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Breast cancer risk prevention methods

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Abstract
Over the last twenty years, breast cancer in women under the age of 40 has been rising. Less than 10% of breast cancer cases can be attributed to inherited genetic abnormalities. Factors related to the environment, reproduction, and lifestyle are more commonly linked to breast cancer, and some of these factors can be changed theoretically. The fight against breast cancer also relies heavily on prevention. Early tumour detection and life extension can be supported by various levels of breast cancer prevention. This study focuses on the causes and methods of breast cancer prevention and analyse the facts about potential female breast cancer risk factors, such as hormone, genetic predisposition, breast-related risks, and the interplay between hereditary and non-genetic variables. The study analysed healthy controls and the brain region of cancer patients were used. The study results stated that the functional brain networks in survivors of chemotherapy-treated breast cancer were less efficient than those in healthy controls.

Keywords: breast cancer, risk, prevention methods, healthy controls,

INTRODUCTION:

At 22.9% of all female tumours, breast cancer is by far the most frequent malignant tumor among women globally [1-3]. Compared to men, women have breast cancer at a rate that is 100 times higher [4]. Because it can spread to other organs, this metastatic disease is notoriously hard to cure [5-7]. Despite its higher prevalence in the Americas, data reveals

that, because to rapid discovery, the five-year survival rate of breast cancer patients is over 80% [8]. Not to mention that developing nations still have an increasing incidence rate. A good prognosis and a high survival rate can be achieved with early detection of breast cancer [9-10].

Breast cancer can be categorized into five distinct categories based on molecular features: luminal A, luminal B, basal-like, HER2-enriched, and normal-like [11–12]. There is a wide range of beginning age and prognosis effect due to the fact that distinct molecular subtypes are associated with different causes and risk factors. Age, hereditary abnormalities, family history, hormonal factors, being pregnant, leading an unhealthy lifestyle, and poor food choices are among the many risk factors associated with breast cancer and its increasing incidence [13–16].

The goal of this study is, therefore, to provide a synopsis of the most recent findings about the correlation between various breast cancer risk factors. In this article, we will examine the role of genetic factors in the risk of developing and recurrent breast cancer in more detail. Breast cancer is more likely to be morbid and to reactivate when several environmental and genetic factors are present, particularly at the same time. We will also highlight recent research on the influence of environmental and lifestyle prevention and early detection in order to obtain a deeper understanding of the significance of prevention for cancer patients.

Literature review:

A tiny percentage of breast cancers are thought to be caused by inherited genetic mutations. However, over 90% of breast cancer cases are associated with environmental, reproductive, and lifestyle factors. Density, as measured by mammography and representing the ratio of fibrous and glandular to fatty tissue in the breast, is a strong predictor of breast health [17]. The mammographic density, however, has been associated with an increased risk of cancer, regardless of the method of detection [18]. Dense breasts are associated with an increased risk of breast cancer in women, however whether or not less dense breasts lower that risk is unknown. Age and postmenopausal weight gain, for instance, are linked to both a lower breast density and an increased risk of breast cancer [19]. Further investigation into the correlation between breast density and risk is required. Even though fibroadenomas and simple cysts are benign breast lesions, they raise the risk of breast cancer [20]. A greater risk ratio of 1.41 was seen in people with benign breast lesions compared to those without [21].

Reproductive variables, including menarche, menopause, age at first pregnancy, and others, are another contributor to the increased likelihood of breast cancer. Early menarche increases a woman's risk of breast cancer over her lifetime. Premenopausal breast cancer incidence drops by 9% and postmenopausal breast cancer incidence drops by 4%, according to data from prior studies. Delaying menarche by one year further reduces these rates. There was an increase of 1.029 times the relative risk for every year that menopause was postponed [22–23]. Previous research has also shown a robust correlation between the age at which a child is born and the risk [24-25]. Women who have their first child later in life are at a higher risk. According to the statistics, the risk of breast cancer is reduced in women whose first child is born before the age of 35. As a general rule, having fewer children lowers the risk of breast cancer. Women with fewer than five children have half the risk of breast cancer as women with five or more children [26]. Breastfeeding is one of the many potential dangers that come with being a parent. Breast cancer incidence is correlated with the duration of nursing. Reducing estrogen levels and protecting against breast cancer can be achieved by nursing for longer periods of time. A 6-month extension of the nursing time for each kid can reduce the incidence of breast cancer by 6% to 6.3%, according to a study by the institution [27]. Furthermore, a theory has been put forth on the link between abortion and breast cancer, which states that a woman's risk of developing breast cancer increases after an abortion. Nonetheless, high-quality scientific evidence has failed to confirm this, and the majority of scientists does not yet hold the idea in the scientific community.

Dietary habits may play a significant role in the etiology of breast cancer, in addition to other high-risk variables [28]. The association between certain meals and the incidence of breast cancer has been the subject of a great deal of epidemiological study. An increased risk of breast cancer has been linked to the Western diet's heavy consumption of red meat and animal fats. Asians are at an increased risk of developing breast cancer if their body mass index (BMI) is higher prior to diagnosis. After a breast cancer diagnosis, particular mortality increased by 13% for every 5 kg gain in body weight [29]. Regular exercise reduces the risk of breast cancer in women compared to inactive women. In terms of breast cancer risk, there is a 10-20% difference between the two groups. The recovery and prevention of breast cancer both rely heavily on physical exercise. Those who exercise regularly after a breast cancer diagnosis have a lower risk of the disease returning, a lower risk of dying from the disease, better fitness overall, and less lymphedema and its sequelae [30]. Concerning smoking, the

risk of breast cancer is 30% higher in young women who have smoked in the past compared to those who have never smoked.

Materials and Method

Correlation analysis, comparative studies, and descriptive statistics were all carried out using SPSS for Windows. We show the means, SDs, and ranges of the descriptive statistics. When compared to the healthy control group, cancer patients showed cognitive impairment on two or more neurocognitive tests, specifically on "tests with a Z-score of -1.5" or lower. The difference between the subjects' raw scores and the group mean scores was multiplied by the standard deviation to obtain the z-score. Using the Pearson correlation coefficients (chi-square test), the significance of the association between brain connectivity and neurocognitive function was evaluated. We used either an independent or paired t-test to examine the differences between the groups. A two-tailed test was used for each statistical test, and results were considered significant if they had a P value of 0.05 or below.

chi-squared test

To determine whether the observed variation in category means is indeed accidental, the Pearson chi-squared test is employed. It looks at whether a collection's specific occurrences' frequency distribution matches an analytical distribution or not. The possibilities that are being evaluated need to be mutually exclusive and have a cumulative probability of one to one. Every episode often provides data along with classifications, as shown in the example below. The notion that a conventional six-sided die is "fair" is actually oversimplified. If a contingency board looks at independence, data made up of measurements for two components can be deemed independent.

$$Pearson'schi-squaredtest = \sum_{l=1}^{m} \frac{(R_j - H_j)^2}{l}$$

(1)

Where, R_j =metric type values j

R =metric total

H_j=expected type frequency j

m = number of cells

Pearson then substitutes e for u in the definition of u^2 instead. The multinomial standard deviations and correlation coefficients are substituted as follows in Equation (2):

$$u^2 = R\left(\frac{e^2}{m}\right) \quad (2)$$

If not, they would have received care. The following is how expected Chi-Square values are determined:

$$H = \frac{m_c \times m_v}{i}$$

(3)

Here: H = represents the worth of the unit's effort,

m_c= the cell nucleus row edge is indicated.

m_V= indicates the row edge of that cell, and

i = reflects the sample's entire population.

The number of samples count is separated by the marginal sum for the row and column of each cell.

$$u^2 = \frac{(N-H)^2}{H}$$

(4)

Correlation metrics are statistical assessments of a link's strength. The most popular method for determining Chi-square strength is Cramer's F test. It is straightforward to compute using the following formula:

$$\sqrt{\frac{y^2/m}{(j-1)}} = \sqrt{\frac{y^2}{m(j-1)}}$$

(5)

The Chi-square is a useful tool for analyzing data and classifying the many types of research data.

Result and discussion

18 eligible patients with breast cancer and 15 of whom consented to take part in this study. The applications of three patients were turned down on the grounds that the neurocognition tests and MRI scans would be excessively difficult. The age range of the healthy controls was 29 to 59, with a mean age of 49.6. Every single healthy control participant was present during the assessment. Furthermore, of the individuals in the patient group, half (n = 8, 53.3%) had

been diagnosed with breast cancer. Chemotherapy had been added to the cancer treatments for each patient.

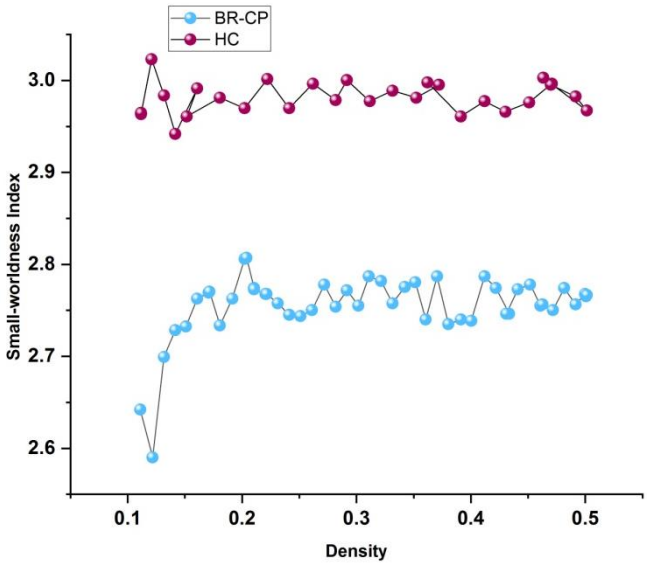

Figure 1: worldwide connectome integrity

Figure 1 illustrates that neither participant group's small-worldness score was less than 1. Small-worldness scores greater than 1 throughout network densities, according to Humphries and Gurney, are indicative of the existence of small-world connectome organization. The sick group had a lower small-worldness score than the controls who were in good health (Figure 1). The average degree of structural connection at each node was calculated in this study using features of regional connectomes. The sick group showed lower mean node degrees than the healthy control group across 90 different brain areas, according to the AAL

(Automated Anatomical Labelling) atlas template.

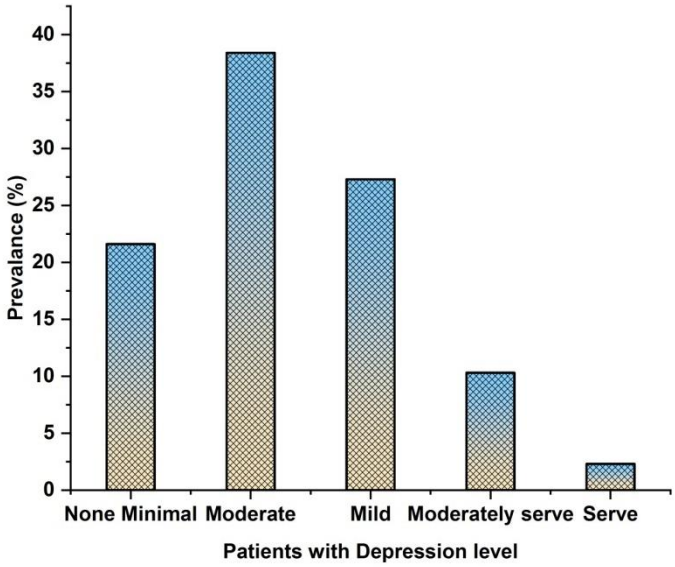

Figure 2: Prevalence of patients with depression level

The frequency of patients with depression is seen in Figure 2. 39.2% of respondents said they suffered from major clinical depression. Further analysis, however, concentrated on non-minimal depression, which affected 21.6% of the population. Non-minimal depression has been associated with a number of lifestyle and demographic characteristics, as well as comorbid conditions such as sex, occupation, hypertension, a stressful past or present, previous or current depressed symptoms, frequent exercise, and loneliness. However, diabetes, race, education level, or religion had no effect on depression.

The HC group did not exhibit the statistically significant association between the sick group's worse verbal memory scores and their overall performance. Poor local efficiency and low raw TMT-A scores have a statistically significant correlation.

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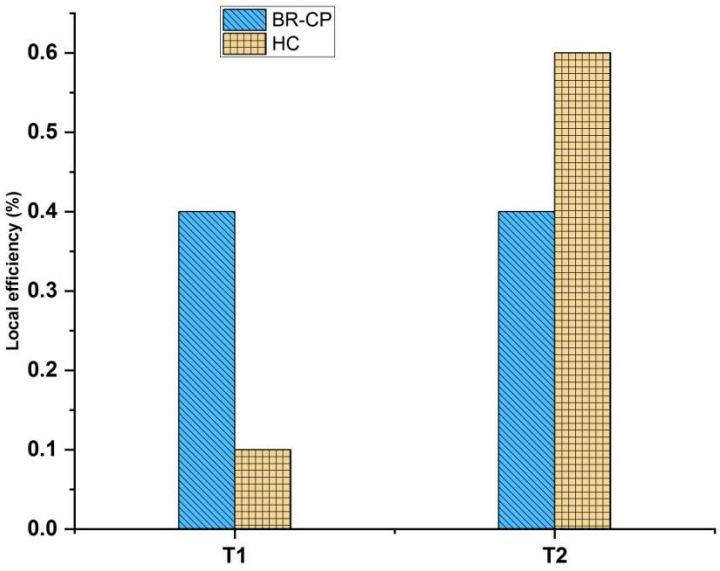

Figure 3: Local efficiency

This is the local efficiency shown in Figure 3. A network's resilience at the small scale is gauged by its local efficiency. That is the local efficiency of a node. It explains the extent to which its neighbors can exchange information once it is removed. The network's maximum local efficiency is shown by a scaled indication of local efficiency, which has a range of 0 to 1. Functional brain networks with high local efficiency have a topological structure reminiscent of segregated neural processing. It was found that the brain regions designated for cancer patients (BR-CP) are compared to the currently used healthy controls (HC), such as T1 and T2. Compared to the estimated T2, the indicated T1 is higher.

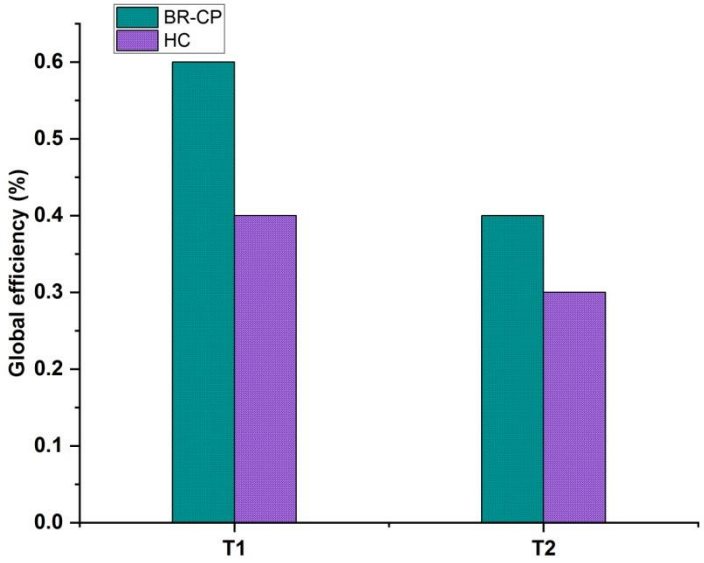

Figure 4: Global efficiency

Figure 4 shows the worldwide efficiency. The efficiency principle states that when the marginal social costs and benefits of an activity's resource allocation are equal, the activity will yield the maximum benefit. The concept of global efficiency has been applied to enhance neural networks and transportation infrastructure. The average inverse shortest path length of the network is called the global efficiency, and it is inversely related to the characteristic route length. It was found that the HC being used, like T1 and T2, is compared to the suggested BR-CP. Compared to the estimated T2, the indicated T1 is higher.

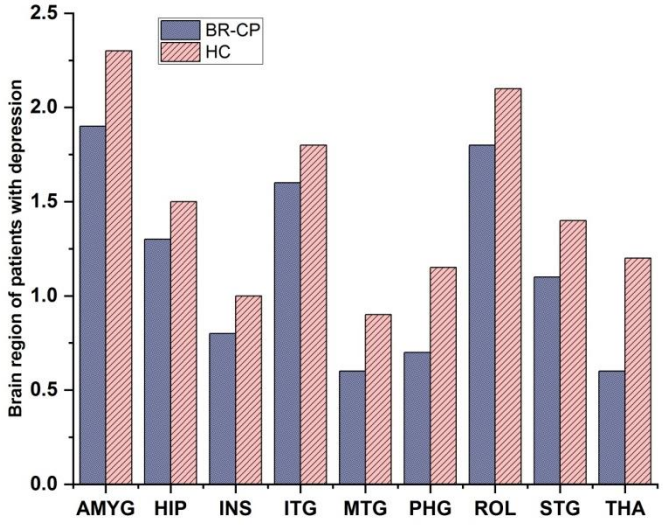

Figure 5: Brain region of patients with depression stage

The brain regions of patients at each stage of depression are shown in Figure 5. The main source of activating input is the brain region known as the amygdala, which is important for controlling emotional responses. In order to initiate the stress response, an individual suffering emotional discomfort may activate the hypothalamus, pituitary gland, and adrenal cortex, or HPA axis. An increasing body of research indicates that depression causes specific brain regions to shrink. In these regions, there is a specific decrease in gray matter volume (GMV). The brain has a large number of neurons. Individuals with severe and chronic depressive symptoms seem to be more likely to experience GMV loss. The brain's parietal regions are the functional hubs for healthy controls, while the temporal portions are the hubs for cancer patients.

Discussion:

Changes to small-world characteristics were more noticeable in breast cancer patients. Functional networks with observable small-world properties are advantageous for information processing that is both globally interconnected and locally specialized. A higher small-

worldness index has been linked to slower processing speeds in cancer patients, with a significant correlation seen between lower raw TMT-A scores and lower local network efficiency. While both controls and cancer patients showed small-world characteristics of functional brain networks, local efficiencies were much higher in the cancer patients during chemotherapy. Because increasing neurocognitive impairment and decreased network attack tolerance are associated in cancer patients, improving local performance in these patients may hamper the flow of information across distant brain regions. This analysis found significantly lower global efficiency and statistically favorable connections between lower global efficiency and worse memory scores in the sick group, but not in the healthy group. The findings corroborated those of previous studies that demonstrated, in reaction to a neurodegenerative simulation, that functional brain networks in survivors of chemotherapy-treated breast cancer were less efficient than those in healthy controls.

The main limitation of this study is the small sample size, which might have made any significant changes in functional abilities between study participants and their healthy counterparts difficult to discern. Partially because of the study's limited power, group differences on cognitive tests may not have been detected. This means that in order to replicate these findings and ascertain whether or not the alterations caused by chemotherapy are potentially reversible, larger sample numbers and longer follow-ups should be used in future research. Because the study used a convenience sample, which is not representative of the population, the results could possibly be skewed. Lastly, other brain parcellation techniques were not taken into account for this study.

Methods for prevention

Tertiary prevention refers to the clinical therapy that occurs after a disease diagnosis; for example, ensuring that breast cancer patients receive timely and effective treatment following a clear diagnosis helps to reduce mortality rates and increase survival rates. Depending on the stage of breast cancer, patients may be prescribed either topical treatments like radiation or systemic therapies like chemotherapy, endocrine therapy, or targeted therapy.

Surgery: One of the most important treatments for breast cancer is surgery to remove the malignant cells. Surgical procedures may be considered as a future risk reduction measure for patients with an exceptionally high risk of breast cancer. Surgical procedures can be administered alone or in conjunction with other treatments such as hormone replacement,

targeted therapy, surgical chemotherapy, or radiation. In the multi-stage treatment of breast cancer, surgical therapy is commonly used for high-risk, non-invasive, locally progressed, and recurring cases. Metastatic breast cancer, which has progressed to other parts of the body, is particularly difficult to treat surgically. There are several different kinds of breast cancer surgeries, including whole breast removal (mastectomy), partial breast removal (lobectomy), and removal of nearby lymph nodes. Surgical removal of breast cancer helps lower recurrence rates and improve local and regional control rates.

Radiation therapy: By utilizing X-rays with a high energy density and specific particles like protons that can destroy cancer cells, breast cancer radiotherapy is able to eradicate the disease. It is worth noting that radiation therapy is more effective on rapidly dividing cells, such as cancer cells, than on slower-growing cells. External radiation and internal radiation (brachytherapy) are the two main approaches to breast cancer radiotherapy. When a machine delivers radiation to the breast from an external source, this is known as external radiation. During internal radiotherapy, the radiation source is temporarily placed in a device that surgeons insert into the breast near the tumor site following surgery to remove the tumor. This allows for treatment to continue while the radiation is administered. Radiotherapy is an effective treatment for breast cancer at nearly every stage. Radiation therapy has been shown to increase the likelihood of a full recovery from breast cancer, prolong the time patients can live after surgery, and decrease the likelihood of the disease returning. Radiation treatment following breast conserving surgery is, in theory, necessary for all patients, including those with intraductal carcinoma and invasive carcinoma, as well as high-risk patients following mastectomy. Another common method for treating cancer that has spread to other areas of the body is radiation therapy. A patient's individual needs dictate the length of treatment, which can range from as little as one week to as much as six or seven weeks.

Treatment with chemotherapy: The purpose of chemotherapy in treating breast cancer is to selectively kill cancer cells. Tablets or intravenous infusions are the most common methods of pharmaceutical administration. By alleviating symptoms and decreasing the likelihood of recurrence, chemotherapy can aid breast cancer patients in living longer and with a better quality of life. Combinations of chemotherapy and other treatments, such as surgery, radiation, or hormone therapy, are common for breast cancer patients. Preoperative chemotherapy and postoperative chemotherapy are the two main categories of chemotherapy used to treat early breast cancer. Sometimes, in early-stage breast cancer, this procedure is employed prior to surgery in order to reduce larger tumors. Instead of removing the entire

breast, this gives the doctor the best chance of completely eliminating the tumor. When a lump is removed from the breast after surgery, doctors may advise chemotherapy to kill any remaining cancer cells and reduce the chance of the disease coming back. On the other hand, rather than aiming to cure the disease, chemotherapy for advanced breast cancer primarily aims to improve quality of life and prolong life. Chemotherapy for breast cancer is not without its potential side effects, some of which are minor and short-lived while others may be more serious and even permanent in extreme cases.

Concentrated medicinal treatment. A key component of targeted therapy is the use of molecularly targeted medicines to inhibit specific targets, such as tumor cells or related cells, by disrupting their signal transduction pathways. The goal of targeted therapy in breast cancer is to eradicate tumor cells while sparing healthy cells from harm by combining chemo medicines at specified areas. Due to its low toxicity and side effects, great curative efficacy, and high specificity, targeted therapy has emerged as one of the most effective therapies for solid tumors, joining the traditional options of radiation, chemotherapy, and surgery [99–100]. It is challenging to identify the optimal targets that impact tumor development and proliferation in clinical practice while also having biological effects. Presently, HER-2, VEFG, EGFR, TROP-2, LIV-1, etc. are the primary targets or pathways that breast cancer primarily targets. It is the gold standard and most studied targeted therapy for HER-2 overexpression. There are now three primary types of medications that target HER2. One type is small molecule tyrosine kinase inhibitors, such as lapatinib. Another type is monoclonal antibodies, such as trastuzumab and pertuzumab. Finally, there are antibody conjugated pharmaceuticals, including trastuzumab emtansine.

Conclusion

There are a lot of factors that increase the risk of breast cancer, and the disease is on the rise globally. An increased risk of breast cancer has been associated with changes in reproductive variables, lifestyle choices, and breast health. Hormone levels and family history have also been linked to an increased risk of breast cancer. There are three distinct approaches to reducing the likelihood of breast cancer: primary, secondary, and tertiary prevention. Reducing obesity and controlling weight, avoiding alcohol, and increasing physical activity are the mainstays of primary prevention, a rather simplistic approach to health promotion. Breast self-examinations, mammograms, ultrasounds, and magnetic resonance imaging (MRI) are the mainstays of secondary prevention. Treatments such as surgery, radiation,

chemotherapy, endocrine therapy, and targeted treatment for breast cancer patients mostly constitute tertiary prevention strategies. Patients whose breast cancer tests positive for estrogen receptors typically benefit from endocrine treatment. Treatments that are tailored to specific molecules can help people with HER2-positive breast cancer. An example of a targeted medicine is a breast cancer treatment that blocks HER2. Despite this, triple-negative breast cancer patients predominantly undergo chemotherapy. However, more and more women are being found with early-stage breast cancer thanks to screening and prevention programs. The death rate from breast cancer will decline as sequencing technology improves, our understanding of the molecular subtype heterogeneity of the disease grows, and more effective treatments are developed.

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