

Breast Cancer Epidemiology and Early Detection

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Introduction

- Breast cancer is **the most frequently diagnosed cancer** in women worldwide with **2.26 million** new cases in **2020**.
- Besides being **the most common**, breast cancer is also the **leading cause of cancer death** in women worldwide.

- Although **incidence rates** were the **highest** in **developed regions**, the countries in **Asia** and **Africa** shared **63% of total deaths in 2020**.
- Most women who **develop breast cancer** in a **high-income country** will **survive**; the opposite is **true** for women in most **low-income** and many **middle-income** countries.

- In 2020 breast cancer **mortality-to-incidence ratio (MIR)** as a representative indicator of 5-year survival rates was 0.30 globally.

- In locations with developed health care (Hong-Kong, Singapore, Turkey) the **5-year survival** was **89.6%** for localized and **75.4%** for regional cancer.
- In less developed countries (Costa Rica, India, Philippines, Saudi Arabia, Thailand) the **survival rates** were **76.3%** and **47.4%** for localized and regional breast cancer respectively.

- Breast cancer incidence and death rates have **increased** over the **last three decades**.
- Between 1990 and 2016 breast cancer incidence has **more than doubled** in 60/102 countries (Afghanistan, Philippines, Brazil, Argentina), whereas deaths have **doubled** in 43/102 countries (Yemen, Paraguay, Libya, Saudi Arabia).

- Current projections **indicate** that by **2030** the worldwide number of **new cases diagnosed** reach **2.7 million annually**, while the **number of deaths 0.87 million**.

- In **low-** and **medium** - income countries, the breast cancer incidence is expected to **increase** further due to the **westernization of lifestyles** (delayed pregnancies, reduced breastfeeding, low age at menarche, lack of physical activity, and poor diet), **better cancer registration**, and **cancer detection**

- The **incidence of breast cancer** by **age** and geographic distribution shows that in **developing countries** this incidence is **23%** in **young adults** (15-49 years) versus **10%** in **developed countries**.
- In **menopausal** females (>50 years) the incidence is **28%** in **developing countries** versus **39%** in **developed countries**.
- **Menopausal** females from developed countries have a **greater** incidence of cancer.

Breast Cancer Epidemiology in IRAN

- Akbari et al. reported that the mean age for breast cancer in Iran was **5 years earlier** in **Iranian women** compared to women from developed countries.
- According to the national cancer registry database, **57.6% of breast cancer cases** were seen in **women <50 years of age**.

Akbari ME, Khayamzadeh M, Khoshnevis S, Nafisi N, Akbari A. Five and ten years survival in breast cancer patients mastectomies vs. breast conserving surgeries personal experience. *Iran J Cancer Prev.* 2012;1(2):53-6.

Age and gender

- In Iran, the **mean age** at breast cancer diagnosis is 47.95 - 54.6 years.
- The **most** common patient age group is 41-49 years.
- The **rate** of breast cancer in **iranian men** is **2.8%**, which is **higher than** other parts of the world.

Table 3. Age distribution of breast cancer patients according to age (years) in Iran.

Age (years)	Number	Percent
<30	39	6.4
30-34	42	6.9
35-39	89	14.5
40-44	114	18.6
45-49	125	20.4
50-54	83	13.5
55-59	59	9.6
60-64	23	3.8
65-69	22	3.6
70-74	17	2.8

Risk Factors of Breast Cancer

Table 1. Modifiable and non-modifiable risk factors of breast cancer.

Non-Modifiable Factors	Modifiable Factors
Female sex	Hormonal replacement therapy
Older age	Diethylstilbestrol
Family history (of breast or ovarian cancer)	Physical activity
Genetic mutations	Overweight/obesity
Race/ethnicity	Alcohol intake
Pregnancy and breastfeeding	Smoking
Menstrual period and menopause	Insufficient vitamin supplementation
Density of breast tissue	Excessive exposure to artificial light
Previous history of breast cancer	Intake of processed food
Non-cancerous breast diseases	Exposure to chemicals
Previous radiation therapy	Other drugs

Family History

- **13–19%** of patients diagnosed with **breast cancer** report a **first-degree** relative affected by the same condition.
- Breast cancer **risk** significantly increases with an increasing **number** of first-degree relatives affected.
- Risk might be even **higher** when the affected **relatives** are **under 50 years old**.

Reproductive History

- Numerous studies confirmed a strict relationship between exposure to **endogenous hormones** and **excessive risk** of breast cancer in females.
- Occurrence of specific events such as **pregnancy, breastfeeding, first menstruation, and menopause along with their duration and the concomitant hormonal imbalance, are crucial** in carcinogenic events in the **breast microenvironment**.

Reproductive History

- **First full-term pregnancy** at an early age (especially in the **early twenties**) along with a subsequently **increasing number of births** are associated with a **reduced risk of breast cancer**.

Density of Breast Tissue

- Greater breast tissue **density** correlates with the **greater** breast cancer risk; this trend is observed both in **premenopausal** and **postmenopausal** females.

Exposure to Artificial Light

- Artificial light at night (**ALAN**) has been recently linked to **increased** breast cancer risk.
- The probable causation might be a **disrupted melatonin** rhythm and subsequent epigenetic alterations.
- **Increased** exposure to ALAN is associated with a **significantly** greater risk of breast cancer compared to individuals with **lowered ALAN** exposure.

Chosen Drugs

- The intake of **diethylstilbestrol** during **pregnancy** is associated with an **increased risk** of **breast cancer** not only in **mothers** but also in the **offspring**.
- Numerous researches indicate that **females** who use **hormonal replacement therapy (HRT)** especially longer than **5 or 7 years** are also at **increased risk** of **breast cancer**.

Breast cancer early detection

Introduction

- Previous studies have suggested that **early breast cancer detection** with **suitable treatment** could reduce breast cancer **death rates** significantly in the long-term.

- Mammography is the current **standard** breast screening technique, but it is less effective for subjects under 40 years old and dense breasts, less sensitive to small tumors.
- Ultrasound has been applied as an additional medical imaging tool for **mammography**.

- Magnetic resonance imaging (**MRI**) has the ability to **detect small lesions** that cannot be detected by mammography, however, it is also **expensive** and has **low specificity**, which can lead to **overdiagnosis** .
- Positron emission tomography (**PET**) is the most **accurate method** for visualizing the **spread** of tumors or their **response to therapy**.

- Microwave imaging (**MI**) techniques have been recently recommended as a **safe** and **low-cost** alternative approach to **mammography** for diagnosing breast cancer.

Mammography

- **Annual mammograms** are recommended for females beginning at age 40, and they are particularly beneficial for females aged between the ages of 40 and 74.
- **Contrast-enhanced (CE) digital mammography** that uses **intravenous** contrast injections, generates **higher sensitivity** compared to **mammography**.

Ultrasound

- Breast ultrasonography is a **cost-effective** and **widely available** screening tool.
- Breast ultrasonography helps to:
 1. identify **cysts** and **solid masses**
 2. increases the **cancer detection rates** but **less efficient** compared to mammography

Ultrasound

- **Breast ultrasonography** has been recommended as a supplement to mammography for subjects with high breast cancer risk, pregnant women and subjects who cannot to have mammography.

MRI

- **Breast MRI** has been recommended for subjects with **high breast cancer risk**, but it has not been recommended for the **general population** due to its high false-positive rate, high cost, time consumption, the need for experienced radiologists.

Microwave Breast Imaging (MI)

- **MI** techniques can be grouped as **passive** and **active**, and **active approaches** can be sub-grouped into two major groups:
 1. microwave tomographic
 2. radar-based MI

- **Passive MI** uses radiometry to measure the **temperature differences** between **normal** and **malignant tissues**.
- **Active MI** measures the **dielectric properties (DPs) contrast** between **healthy tissue** and **malignant tissue**.

Microwave Imaging

- MI has the potential to become a **low risk alternative** or **clinical complement** to conventional **mammography** for diagnosing breast cancer.
- MI and **biosensor techniques** are still **not mature** and **many challenges** need to be solved before they can be implemented for **clinical trials**.

