy lifestyle is very important in prevention of breast cancer. High intake of fruits and vegetables, proper BMI and low intake of alcohol and fried food rich in saturated fatty acids are common known to be anti-cancer prevention. Soy food, black pepper and turmeric are suggested to inhibit cancer's proliferation. Nevertheless, diet should never be a replacement for a medical therapy of a breast cancer. Doctors' and dietitians' attention should be paid to inform patients about the role of diet in breast cancer's treatment process and prevention of the disease. Well-balanced diet is only one of many factor affecting breast cancer's development. Patients should remember about physical activity, proper BMI, rest and stress reduction.

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