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Breast Cancer in Young Women: Epidemiology, Risk Factors, and Screening Challenges

Ru Chen[1,a,*], Shuzhen Xu[2,b]

[1]*Mailman School of Public Health, Columbia University, 722 West 168th Street, New York, NY, United States*
[2]*School of Medicine, Xiamen University, Xiang'an South Road, Xiang'an District, Xiamen, Fujian, China*
a. rc3764@cumc.columbia.edu, b. shuzhenxu@stu.xmu.edu.cn
**corresponding author*

Abstract: Breast cancer is the most commonly diagnosed cancer among women worldwide, with an estimated 2.3 million new cases annually. In the United States, it accounts for 15.5% of all new cancer cases in 2024, with over 42,000 deaths reported annually. Despite advancements in detection and treatment, mortality remains a concern. This paper explores breast cancer's biological and clinical characteristics, risk factors, and screening strategies, with a particular focus on young women. The disease originates from abnormal cell growth in breast tissue and is classified into various subtypes based on molecular markers. Key risk factors include age, genetic predisposition (e.g., BRCA mutations), and lifestyle influences such as obesity and alcohol consumption. The disease often manifests in a more aggressive form with less favorable outcomes in younger women.Early detection through mammography significantly reduces mortality, but debates persist over the optimal screening age due to concerns about false positives and overdiagnosis. This study examines existing screening guidelines, the economic burden of screening, and barriers to access for young women. This study examines approaches to boost early detection and close the gaps in breast cancer survival rates. It also highlights the critical need for addressing inequalities by increasing diversity in clinical trials and providing equal access to high-quality care and screening.

Keywords: breast cancer, young women, screening, risk factors, disparities

1. Introduction

Globally, breast cancer is the most frequently diagnosed cancer in women, with around 2.3 million new cases each year. In the U.S., it ranks second in prevalence among women, after skin cancer. In 2021, close to 300,000 new cases were reported, and in 2022, over 42,000 women lost their lives to the disease [1]. Breast cancer cases are on the rise, with projections indicating more than 310,000 new diagnoses in 2024, representing 15.5% of all new cancer cases. The estimated number of deaths from breast cancer in 2024 is around 42,250, making up 6.9% of total cancer-related deaths. About 1 in 8 women will get invasive breast cancer in their lifetime [2]. When breast cells in breast tissue mutate and grow out of control, they will create a mass of tissue called tumor. Similar like other cancer, breast cancer can be invasive, and it can grow into the tissue surrounding the breast. It can also travel to other parts of the body and form new tumors [3]. This process is called Metastasis.

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Many different methods can be used to define the various breast cancer type. The typical cells in the breast that become cancer can determine the breast cancer type. In accordance with the cell origin that is involved, breast cancers are classified into two broad categories, carcinomas and sarcomas. Breast cancer is primarily composed of carcinomas, which develop from the epithelial cells in the lobules and ducts responsible for milk production and transport. Sarcomas, however, are much less common, accounting for under 1% of primary cases, and originate from the connective tissues such as blood vessels and myofibroblasts. These classifications, though, can be limited, as some tumors may include a blend of various cell types.

In the group of carcinomas, many kinds of breast cancer are identified based on their invasiveness relative to the primary tumor sites. Distinguishing between the various subtypes is crucial because each one has its own unique prognosis and treatment implications. Breast cancers are typically divided into three main categories, defined by their pathological characteristics and degree of invasiveness: non-invasive (or in situ), invasive, and metastatic [4]. Approximately 25% of breast cancer cases are invasive, with the majority being benign. The disease is generally divided into three subtypes based on molecular markers: hormone receptor-positive/ERBB2-negative (70%), ERBB2-positive (15-20%), and triple-negative (15%). When diagnosed, over 90% of breast cancers are found to be localized rather than metastatic [5].

The prevention, screening, diagnosis, and treatment of breast cancer extend beyond mere medical concerns, representing urgent social and public health issues. Despite continuous advancements in medical research and interventions, public awareness and societal understanding of this disease remain relatively underdeveloped. Therefore, in addition to reviewing critical aspects such as breast cancer symptoms and classifications, this paper argues for the necessity of examining monitoring and response measures from a public health perspective. This approach aims to mitigate the detrimental effects caused by structural inequalities in resource allocation and information dissemination. The complex interplay between social determinants and breast cancer outcomes necessitates a multifaceted approach to address disparities in prevention, screening, and treatment. The quality of life and health outcomes for breast cancer survivors are significantly impacted by social networks and support systems. Moreover, cultural factors, socioeconomic status, and geographical location significantly impact access to and utilization of breast cancer screening services. To effectively combat these disparities, it is imperative to implement community-based initiatives that engage underserved populations directly. Collaborative efforts among healthcare providers, community organizations, and outreach programs can facilitate the development of targeted interventions that address multiple barriers simultaneously. By focusing on reducing structural inequalities and improving access to resources and information, we can work towards minimizing the disparities in breast cancer outcomes and enhancing overall public health.

2. Risk Factors for Breast Cancer

Breast cancer is influenced by several risk factors, with gender and age being the most prominent. It is primarily a disease affecting those assigned female at birth, though it can also occur in individuals assigned male at birth, accounting for less than 1% of cases. Male breast cancer patients are typically diagnosed at older ages and often have a poorer prognosis, with cancer being at a more advanced stage.

Except gender, age is the number one risk factor for breast cancer. The incidence rate of breast cancer rise significantly with age, peaking around the menopausal years, after which it either gradually declines or stabilizes. The median age at which women are diagnosed with breast cancer is 62, meaning 50% of all breast cancer cases are diagnosed before this age, and the other 50% are diagnosed after [6]. However, cases in young women also take a significant part.A study indicates that 4% of new breast cancer diagnoses occur in women under 40, totaling around 11,000 cases, with

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the number continuing to increase [7]. In addition, breast tumors in younger women normally have large size, advanced stages, positive lymph nodes, and weaker survival. Several common risk factors for breast cancer are beyond an individual's control. Risk factors include inherited genetic mutations like BRCA1 and BRCA2, along with a family history of breast or ovarian cancer. Reproductive factors, such as early menstruation (before age 12) and late menopause (after age 55), also contribute to an increased risk. Additionally, having dense breast tissue is an uncontrollable factor that can increase breast cancer risk. Conversely, there are risk factors that individuals can potentially modify. These include maintaining a physically active lifestyle, managing weight to avoid obesity, and limiting alcohol consumption. Reproductive choices also influence risk, with factors such as having a first pregnancy after age 30, not breastfeeding, or never having a full-term pregnancy potentially increasing the likelihood of breast cancer. The use of certain hormone therapies can also contribute to elevated risk. By addressing these modifiable factors, individuals may have some ability to influence their overall breast cancer risk profile.

Annual mammography from ages 40 to 84 can significantly reduce breast cancer mortality and the incidence of advanced breast cancers.Studies show that annual mammography screening can lower breast cancer mortality by 20-25% for women aged 50-69. For those aged 40-49, screening reduces mortality by about 25% within the first decade. Furthermore, advanced breast cancer rates are thought to decline by roughly 20% [8]. Several major medical organizations, including the American Cancer Society, Society of Breast Imaging, American College of Radiology, and American College of Obstetricians and Gynecologists, recommend annual mammography screening for average-risk women starting at age 40. These recommendations are based on evidence suggesting that annual screening from age 40 can maximize the number of lives saved from breast cancer. Nevertheless, the exact optimal age to commence screening and frequency is still debating among societies. As the breast cancer rates is increasing in young women, and at the same time screening also carries potential risks such as false positives, over diagnosis and psychological distress from screening tests. But the benefits of breast cancer screening far outweigh the associated risks. Screening enables the early detection of breast cancer at more manageable and treatable stages, resulting in reduced mortality rates and better long-term outcomes. It significantly enhances the chances of successful treatment and survival for women.

This paper investigates the specific biological and clinical traits of breast cancer in younger individuals, compares various screening guidelines, and analyzes the associated costs in the United States. It also identifies barriers that young women face in accessing breast cancer screening. Through this comprehensive analysis, the study aims to uncover potential opportunities to address existing gaps in early detection and prevention strategies.

3. Biological and clinical characteristics of breast cancer in young women

Recent evidence shows that breast cancer rates are increasing among individuals aged 25 to 39, and they generally face worse outcomes compared to older patients. In young women, the disease more often manifests as hormone receptor-negative, triple-negative, or HER2-positive tumors, which heighten the risk of recurrence and metastasis. Additionally, these patients frequently present with larger tumors (>20 mm), increased proliferation, lymph vascular invasion, and lymph node involvement—all factors linked to higher mortality [9].

Typically, breast cancer is deemed as a disease of older women, but women under 45 account for a considerable portion of overall breast cancer patients, ranging from 5% to 25%, with estimates vary based on study, country, and ethnicity. Although screening and enhanced therapies have led to better outcomes for older patients, these improvements have not translated to young patients. While young breast cancer patients experienced improved outcomes through the late 20th century, recent trends have either plateaued or, in some cases, reversed. More alarmingly, the development of breast cancer

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before age 45 is associated with a twofold increase in both metastasis risk and mortality rate compared to diagnoses made after this age threshold. This stark contrast underscores the unique challenges faced by younger women with breast cancer and highlights the urgent need for targeted interventions and research to address these disparities in outcomes across age groups [10].This age-based discrepancy in outcome suggests that there is an unmet need in the care of patients under 45 with breast cancer.

For women under 45, strong evidence indicates that breast cancer is the leading cause of cancer-related deaths. Moreover, data reveal that the incidence of breast cancer is rising in this age group, with a disproportionate number of young women succumbing to the disease each year. While the definition of "young women" in breast oncology varies—most studies focus on those under 35, 40, or 45—research suggests that further categorizing premenopausal breast cancer cases into very early onset (<40 years) and relatively early onset (40–49 years) may provide a more nuanced understanding.

In conclusion, women under the age of 40 years old diagnosed with breast cancer is linked to poorer prognosis and higher mortality rates. They constitute a unique group of breast cancer patients, characterized by differences in tumor biology, prognosis, diagnostic challenges, treatment options, survivorship, and concerns about fertility. Tumors in this age group are generally more aggressive, often presenting as estrogen receptor-negative, triple-negative, or HER2-positive subtypes. In addition, lower tumor differentiation, higher Ki-67 expression, and greater lymph node involvement compared to women over 50 resulted inferior treatment outcomes [11]. In addition, routine breast cancer screening is typically not provided to women under 40, unless they are classified as high-risk. But not too many young women know breast cancer very well, and not too many people know whether they have a higher risk in breast cancer comparing with others. So, it is harder for young women to make good choice about breast cancer screening.

4. The Cost of Breast Cancer Screening

Breast cancer screening for young women has been widely debated in terms of clinical benefits and harms, yet the substantial financial burden associated with screening this population has received limited attention. Research shows that the cost of screening privately insured women in this age group is not only high but also varies significantly across different regions in the United States, emphasizing the need to examine the factors driving these cost discrepancies.

One major contributor to the high costs of screening younger women is the increasing adoption of advanced imaging technologies such as digital breast tomosynthesis (DBT). While DBT may offer clinical advantages over conventional 2-D mammography, its uneven adoption across regions leads to inconsistencies in overall screening expenditures. In addition, previous studies have demonstrated significant regional variation in healthcare costs and utilization in the U.S., yet the degree to which these disparities stem from differences in screening modalities and unit costs remains unclear [12]. Understanding whether these cost variations arise from differences in technology adoption, regional pricing structures, or reimbursement policies is crucial for informing strategies that promote cost-effective healthcare resource allocation for young women.

Recent studies showed that privately insured population of U.S. young women revealed substantial regional differences in the costs of breast cancer screening. The average per-screened-beneficiary cost was $353, with a median cost of $250 and an interquartile range of $174–$367. Costs for specific screening and diagnostic procedures varied widely across hospital referral regions (HRRs): 2-D mammography screening costs ranged from $107 to $471; Digital breast tomosynthesis (DBT) screening costs varied between $113 and $714; Supplementary screening ultrasound averaged $260, with a range of $58 to $1,046; Diagnostic biopsy costs averaged $2,002, spanning from $696 to $6,468; Diagnostic MRI expenses ranged from $445 to $3,512, with a mean of $1,397 [13]. Interestingly, in some regions, DBT screening was less expensive than 2-D mammography in others,

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highlighting inconsistencies in pricing and reimbursement policies across different areas. This substantial variation in costs underscores the complex landscape of breast cancer screening expenses and suggests potential inequities in access to these crucial health services across different regions of the United States.

The largest contributors to regional cost variation were the costs associated with DBT screening, 2-D mammography, and biopsy procedures. There is a strong correlation between the mean regional costs of 2-D mammography, DBT screening, and diagnostic 2-D mammography, indicating that disparities in these key procedures drive the overall cost differences across regions [14]. These inconsistencies in pricing structures, combined with variations in the adoption of newer technologies, directly contribute to the high costs of breast cancer screening for young women. These findings underscore the financial burden that younger women face when undergoing breast cancer screening and highlight the importance of policy interventions aimed at improving cost efficiency. By mitigating regional cost discrepancies and optimizing resource allocation, policymakers can enhance the sustainability of breast cancer screening programs while ensuring equitable access to these critical healthcare services.

5. Barriers to Breast Cancer Screening in Young Women

Breast cancer is a leading health problem for women, and early detection through routine screening is crucial in reducing mortality rates. At present, the most effective method for early detection of breast cancer is regular mammography screening. However, young women often face significant barriers that impede their access to breast cancer screening services. These barriers encompass limited access to screening programs, high costs, inadequate insurance coverage, and insufficient awareness of both risk factors and the benefits of early detection.

One of the primary challenges is the limited access of screening programs for young women. National guidelines and public health initiatives have typically focused on women over the age of 40 or 50, when the risk of developing breast cancer is statistically higher. As a result, women under 40, unless identified as high risk due to genetic factors or a strong family history, are often excluded from routine screening programs. This age-based prioritization results in missed opportunities for early detection among younger populations, potentially delaying diagnosis until the cancer has advanced.

Financial constraints further complicate the issue. The cost of breast cancer screening can vary widely depending on the screening method, geographic location, and technological advancements used in imaging. For example, while digital mammography and newer imaging techniques may offer improved detection rates, they also come with significantly higher costs. Young women, who are often early in their careers and may have limited financial resources, frequently face the burden of these high expenses. Without affordable screening options or governmental subsidies, many opt out of routine screening, thus increasing their risk of late-stage diagnosis. In addition to high costs, insurance coverage presents a formidable barrier. Many insurance plans are primarily tailored to cover older women, who are viewed as more susceptible to developing breast cancer. As a result, younger women may find themselves with insufficient coverage for routine screening services or may need to bear a larger portion of the costs themselves. This insurance coverage disparity creates a financial barrier for young women seeking early detection, thereby increasing the risk of delayed diagnosis and treatment. The resulting disincentive compounds the already significant challenges in addressing breast cancer in younger populations.

Another significant barrier is the lack of awareness among young women regarding their breast cancer risk and the importance of early detection. There is a common misconception that breast cancer predominantly affects older women, which can lead younger women to underestimate their own risk. This perception is exacerbated by limited public health messaging directed toward younger populations. Additionally, the stigma and fear associated with a cancer diagnosis can discourage

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young women from pursuing screening, even when it is be beneficial. Educational campaigns tailored specifically to young women could play a crucial role in altering these perceptions and encouraging proactive health behavior.

As such, the barriers preventing young women from undergoing breast cancer screening are multifaceted, involving limited access to age-appropriate screening programs, high associated costs, inadequate insurance coverage, and a pervasive lack of awareness about the importance of early detection. Addressing these obstacles requires coordinated efforts from healthcare policymakers, insurance companies, and community organizations. By developing targeted strategies, such as subsidized screening programs, enhanced insurance coverage for younger women, and focused public health campaigns. Early detection and treatment outcomes can be advanced, ultimately reducing breast cancer mortality in this vulnerable demographic. Furthermore, fostering collaboration between healthcare providers, policymakers, and community organizations is crucial to ensure the widespread adoption and effectiveness of these initiatives. By addressing both the financial and awareness barriers, it is important to create a more comprehensive approach to breast cancer prevention and management in younger populations.

6. Screening guidelines and gaps in early detection among high-risk younger populations

Breast cancer screening guidelines have been updated over time to incorporate the latest findings on early detection and risk factors. On April 30, 2024, the United States Preventive Services Task Force (USPSTF) recommended that all women begin biennial screenings starting at age 40 and continue through age 74 to reduce breast cancer mortality. This change replaces earlier guidelines, which permitted screening to begin between ages 40 and 50. This new guidance, widely supported by organizations such as the CDC, also affects insurance coverage, ensuring that most plans now cover mammograms for women 40 and older. The update is based on research indicating a rise in breast cancer cases among women in their 40s, with early screening proving to be more beneficial than harmful for this age group [15].

The American Cancer Society (ACS) offers a more detailed framework, distinguishing between women at average risk and those at high risk. For women at average risk, ACS suggests that women can choose to start screening as early as age 40 and recommends annual mammograms from ages 45 to 54, after which women may choose to continue yearly screenings or switch to biennial mammograms from age 55 onward. Screening is advised to continue as long as a woman is in good health and has a life expectancy of at least 10 more years. In contrast, high-risk women—such as those with BRCA1 or BRCA2 gene mutations, a strong family history, prior chest radiation therapy, or certain genetic syndromes—should undergo annual breast MRI and mammography starting at age [16].

Similarly, Memorial Sloan Kettering Cancer Center (MSK) categorizes women into average, intermediate, and high-risk groups, with specific screening recommendations. Women at average risk are encouraged to become familiar with their breasts by age 20 and begin annual mammograms or tomosynthesis at age 40, while those at intermediate risk, including individuals with atypical hyperplasia or lobular neoplasia, should begin mammograms by age 30. High-risk women require more intensive screening, including breast exams every six months starting at age 20, along with annual mammograms or tomosynthesis and MRIs alternating every six months beginning at age 25 or 10 years before the youngest breast cancer diagnosis in a close blood relative. For those who have undergone radiation treatment, screenings should start eight years after therapy [17].

Several organizations, including the American College of Radiology (ACR), the Society of Breast Imaging (SBI), the American Society of Breast Surgeons (ASBrS), and the National Comprehensive Cancer Network (NCCN), agree that women at average risk should start annual mammograms at age 40, emphasizing the need for early and frequent screenings [18]. However, discrepancies still exist in

screening intervals, guidelines for women under 40, risk classification, and the use of supplemental imaging for high-risk groups. Current guidelines could be improved by incorporating more personalized risk assessments and expanding access to advanced imaging technologies like MRI and tomosynthesis for high-risk and younger women. Filling these gaps could improve early diagnosis and help reduce variations in breast cancer survival rates.

7. Conclusion and Future Directions

Breast cancer remains a critical public health concern, with rising incidence rates among young women requiring urgent attention. While screening guidelines vary, the importance of early detection cannot be overstated. Expanding access to affordable screening, increasing awareness of risk factors, and refining guidelines to address the unique challenges faced by younger patients are crucial steps toward reducing breast cancer mortality.

Addressing disparities in screening access and affordability is essential to ensure that all women, regardless of age, receive timely and effective care. By implementing targeted strategies such as subsidized screening programs, enhanced insurance coverage for younger women, and focused public health campaigns, we can improve early detection and treatment outcomes. These efforts are particularly crucial given that breast cancer diagnosis before age 45 is associated with a twofold increase in metastasis risk and mortality rate compared to later-life diagnoses.

Furthermore, overcoming barriers such as limited access to screening programs, high costs, inadequate insurance coverage, and insufficient awareness of risk factors is vital for improving early detection rates among young women. By closing these gaps in breast cancer diagnosis and treatment, we can work toward better outcomes for all patients, ultimately reducing the disproportionate impact of this disease on younger populations.

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