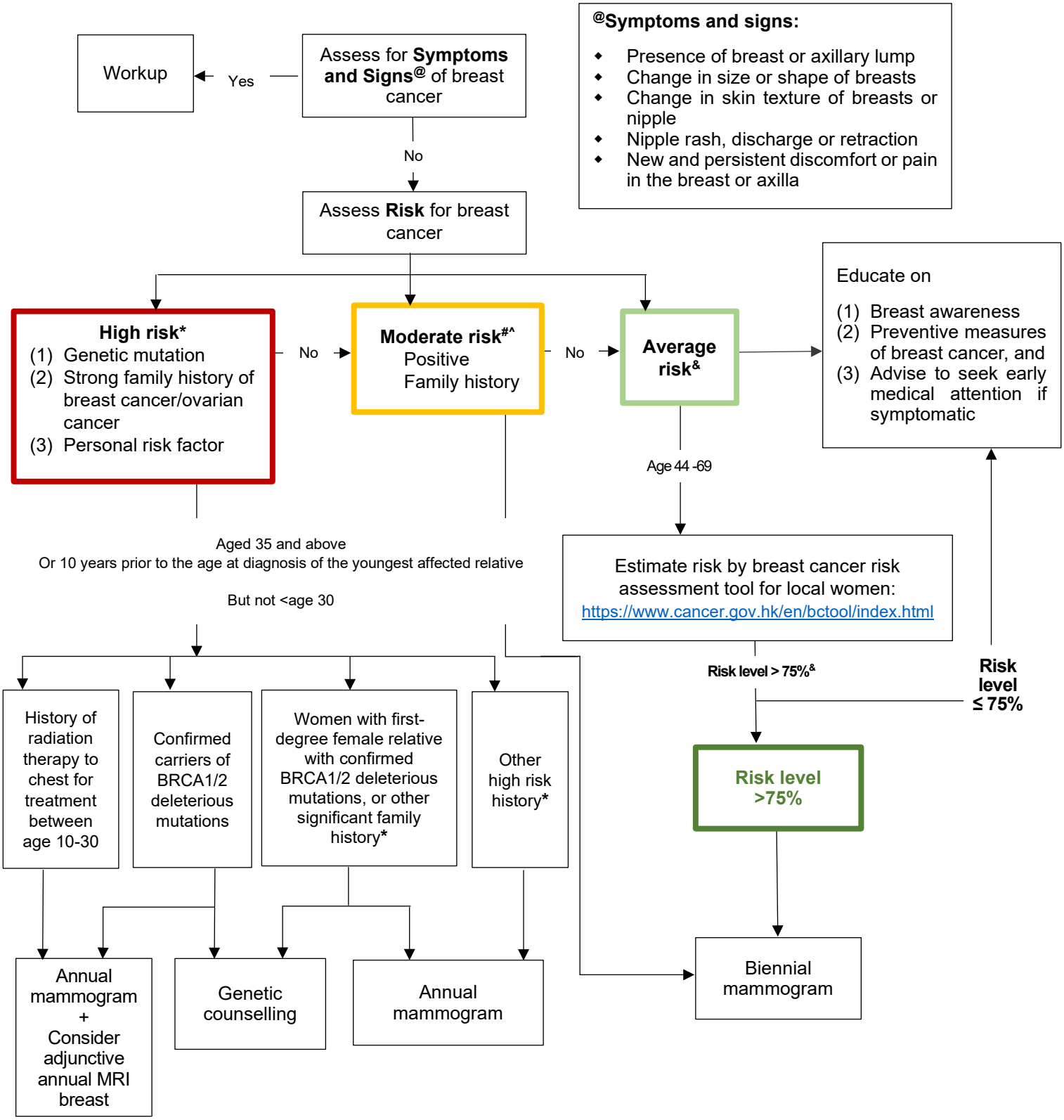
# Breast Cancer Screening

| Recommendations | Grades of Recommendations^ |
|---|---|
| 1. **Educate all women on breast awareness, symptoms, signs and risk factors of breast cancer, and importance of regular breast cancer screening**[1] | **A** |
| 2. **Offer breast cancer screening to asymptomatic women at**[2, 3]**:**<br>- **High risk starting at age 35 or 10 years prior to the age at diagnosis of the youngest affected relative (whichever is earlier), but not younger than age 30, annually**<br>- **Moderate risk, biennially**<br>- **Increased risk between age 44-69, biennially** | **A** |

^ Scottish Intercollegiate Guidelines Network (SIGN) classification

## Figure 1. Breast Cancer Screening Workflow

***(For details, refer to the Recommended Care Component)***




Adapted from the ***Cancer Expert Working Group on Cancer Prevention and Screening (CEWG) – Recommendations on Prevention and Screening for Breast Cancer***[2]

| Risk Groups | Risk Factors |
|---|---|
| **High Risk*** | ***If any one of the below risk factors:***<br><br>**1. Genetic mutation**<br>◆ Carriers of BRCA1/2 deleterious mutations confirmed by genetic testing<br><br>**2. Family history of breast cancer/ovarian cancer**<br>◆ Any first-degree female relative is a confirmed carrier of BRCA1/2 deleterious mutations<br>◆ Any first- or second-degree female relative with both breast cancer and ovarian cancer<br>◆ Any first-degree female relative with bilateral breast cancer<br>◆ Any male relative with a history of breast cancer<br>◆ 2 first-degree female relatives with breast cancer AND one of them being diagnosed at age ≤50 years<br>◆ ≥2 first- or second-degree female relatives with ovarian cancer<br>◆ ≥3 first- or second-degree female relatives with breast cancer OR a combination of breast cancer and ovarian cancer<br><br>**3. Personal risk factors**<br>◆ History of radiation therapy to chest for treatment between age 10 and 30 years, e.g. Hodgkin's disease<br>◆ History of breast cancer, including ductal carcinoma in situ (DCIS); lobular carcinoma<br>◆ History of atypical ductal hyperplasia or atypical lobular hyperplasia |
| **Moderate Risk#** | **1. Family history**<br>◆ Only one first-degree female relative with breast cancer diagnosed at ≤50 years of age<br>◆ Two first-degree female relatives diagnosed with breast cancer after the age of 50 years |
| **Increased Risk&** | Estimated by **breast cancer risk assessment tool** for local women (www.cancer.gov.hk.hk/bctool) to be at **>75% risk** compared to women of the same age, based on the following personalised risk factors:<br>◆ Family history of breast cancer among first-degree relative<br>◆ Prior diagnosis of benign breast disease<br>◆ Nulliparity<br>◆ Late age of first live birth<br>◆ Early age of menarche<br>◆ High body mass index<br>◆ Physical inactivity |

DCIS = Ductal Carcinoma in Situ

## Recommended Care Components

| For Who? | Recommended Care Components[a] | By Whom?[b] | How Often? |
|---|---|---|---|
| **Empowerment** | | | |
| Women of all ages | Educate on:<br>◆ **Breast awareness (Table 1.)**<br>◆ **Risk factors** of breast cancer<br>◆ Primary **preventive measures** for breast cancer **(Table 2.)**<br>◆ Importance of **breast cancer screening**<br><br>Advise against Clinical breast examination and Self-breast examination for breast cancer screening | Primary Healthcare Providers | Opportunistically |
| **Assessment** | | | |
| Women of all ages | Assess:<br>**(1) Risk** for breast cancer<br>◆ BRCA1/2 deleterious mutation<br>◆ Personal history of breast diseases or radiation therapy to chest for treatment between 10 to 30 years<br>◆ Family history of breast/ovarian cancer<br>- Number of 1° vs. 2° degree relative and Age at diagnosis<br>- Genetic mutation<br>◆ Other risk factors by breast cancer risk assessment tool for local women (www.cancer.gov.hk/bctool)<br>- History of benign breast disease<br>- Early age of menarche<br>- Nulliparity<br>- Late age of first live birth<br>- High body mass index<br>- Physical inactivity<br><br>**(2)** Presence of **symptoms and signs** suggestive of breast cancer[2]<br>◆ Presence of breast or axillary lump<br>◆ Change in size or shape of breasts<br>◆ Change in skin texture of breasts or nipple<br>◆ Nipple rash, discharge or retraction<br>◆ New and persistent discomfort or pain in the breast or axilla | Nurses<br>Doctors | Opportunistically |
| Women with symptoms or signs suggestive of breast cancer | Refer to seek early medical attention<br>*OR*<br>Provide work up assessment | Nurses<br><br>Doctors | When symptomatic or having signs |

| For Who? | Recommended Care Components[a] | By Whom?[b] | How Often? |
|---|---|---|---|
| **Screening** | | | |
| Asymptomatic women who are eligible for breast cancer screening | Discuss screening methods, and address misconceptions and concerns | Nurses<br>Doctors | Opportunistically |
| Women **aged 35 or above** who had **radiation therapy to chest for treatment between age 10 to 30**[2] | Offer screening by **Mammography**<br><br>+ Consider additional **MRI** | Doctors | Annually |
| **Confirmed carriers of BRCA1/2 deleterious mutations**[2] | *Starting at age 35 or 10 years prior to the age at diagnosis of the youngest affected relative (whichever is earlier), but not < age 30:*<br><br>Offer screening by **Mammography**<br><br>+ Consider additional **MRI**<br><br>Offer referral to **specialist cancer clinic** if wishing to consider prophylactic surgery / chemoprevention for advice and counselling | Doctors | Annually<br><br>Annually |
| Women who have any first degree female relative with confirmed BRCA1/2 deleterious mutations | *Starting at age 35 or 10 years prior to the age at diagnosis of the youngest affected relative (whichever is earlier), but not < age 30:*<br><br>Offer screening by **Mammography**<br><br>Offer referral to specialist cancer clinic for **genetic counselling and testing*** | Doctors | Annually |
| Women at high risk due to other types of family history | *Starting at age 35 or 10 years prior to the age at diagnosis of the youngest affected relative (whichever is earlier), but not < age 30:*<br><br>Offer screening by **Mammography**<br><br>Discuss and consider to offer referral to specialist cancer clinic for **genetic counselling and testing*** | Doctors | Annually |
| Other **women aged 35 or above** with **high risk*** | Offer screening by **Mammography** | Doctors | Annually |
| Women at **moderate risk#** | Offer screening by **Mammography** | Doctors | Biennially |
| Asymptomatic Women **aged 44 to 69** who are at **increased risk&** according to assessment tool | Offer screening by **Mammography** | Doctors | Biennially |

| For Who? | Recommended Care Components[a] | By Whom?[b] | How Often? |
|---|---|---|---|
| **Management** | | | |
| Women who underwent mammography screening[4] | Manage result according to the BI-RADS guideline **(Table 3.)** | Doctors | When result available |

MRI = Magnetic Resonance Imaging; BI-RADS = Breast Imaging-Reporting and Data System

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[a] **Grade of recommendation according to colour code**:

| Recommended (Strong) | Conditionally recommended | Practice points | Generally not recommended | Not recommended (Strong) |
|---|---|---|---|---|

[b]

**Primary Healthcare Providers** – All providers of health services in primary healthcare settings

**Primary Healthcare Professionals** – Includes doctors, dentists, chinese medicine practitioners, nurses, pharmacists, physiotherapist, occupational therapist, dietitians

**"Trained"** Healthcare Professionals – Additional post-qualification training required to deliver the respective care component(s)

## Collaborative Care

| Specialist Referral Recommended |
| --- |
| **Early Referral to Surgeon:**<br>◆ Clinical features suggestive of breast cancer<br>◆ BI-RADS Category (4) to (6) |
| **Referral to Specialised Cancer Centres with Expertise in Genetic Counselling*:**<br><br>◆ **For genetic counselling and testing:** Women who have any **first-degree female relative with confirmed BRCA1/2 deleterious mutations** should be offered genetic testing to confirm or refute their carrier status.<br><br>◆ **For advice and counselling on prophylactic surgery / chemoprevention: Confirmed carriers of BRCA1/2 deleterious mutations** who wish to consider prophylactic surgery / chemoprevention<br><br>◆ **Discuss and consider referral for genetic testing and counselling:** Women at **high risk due to other types of family history** who wish to clarify their genetic risk or that of their family |

BI-RADS = Breast Imaging-Reporting and Data System

*Healthcare professionals should discuss with their clients in detail about the uncertainties and implications of the test results

**Table 1. The Breast Awareness 4-point Code**[5]

To empower women on their own breast health and facilitate early detection of abnormalities, all women are advised to be "**Breast Aware**", i.e. to familiarize themselves with the normal look and feel of their breasts, and to consult a doctor promptly if they notice any unusual changes.[2, 6]

| Breast Awareness 4-Point Code | | |
|---|---|---|
| | ◆ Educate on what is normal | ◆ During childbearing years, breasts frequently become larger, tender, and lumpy just before menstruation, but they typically return to their normal state afterwards.<br>◆ After menopause, breast tissue is often less dense and firm, and becomes fattier, making breasts feel softer. |
| | ◆ Educate on breast changes to look and feel for | ◆ The breast<br>- Change in the outline, shape or size<br>- Puckering or dimpling of the skin<br>- Any new discrete lump<br>- Unusual pain or discomfort, particularly if new, persistent and localized<br><br>◆ The nipple<br>- Recent inversion or change in shape<br>- Any discharge<br>- Rash around the nipple<br><br>◆ The armpit<br>- Swelling under the armpit<br>- Constant pain |
| | ◆ Encourage to look and feel their breasts | ◆ Encourage women to examine their breasts by looking in a mirror while changing or to feel them during bathing or while lying down. |
| | ◆ Encourage to seek medical attention if breast abnormalities are noticed | ◆ If any breast changes are noticed, advise them to seek medical consultation promptly. |

Source: https://www.fhs.gov.hk/english/health_info/woman/12545.html

**Table 2. CEWG Recommendation on Primary Preventive Measures for Breast Cancer[2]**

| Primary Prevention of Breast Cancer |
| --- |
| **Certain breast cancer risk factors are modifiable and related to personal lifestyle and behaviour. Women can lower their risk of getting breast cancer by pursuing primary preventive measures below:**<br>◆ ***Be physically active:*** Women should do at least 150 minutes of moderate-intensity or equivalent aerobic physical activities per week (e.g. climbing stairs or brisk walking)<br>◆ ***Do not drink alcohol***<br>◆ ***Maintain healthy body weight:*** Asian women should aim for a body mass index (BMI) between 18.5 and 22.9, and a waist circumference of less than 80 cm (~32 inch)<br>◆ ***Have childbirth at an earlier age and breastfeed each child for a longer duration****  |

CEWG = Cancer Expert Working Group; BMI = Body Mass Index
*Breast feeding for at least 5-6 months has a protective effect on the risk of developing breast cancer[7]

**Table 3. Management of Mammography Results**[8]

| BI-RADS Categories | Mammographic Abnormality | Likelihood of Malignancy | Recommended Care<br>Explain significance of findings and required next step |
|---|---|---|---|
| **0** | Incomplete | N/A | • Need additional imaging evaluation and/or prior mammograms for comparison |
| **1** | Negative | No evidence of malignancy | • Routine screening as mentioned |
| **2** | Benign finding | No evidence of malignancy | • Routine screening as mentioned |
| **3** | Probably benign finding | >0% but ≤2% | • Short-interval (6-month) follow-up or continued surveillance mammography |
| **4** | Suspicious abnormality | >2 but <95% | • Refer to specialist to consider tissue biopsy |
| **4A** | *Low* suspicion for malignancy | >2 to ≤10% | |
| **4B** | Moderate suspicion for malignancy | >10 to ≤50% | |
| **4C** | *High* suspicion for malignancy | >50 to <95% | |
| **5** | Highly suggestive of malignancy | ≥ 95% | • Early refer to specialist to consider tissue biopsy |
| **6** | Known biopsy proven malignancy | 100% | • Refer to specialist to consider surgery |

BI-RADS = Breast Imaging-Reporting and Data System

## Further Readings

### *Natural History and Risk Factors for Breast Cancer*

- There are 2 types of breast cancer: ductal carcinoma in situ (DCIS) and invasive breast cancer. DCIS consists of presumably malignant cells confined to the mammary ducts and is considered a precursor to invasive breast cancer, with 10-53% of cases progressing to invasive forms.[9-12] Invasive breast cancer consists of cancer cells that have invaded surrounding tissues. It can be further divided into histological subtypes, with invasive ductal carcinoma being the most common, followed by invasive lobular carcinoma.[9, 13] Molecular subtypes include Luminal A, Luminal B, basal-like, and HER2-enriched, each associated with different treatment responses and prognoses. The basal-like and triple-negative subtypes (lacking estrogen receptors, progesterone receptors, and absence of HER2 overexpression) have poorer prognoses; Individuals with BRCA-1 mutations have a higher risk of these subtypes.[14-16] Risk factors for breast cancer were listed in **S Table 1.**

- Breast cancer may not always present as a palpable lump in its early stages, particularly in cases of DCIS. When tumors become large enough to be felt, they often indicate a later stage of the disease. Without breast cancer screening, 83% of breast cancer patients presented with a painless lump, 6.8% presented with nipple abnormalities, 6.4% presented with breast pain, 2% presented with breast skin abnormalities, 1.2% presented with axillary lump, 0.6-0.7% presented with breast contour abnormalities or inflammation.[17] Both screening and early diagnosis facilitated disease detection at earlier stages and improve survival outcomes.[18]

### *Effectiveness of Breast Cancer Screening*[2]

- Mammography (MMG) screening allows disease detection at an asymptomatic stage and improves survival outcomes. For women aged 39-49 at average risk, breast cancer screening is associated with a relative risk (RR) of 0.92 (95% CI 0.75-1.02) in breast cancer mortality compared to those without screening over 10 years of follow-up.[3] For women aged 50-59, the RR was 0.86 (95% CI 0.68-0.97); for those aged 60-69, the RR was 0.67 (95% CI 0.54-0.83); and for ages 70-74, the RR was 0.80 (95% CI 0.51-1.28). Additionally, women aged 50-69 who participated in organised mammography screening were found to have approximately 40% reduction in the risk of breast cancer mortality.[19]

Screening for women under 30 is not recommended due to increased false positive results and risk of over-diagnosis in this younger age group.[20]

- Clinical breast examination is no longer recommended for breast cancer screening due to insufficient evidence regarding its effectiveness in reducing breast cancer mortality,[21] with reported sensitivity of 54.1% (95% CI: 48.3%-59.8%), specificity of 94.0% (95% CI: 90.2%-96.9%), positive predictive value of 14% (95% CI, 2-43%) and negative predictive value 92% (95% CI, 89-94%).[22, 23] Similarly, self-breast examinations are also discouraged because of potential harms related to false positives and unnecessary biopsies.[24, 25] The sensitivity of self-breast examinations ranged from 20% to 30%, while their specificity was 87.4%.[26]

- Risk-based biennial mammography screening was found to be cost-effective in reducing the lifetime risk of breast cancer mortality for women aged 44 to 69 in Hong Kong. A local study estimated that risk-based screening among average-risk women in Hong Kong could yield a health gain of 0.009 quality-adjusted life years (QALY) at a net cost of $159 per woman, resulting in an incremental cost-effectiveness ratio of $18,151 per QALY.[27] Personalized risk-based screening for breast cancer was demonstrated to be more cost-effective than universal age-based screening in Chinese women with average risk. This contrasts with recommendations from other countries, such as the United Kingdom, Australia, and Singapore, which offer universal screening for all women starting at age 50.

- Recommendations for breast cancer screening for high- and moderate-risk women were made by the CEWG based on evidence from international studies and practices. Studies have shown that MRI screening in high-risk women significantly shifted cancer diagnosis from advanced stages to earlier and pre-invasive stages compared to other screening modalities, such as mammography (MMG), and ultrasonography. The International Agency for Research on Cancer (IARC) concluded that MRI, when used as an adjunct to mammography (MMG), could increase sensitivity and decrease specificity in screening women with a high familial risk and BRCA1/2 mutation.[19, 28] Therefore, individual screening strategies for high risk individual should take into consideration the increased risk of false positive results associated with adjunctive MRI.

- Adjunctive MRI is not recommended for breast cancer screening of women with moderate risk due to risk of false positive results and reduced-cost-effectiveness.[19, 28-31] Adjunctive ultrasound to MMG for breast cancer screening in women with radiologically dense breasts could enhance cancer detection sensitivity.[32] However, the accuracy of breast ultrasound is operator-dependent, and its use alongside MMG has been associated with an increased rate of false positives and unnecessary biopsies compared to MMG alone.[19, 33, 34] Breast cancer screening with ultrasound alone is not recommended due to higher risk of false positive results compared to MMG alone.[35]

- The performances, advantages and limitations of different breast cancer screening methods were summarized in **S Table 2.**

***Interventions to Promote Uptake of Breast Cancer Screening***

- Despite the benefit of breast cancer screening, the uptake rate of mammography screening is yet to be optimised. Barriers for individuals to undergo mammography included: (1) they do not see the need for screening as they are asymptomatic and healthy; (2) they were never recommended to undergo screening by healthcare professionals; (3) cost for mammography is too high; (4) low health literacy with lack of knowledge on the importance of breast cancer screening.[36, 37] Community-based health education interventions promoting breast cancer screening through newspapers, exhibitions, lectures, information stalls, posters were demonstrated to be effective in encouraging mammography uptake (OR = 3.14, 95% CI 1.98 - 5.01).[38] Campaign on raising medical professional awareness on breast cancer screening may be relevant in near future to encourage referral of eligible individuals to breast cancer screening.

## S Table 1. Risk Factors of Breast Cancer

| Risk Groups | Risk Factors of Breast Cancer | Relative Risks (RR) (95%C.I) | Level of Evidence |
|---|---|---|---|
| **High Risk** | Genetic deleterious mutation<br>◆ BRCA1<br>◆ BRCA2 | <br>11 (7.5 – 15)<br>4.6 (2.7 – 7.8) | 2++[39] |
| | History of receiving radiation therapy at young age (≤30 years)<br>◆ Dose of 41 to 61Gy<br>◆ Dose of ≥4 Gy | <br>8.0 (2.6 – 26.4)<br>3.2 (1.4 – 8.2) | 2++[40] |
| | Prior history of benign breast diseases<br>◆ With atypia Proliferative change (e.g. atypical ductal hyperplasia, atypical lobular hyperplasia)<br>◆ Proliferative changes without atypia<br>◆ Non proliferative lesion | 4.24 (3.26 – 5.41)<br><br><br>1.88 (1.66 – 2.12)<br>1.27 (1.15 – 1.41) | 2++[41] |
| **Moderate Risk** | Family history of breast cancer<br>◆ First-degree relative<br>◆ Second-degree relative | <br>1.80 (1.69 – 1.91)<br>1.5 (1.4 – 1.6) | <br>2++[42]<br>2++[43] |
| **Average Risk** | Use of hormonal replacement therapy<br>◆ increase in the relative risk of breast cancer for each year of use<br>◆ ≥ 5 years of use | <br>1.023 (1.011 – 1.036)<br><br>1.35 (1.21 – 1.49) | 2++[44] |
| | Use of oral contraceptive pills<br>Regardless of duration used<br>◆ ≥ 10 years of use<br>◆ ≤ 1 year of use | Pooled OR = 1.19<br>(1.09 – 1.29)<br>1.38 (1.26 – 1.51)<br>1.09 (0.96 – 1.23) | 2++[45]<br><br>2++[46] |
| | Alcohol consumption*<br>◆ Heavy drinking ( > 50g)<br>◆ Moderate drinking( ≤ 50g )<br>◆ Light drinking( ≤ 12.5g) | <br>1.61 (1.33 – 1.94)<br>1.23 (1.19 – 1.28)<br>1.04 (1.01 – 1.07) | 2++[47] |
| | Smoking | 1.35 (1.13 – 1.63) | 2++[48] |
| | Obesity (BMI ≥ 30) after menopause | OR = 1.26 (1.19 – 1.34) | 2++[49] |
| | Nulliparity | 1.27 (1.21 – 1.34) | 2++[50] |
| | Later age of first live birth<br>◆ Age>35<br>◆ Age>30 | <br>1.26 (1.10 – 1.44)<br>1.07 (1.02 – 1.13) | <br>2++[51]<br>2++[52] |
| | ◆ Earlier menarche (age < 12) | 1.050 (1.044 – 1.057) | 2++[53] |
| | ◆ Later menopause (age >54) | 1.029 (1.025 – 1.032) | 2++[53] |
| **Protective Factor** | Physical activity<br>◆ ≥ 4 hours of leisure exercise per week | <br>0.63 (0.42 – 0.95) | 2++[54] |
| | Breast feeding<br>◆ Ever Breastfed<br><br><br><br>◆ For every 5 months of breast feeding | <br>Triple negative breast cancer : RR decrease by 27%<br><br>ER-PR breast cancer : RR decrease by 16%<br><br>RR decrease by 2% | <br>2++[55]<br><br><br><br>2++[7] |

RR = Relative risk; OR = Odd Ratios; ORR = Overall Relative Risk; BMI = Body Mass Index

*10 grams of alcohol = 250 ml of beer with 5% alcohol content, 100 ml of red or white wine with 12% alcohol content.[2]

## S Table 2. Method of Breast Cancer Screening

| Radiological Screening Methods | Performance | | | |
|---|---|---|---|---|
| | Sensitivity | Specificity | PPV | NPV |
| **Mammogram (2-D MMG)**<br>◆ Uses X-Ray to produce clinical images of the compressed breast with cranio-caudal (CC) or medio-lateral oblique (MLO) views | Detecting DCIS or Invasive:<br>77.0%<br>(70.3% – 83.7%)[32] | Detecting BI-RADS ≥4:<br>98.5%<br>(97.8% – 99.2%)[31] | Detecting DCIS or Invasive:<br>25.9%<br>(21.6% – 30.7%)[56] | Detecting DCIS or Invasive:<br>99.6%<br>(99.4% – 99.7%)[56] |
| | *Denser breast, age below 50 have lower sensitivity and specificity[57-60]<br><br><u>Denser breast</u><br>Detecting BI-RADS ≥3:<br>Sensitivity = 62.9%<br>Specificity = 89.1%[57]<br><br><u>Age below 50</u><br>Detecting BI-RADS ≥3:<br>Sensitivity = 68.6% – 72.5%<br>Specificity = 90.7% | | | |
| **Digital breast tomosynthesis (DBT or 3-D MMG)**<br>◆ Creates a three-dimensional image of the breast from X-ray images from different angles | Detecting DCIS or Invasive:<br>81.1%<br>(74.2% – 86.9%)[56] | Detecting DCIS or Invasive:<br>97.2%<br>(97.0% – 97.5%)[56] | Detecting DCIS or Invasive:<br>24.1%<br>(20.5% – 28%)[56] | Detecting DCIS or Invasive:<br>99.8%<br>(99.7% – 99.9%)[56] |
| **Magnetic resonance imaging (MRI)**<br>◆ Uses magnets and radiofrequency waves to produce a three-dimensional image of the breast | As an adjunct to MMG:<br><br>Detecting DCIS or Invasive:<br>71% – 100%[61] | Detecting BI-RADS ≥4:<br>96.1%<br>(94.8% – 97.4%)[31, 62] | | |
| **Ultrasonography (USG)**<br>◆ Use sound waves to produce image of the internal structure of the breast. | As an adjunct to MMG:<br><br>Detecting DCIS or Invasive:<br>91.1%<br>(87.2% – 95.0%)[32] | Detecting DCIS or Invasive:<br>87.7%<br>(87.3% – 88.0%)[32] | | |

MMG = Mammogram; DBT = Digital Breast Tomosynthesis; MRI = Magnetic Resonance Imaging; USG = Ultrasonography; DCIS = Ductal Carcinoma in Situ; CC = Cranio-caudal; MLO = Medio-Lateral Oblique; PPV = Positive Predictive Value; NPV = Negative Predictive Value; BI-RADS = Breast Imaging-Reporting and Data System

| Advantages | Limitations | Remarks |
|---|---|---|
| ◆ Lower cost<br>◆ Readily accessible<br>◆ Simple procedure | Risk of radiation exposure.<br>◆ MMG and 1-view DBT have similar radiation level despite DBT creates 3-dimensional image of the breast*[63]<br><br>Pain and discomfort<br>◆ Compression of the breast during the MMG and DBT may cause pain and discomfort<br><br>Chance of False-positives<br>◆ 10-year cumulative rates of false-positive biennial MMG results and biopsies were found to be 42% and 5%[20]<br>◆ DBT have a lower false positive rate than MMG[64]<br><br>Chance of False-negatives<br>◆ It is estimated that 20% of breast cancers are missed at initial MMG screening[65]<br>◆ False-negatives are less common then false positives in MMG screening | ◆ The estimated cumulative risk of breast cancer death due to radiation from mammography screening ranges from 1 to 10 per 100,000 women, depending on age, frequency, and duration of screening. It is at least 100 times smaller than the estimates of breast cancer deaths prevented by mammographic screening across a broad range of ages[19, 66]<br><br>◆ False-positives are more common below 50 year old, lower body mass index<25 for age <50, family history of breast cancer, previous benign breast biopsy and high breast density[67]<br><br>◆ False-negatives are more common in pre-menopausal age group, higher breast density, family history of breast cancer, previous benign breast biopsy and lower body mass index <25 for age <50[67] |
| ◆ Lower recall rate for false positive results and higher cancer detection rates compared to conventional 2-D MMG due to 3-D image formed by reducing overlapping breast tissue and likelihood of concealed malignancy[68, 69] | | ◆ Inconclusive evidence on the effectiveness of reducing breast cancer mortality or lowering interval cancer rates[64, 68-74] |
| ◆ Higher sensitivity and favorable stage shifting of cancer diagnosis from advanced to earlier stage in high risk group compared to MMG alone[62, 75-78]<br>◆ No risk of radiation exposure | ◆ Increase false-positive results and biopsy rate | ◆ Reduce screening cost-effectiveness in moderate and average-risk individuals[19, 28-31] |
| ◆ Increase sensitivity of cancer detection when used as an adjunct to MMG in women with radiologically dense breasts[32] | ◆ Increase false positives and unnecessary biopsies compared to MMG alone[19, 33, 34]<br>◆ Results are Operator dependent | ◆ Insufficient evidence to recommend routine adjunctive ultrasonography screening for reducing mortality rates[79] |

******The corresponding list of References is available on HKRF webpage******