

# Women's Knowledge, Attitudes, and Perception on Personalized Risk-Stratified Breast Cancer Screening: A Cross-Sectional Study in Malaysia

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## Abstract

**Aim:** Breast cancer is commonest cancer among Malaysian women and screening is essential for the early detection. Therefore our study aimed at measuring the levels of knowledge, attitude and perception towards personalized risk stratified breast cancer screening in Malaysia. **Methods:** A cross-sectional study was carried out in Malaysia to assess the knowledge, perception and attitudes of the women in Malaysia. The study was conducted using an online questionnaire, and samples were obtained using convenience sampling. The questionnaire was distributed trilingual in English, Bahasa Malaysia and Chinese. The data was collected with content validated questionnaire. Data was analyzed with descriptive statistics and General Linear Model analysis in SPSS (Version 27). **Results:** A total of 201 respondents' data were analyzed. From our study we were able to summarize that the women in Malaysia have a suboptimal knowledge towards personalized risk-stratified breast cancer screening as only 48.9% aware of the term for personalized risk-stratified breast cancer screening. Meanwhile, the majority of the respondents (96.7%) showed positive attitudes towards the importance of risk assessment and screening. Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening was found to be significantly associated with knowledge, attitude and perception towards personalized risk-stratified breast cancer screening. **Conclusion:** General population's awareness of individualized risk-stratified breast cancer screening was insufficient despite their favourable attitude towards the disease. A multimodal strategy may be used to improve women's knowledge, attitude, and perception of individualized risk-stratified breast cancer screening.

**Keywords:** Breast cancer- risk-stratified screening- breast cancer screening- women's perspective- Malaysia

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## Introduction

Breast cancer remains one of the most prevalent and challenging health concerns affecting women worldwide. In every country in the world, women can develop breast cancer at any age after puberty, however the incidence rates rise as people age [1]. The increased life expectancy, urbanization, and adoption of western lifestyles have all contributed to an increase in the incidence, morbidity, and mortality rates of breast cancer in both high- and low-resource countries [2]. There were more than 2.26 million new cases of breast cancer in women in 2020 and lead to 685,000 deaths which is 6.9% among all cancer deaths [2-4]. Malaysia has a high prevalence of breast cancer (BC), one in nineteen women is at risk with BC, as it is the most commonly diagnosed

cancer among women of all ethnic groups [5].

Breast screening is a widely adopted practice in numerous healthcare systems, aiming to decrease breast cancer mortality by promptly detecting smaller, symptomless breast cancers. The majority of countries employ a population-level breast screening approach based on age, which effectively lowers breast cancer mortality. However, this strategy does not consider the significant diversity in individual women's cancer risks [6]. In an ideal scenario, healthcare professionals should conduct risk assessments for women, beginning between the ages of 25 and 30. For healthy women, this assessment could typically be integrated into their annual physical examination with their primary care physician or during their routine well-woman check-up with their gynecologist [7]. The screening methods for breast cancer include

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clinical breast examination and breast self-examination, which involve breast palpation. Additionally, breast imaging techniques like mammography, ultrasonography, magnetic resonance imaging (MRI), and digital breast tomosynthesis (DBT) are also used [8].

Having a better understanding of breast cancer risk factors allows for a transition from a uniform screening approach to a personalized one based on a woman's individual risk, tailoring screening policies accordingly. Among the European women, they agreed on the process but reported of having differences perceptions on information needs, preferred risk communication format, and counseling preferences [9]. Perceptions of breast cancer screening vary among women due to a combination of cultural, societal, and personal factors. These perceptions can either encourage or hinder women from seeking regular screenings [10]. Understanding the various facets of these perceptions is essential for healthcare professionals and advocates to design effective awareness campaigns and ensure more women benefit from early detection and timely treatment. For some women, the thought of undergoing breast cancer screening triggers fear and anxiety. This fear may be associated with the fear of a potential cancer diagnosis, the uncertainty of medical procedures, or the stigma surrounding breast cancer. Such emotions can create a barrier to accessing screening services. A majority of women are concerned about the veracity of breast cancer risk assessments, and some think that the major reason for risk-stratified screening is to cut costs [11].

By allocating screening and preventative resources to women who are most in need, risk-stratified screening may have a significant positive impact on healthcare policy. From the perspective of Malaysian women who would be eligible to participate, breast cancer screening updated is still moderate to low and influenced by their knowledge about breast cancer, screening, and socio cultural factors [12, 13]. Low level of awareness and knowledge of risk factors for breast cancer as well as the various screening methods was more commonly seen among women especially who are with lower education levels [14]. However, there is a paucity of understanding regarding the awareness and acceptability of an integrated risk-stratified breast cancer screening and prevention programme among Malaysian women. Therefore, this study aimed to assess the knowledge, attitudes, and perception about personalized risk-stratified breast cancer screening among Malaysian women.

## Materials and Methods

### *Study design and population*

This cross-sectional study was conducted from July 2023 to August 2023 among women in Malaysia to dive into their knowledge, attitude and perception towards personalized risk-stratified breast cancer screening.

### *Sample size and sampling*

The sample size was calculated using the OpenEpi info Sample Size calculator, with expected frequency of 63.5% [15], 6% margin of error and 95% confidence

interval. The estimated sample needed for this study was 247. Non-probability sampling, that is convenience sampling, was applied to recruit the respondents. Inclusion criteria for the respondents were (i) women who reside in Malaysia, (ii) age between 20 to 70 years, (iii) who are able to understand English, Malay or Chinese, and voluntarily agreed to participate in the study. Women who have had breast cancer during their lifetime were excluded from the study.

### *Data Collection*

An online questionnaire form was created and distributed to friends and families who shared it further. It was also distributed on social media platforms such as WhatsApp and Instagram and email. This questionnaire was in English and translated to Malay and Chinese languages by forward and back translation methods by the bilingual language experts. There were five sections in this questionnaire in addition to information sheets and informed consent.

Section I included demographic questions, such as age, marital status, ethnicity, education level, employment status, monthly salary range and living area. Section II included the questions related to general breast cancer awareness such as risk factors, signs and symptoms, benefits of regular breast cancer screening, potential consequences of breast cancer screening, and source of information. Section III included four questions related to knowledge of personalized risk-stratified breast cancer screening. Section IV included nine questions to investigate the respondents' attitudes towards personalized risk-stratified breast cancer screening. The attitudes questions were adapted from the study conducted in Canada [15]. Section V included ten questions related to perception towards benefits and limitations of personalized risk-stratified breast cancer screening. The questionnaire was content validated by six experts including public health experts, questionnaire development and validation experts, and surgeons.

### *Data processing and analysis*

Data were analyzed with weighted for ethnic distribution of Malaysian population, 69.9% Malay, 22.8% Chinese, and 6.6% Indian ethnicity [16]. Demographic characteristics of the respondent were analyzed as frequency and percentage.

Respondents' knowledge on breast cancer were assessed with nine risk factors, seven signs and symptoms, two general knowledge factors, four benefits of breast cancer screening, and four potential limitations of breast cancer screening. The correct answer for each item was scored "1" and incorrect answer was scored "0". The total scoring was summed up as general breast cancer knowledge score.

Respondent's knowledge on risk-stratified breast cancer screening was assessed with familiarization of the term, screening methods, recommended age to initiate mammogram screening for average risk women, and factors to be considered in personalized risk-stratified breast cancer screening. The correct answer for each item was scored "1" and incorrect answer was scored

“0”. The total scoring was summed up as personalized risk-stratified breast cancer screening knowledge score.

Respondent’s attitudes towards risk-stratified breast cancer screening was assessed with nine items. The first two items were recorded as “Yes”, “No” responses. While attitudes towards changing screening schedule based on risk categories was recorded with five-point Likert’s scale (Very bad idea, Bad idea, Neither a good or a bad idea, Good idea, Very good idea). It was further categorized as dichotomous data; “Good idea/ Very good idea” vs “Bad idea/ Very bad idea/ Neither good or bad idea”. While attitudes towards providing information, sample, and assess of breast density were recorded as “Very uncomfortable, Uncomfortable, Neither comfortable nor uncomfortable, Comfortable, Very comfortable”). It was further categorized as dichotomous data; “Comfortable/ Very comfortable” vs “Uncomfortable/ Very uncomfortable/ Neither comfortable nor uncomfortable”. The attitudes towards frequency of screening based on personalized risk level was recorded as “No, definitely, not; No, probably, not; Not sure; Yes, probably; Yes, definitely”. It was further categorized as dichotomous data; “Yes, probably; Yes, definitely” vs “No, definitely, not; No, probably, not; Not sure” [15]. The total scoring was summed up as total score of attitudes towards personalized risk-stratified breast cancer screening.

Respondents’ perception towards benefits and limitations of personalized risk-stratified breast cancer screening were assessed with ten items. The responses were recorded as “Agree” or “Disagree”. Agreement was given the score of “1” and disagreement was given the score of “0”. The total scoring was summed up as total score of perception towards personalized risk-stratified breast cancer screening.

Factors associated with knowledge, attitudes, and perception towards personalized risk-stratified screening was assessed with General Linear Model (GLM) analysis.

## Results

Table 1 shows the demographic characteristics of respondents using unweighted and weighted for ethnicity. Weighted analysis was carried out to overcome under or over-representation of ethnic distribution (Kenneth D. Royal, 2019). Approximately two third of the respondents (74.6%) were ≤ 39 years. The majority were studying tertiary education (71.6%) and living in urban area (71.6%) (Table 1).

Table 2 describes the respondent’s awareness on breast cancer risk factors, symptoms, benefits, and potential risk of breast cancer screening. For the risk factors of breast cancer, 97.9% of respondents were aware that family history of breast cancer is the correct statement but only 17.6% of them can identify obesity is the true statement. Regarding common signs and symptoms of breast cancer, 95.3% of respondents knew that a new lump in the breast or underarm is the correct option while only 40.9% of them were aware that redness or rash on the breast skin is the true statement. More than half of the respondents were aware of benefits of screening, meanwhile, 23% to

Table 1. Demographic Characteristics of the Respondents. (n=201)

| Demographic characteristics  | n (%)<br>(unweighted) | n (%)<br>(weighted by ethnicity) |
|--|-----------------------|----------------------------------|
| <b>Age</b>   |                       |                                  |
| ≤ 39 years   | 150 (74.6)            | 155 (75.8)                       |
| 40 years and above   | 51 (25.4)             | 50 (24.2)                        |
| <b>Ethnicity</b>   |                       |                                  |
| Malay  | 38 (18.9)             | 137 (66.9)                       |
| Chinese  | 71 (35.3)             | 50 (24.3)                        |
| Indian   | 40 (19.9)             | 16 (7.8)                         |
| Others*  | 52 (25.9)             | 2 (1.0)                          |
| <b>Marital Status</b>  |                       |                                  |
| Married  | 60 (29.9)             | 65 (31.7)                        |
| Unmarried  | 141 (70.1)            | 140 (68.3)                       |
| <b>Education level**</b>   |                       |                                  |
| Secondary  | 57 (28.4)             | 54 (26.6)                        |
| Tertiary   | 144 (71.6)            | 150 (73.4)                       |
| <b>Employment</b>  |                       |                                  |
| Job  | 77 (38.3)             | 92 (45.1)                        |
| Student  | 102 (50.7)            | 90 (43.9)                        |
| Unemployed/ Housewife  | 22 (10.9)             | 22 (11.0)                        |
| <b>Income</b>  |                       |                                  |
| Bottom 40 (<RM4387)  | 126 (62.7)            | 140 (68.5)                       |
| Middle 40 (>RM4387-<br><RM9695)  | 50 (24.9)             | 40 (19.3)                        |
| Top 20 (>RM12586)  | 25 (12.4)             | 25 (12.2)                        |
| <b>Residential area</b>  |                       |                                  |
| Urban  | 144 (71.6)            | 130 (63.5)                       |
| Sub-urban  | 47 (23.4)             | 67 (32.6)                        |
| Rural  | 10 (5.0)              | 8 (3.9)                          |
| <b>Having first degree relative with breast cancer</b>   |                       |                                  |
| Yes  | 14 (7.0)              | 11 (5.2)                         |
| No   | 187 (93.0)            | 194 (94.8)                       |
| <b>Having second degree relative with breast cancer</b>  |                       |                                  |
| Yes  | 60 (29.9)             | 63 (31.0)                        |
| No   | 141 (70.1)            | 141 (69.0)                       |
| <b>Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening</b> |                       |                                  |
| Yes  | 67 (33.3)             | 66 (32.5)                        |
| No   | 134 (66.7)            | 138 (67.5)                       |
| <b>Experience of personalized risk-stratified screening</b>  |                       |                                  |
| Yes  | 44 (21.9)             | 46 (22.5)                        |
| No   | 157 (78.1)            | 158 (77.5)                       |

28% of the respondents mentioned about the potential limitations and risk of screening (Table 2).

Table 3 demonstrates women’s knowledge of personalized risk-stratified breast cancer screening in Malaysia. 48.9% of the respondents were familiar with the term “personalized risk-stratified breast cancer screening. Only 38.8% of the respondents have the knowledge for recommended age to initiate mammogram in average risk women is 50 years old and above. More than half of the respondents aware of the factors to considered for the risk-stratification for breast cancer (Table 3).

Table 4 shows women’s attitudes towards personalized

Table 2. Respondent’s Awareness on Breast Cancer (n=201)

| Variable   | Correct answers<br>n (%) |
|--|--------------------------|
| <b>Risk factors of breast cancer</b>                           |                          |
| Family history of breast cancer                                | 200 (97.9)               |
| Genetic  | 146 (71.5)               |
| Age  | 96 (46.8)                |
| Dense breast tissue  | 94 (45.8)                |
| Hormone replacement therapy                                    | 77 (37.5)                |
| Alcohol consumption  | 72 (35.1)                |
| Lack of physical activity                                      | 48 (23.5)                |
| Obesity  | 36 (17.5)                |
| Early menarche, late menopause                                 | 29 (14.4)                |
| <b>Common signs and symptoms of breast cancer</b>              |                          |
| A new lump in the breast or underarm                           | 195 (95.3)               |
| Changes in breast size or shape                                | 140 (68.2)               |
| Breast pain or tenderness                                      | 131 (63.9)               |
| Nipple discharge   | 131 (63.8)               |
| Dimpling or puckering of the breast skin                       | 94 (45.9)                |
| Nipple retraction  | 93 (45.7)                |
| Redness or rash on the breast skin                             | 84 (40.9)                |
| Most breast lumps are cancerous                                | 127 (61.8)               |
| Breast cancer is preventable to some extent through lifestyle  | 147 (71.7)               |
| <b>Benefits of regular breast cancer screening</b>             |                          |
| Early detection  | 188 (92.2)               |
| Improved treatment options                                     | 128 (62.5)               |
| Decreased risk of developing breast cancer                     | 111 (54.5)               |
| Reduced mortality rate   | 108 (53.0)               |
| <b>Potential risks associated with breast cancer screening</b> |                          |
| High radiation exposure  | 58 (28.5)                |
| Physical discomfort  | 57 (28.0)                |
| Incorrect positive   | 56 (27.1)                |
| Incorrect negative   | 47 (23.2)                |
| <b>Source of information for breast cancer screening</b>       |                          |
|  | n (%)                    |
| Healthcare provider  | 147 (71.9)               |
| Social Media   | 139 (67.9)               |
| Friends or family  | 112 (54.7)               |
| News   | 90 (43.9)                |
| Brochure and pamphlets   | 85 (41.6)                |

risk-stratified breast cancer screening. Majority of our respondents agree with the statement of effectiveness of personalized risk-stratified breast cancer screening over age-based screening (62.9%). Most of the respondents are willing to provide information (information regarding lifestyle, personal and family medical history) for risk assessment (74%). 83.6% of the respondents are willing to provide a small sample of blood or saliva for genetic testing (Table 4).

Table 5 demonstrates the women’s perception towards personalized risk-stratified breast cancer screening. As per the respondents’ view about benefits of personalized risk-stratified breast cancer screening, early detection for high risk individuals is the most agreed benefit out of the

Table 3. Knowledge of Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Variable   | n (%)                    |
|--|--------------------------|
| <b>Familiar with the term "personalized risk-stratified breast cancer screening"</b> |                          |
| Yes  | 100 (48.9)               |
| No   | 105 (51.1)               |
| <b>Screening methods</b>   |                          |
|  | Correct answers<br>n (%) |
| Mammography  | 99 (48.5)                |
| Breast ultrasound  | 70 (34.0)                |
| MRI  | 40 (19.4)                |
| <b>Recommended age to initiate mammogram in average risk women</b>                   |                          |
| 50 years old and above   | 84 (41.2)                |
| <b>Factors considered in determining personalized risk-stratified screening</b>      |                          |
| Family history of breast cancer  | 177 (86.5)               |
| Age  | 150 (73.5)               |
| Genetic mutations  | 147 (71.8)               |
| Personal medical history   | 114 (55.7)               |

other listed benefits, which is 91.1%. Furthermore, 61.3% agreed that it also encourages the risk and thereby leads to prevention of breast cancers (Table 5).

Table 6 shows the association between different demographic characteristics and general knowledge on breast cancer among respondents. Mean knowledge score among students is 2.59 units higher compared to unemployed or housewives (P 0.046). Mean knowledge score among middle income group is 3.14 units higher compared to high income group (P 0.014). Mean knowledge score of respondents in sub-urban areas are 3.38 units higher compared to respondents from rural areas (P 0.035). Mean knowledge score of respondents having breast cancer in their second-degree relatives are 1.72 units higher compared to those who do not have (P 0.024). Mean knowledge score of respondents who experienced health education on breast cancer are 1.97 units higher compared to those who do not have experienced on health education programme (P 0.010). Mean knowledge score of respondents who have had experienced on personalized risk-stratified screening are 1.95 units higher compared to those who do not have experienced (P 0.032) (Table 6).

Table 7 shows the association between different demographic characteristics and the attitude towards the personalized risk-stratified breast cancer screening. Mean knowledge on personalized risk-stratified breast cancer screening score of respondents who experienced health education on breast cancer are 0.95 units higher compared to those who do not have experienced on health education programme (P <0.001) (Table 7).

Table 8 shows the association between different demographic characteristics and the perception towards the personalized risk-stratified breast cancer screening. Having second degree relative with breast cancer and experience of participating in health education

Table 4. Attitudes towards Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Variable   | n (%)      |
|--|------------|
| Effectiveness of personalized risk-stratified breast cancer screening over age-based screening   |            |
| Yes  | 129 (62.9) |
| No   | 76 (37.1)  |
| Attitudes towards importance of personalized risk-stratified screening   |            |
| Yes  | 198 (96.7) |
| No   | 7 (3.3)    |
| Attitudes towards changing screening schedule based on risk categories   |            |
| Good idea  | 148 (72.5) |
| Neutral/ Bad idea  | 56 (27.5)  |
| Attitudes towards providing information (information regarding your lifestyle, personal and family medical history) for risk assessment                              |            |
| Comfortable  | 151 (74.0) |
| Uncomfortable  | 53 (26.0)  |
| Attitudes towards a small sample of blood or saliva for genetic testing (analysis of your genetic makeup)  |            |
| Comfortable  | 171 (83.6) |
| Uncomfortable  | 33 (16.4)  |
| Attitudes towards having a mammogram to assess your breast density for risk assessment   |            |
| Comfortable  | 150 (73.3) |
| Uncomfortable  | 55 (26.7)  |
| If your estimated level of breast cancer risk was average, would you be willing to have your breast cancer screening less often than every 2 to 3 years?             |            |
| Yes  | 140 (68.6) |
| Not sure/ No   | 64 (31.4)  |
| If your estimated level of breast cancer risk was higher than average, would you be willing to have your breast cancer screening more often than every 2 to 3 years? |            |
| Yes  | 174 (84.8) |
| Not sure/ No   | 31 (15.2)  |
| If your estimated level of breast cancer risk was much lower than average, would you be willing not to be offered any breast screening?                              |            |
| Yes  | 78 (38.1)  |
| Not sure/ No   | 127 (61.9) |

programmes about breast cancer and personalized risk-stratified screening are significantly associated with attitudes towards personalized risk-stratified breast cancer screening. Mean attitudes score of respondents who had second degree relatives with breast cancer are 0.98 units higher compared to those who do not have (P <0.001). Mean attitudes score of respondents who experienced health education on breast cancer are 0.69 units higher compared to those who do not have experienced on health education programme (P 0.010) (Table 8).

Table 9 shows the association between different demographic characteristics and the perception towards the personalized risk-stratified breast cancer screening. Mean perception score of younger respondents ( $\leq 39$  years) are 1.32 units less compared to respondents with age of 40 years and above (P 0.013). Mean perception score of employed respondents and students are 1.47 units (P 0.013) and 2.10 units (P 0.002) respectively higher compared to unemployed respondents. Mean perception score of low income (bottom 40) respondents are 1.24 units less compared to high income respondents (P 0.044).

Mean perception score of respondents living in urban and sub urban areas are 2.69 units (P <0.001) and 3.26 units less compared to those living in rural areas (Table 9). Mean perception score of respondents who experienced health education on breast cancer are 1.41 units higher compared to those who do not have experienced on health education programme (P <0.001) (Table 9).

## Discussion

The majority of the respondents aware of genetic and family history were risk factors of having breast cancer. However, limited awareness on modifiable risk factors including alcohol, obesity, lack of physical activity, hormone replacement therapy (15.5% to 37.5%). Awareness of these factors were reported to be higher in previously conducted study in that risk factor awareness ranged from 45.9% to 53.3% [17]. The difference might be contributed by the fact that the previous study was conducted in urban population, while, our respondents were from both urban, sub-urban, and rural areas.

Table 5. Perceptions towards Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Perceptions on benefits of risk-stratified breast cancer screening       |            |
|--|------------|
| Early detection for High-Risk Individuals                                |            |
| Agree  | 186 (91.1) |
| Disagree   | 18 (8.9)   |
| Reduced overdiagnosis and incorrect positives                            |            |
| Agree  | 99 (48.2)  |
| Disagree   | 106 (51.8) |
| Cost effectiveness and optimized resource allocation                     |            |
| Agree  | 93 (45.6)  |
| Disagree   | 111 (54.4) |
| Individualized screening schedules                                       |            |
| Agree  | 103 (50.4) |
| Disagree   | 101 (49.6) |
| Encourage risk reduction and prevention                                  |            |
| Agree  | 125 (61.3) |
| Disagree   | 79 (38.7)  |
| Perceptions about limitations of risk-stratified breast cancer screening |            |
| Data accuracy and reliability  |            |
| Agree  | 118 (57.9) |
| Disagree   | 86 (42.1)  |
| Risk prediction limitations  |            |
| Agree  | 122 (59.7) |
| Disagree   | 83 (40.3)  |
| Access and equity  |            |
| Agree  | 118 (57.9) |
| Disagree   | 86 (42.1)  |
| Potential for missed diagnoses   |            |
| Agree  | 118 (57.9) |
| Disagree   | 86 (42.1)  |
| Psychological impact due to uncertain risk predictions                   |            |
| Agree  | 118 (57.9) |
| Disagree   | 86 (42.1)  |

Knowledge on modifiable risk factors could be improved through health education programs, public awareness campaigns, and by providing women with access to information about breast cancer risk and screening. Mass media campaign as population intervention [18], small group education programme [19], and print materials such as leaflets, posters and banners were found to be effective to improve awareness and knowledge on breast cancer. In addition to raising awareness, it is also important to address the factors that might influence on knowledge of breast cancer. This includes addressing the socioeconomic disparities in breast cancer knowledge and access to screening. It is also important to develop culturally appropriate educational materials and programs that are tailored to the needs of different groups of women [18].

Furthermore, we found that women with knowledge of risk-stratified breast cancer screening mainly related

Table 6. Factors associated with General Knowledge on Breast Cancer (n=201)

| Demographic characteristics   | B         | 95%CI        | P     |
|---|-----------|--------------|-------|
| Age   |           |              |       |
| ≤ 39 years  | -1.69     | -3.72, 0.34  | 0.103 |
| 40 years and above  | Reference |              |       |
| Ethnicity   |           |              |       |
| Malay   | -1.31     | -2.69, 0.06  | 0.06  |
| Chinese   | Reference |              |       |
| Marital Status  |           |              |       |
| Married   | -0.22     | -2.09, 1.65  | 0.818 |
| Unmarried   | Reference |              |       |
| Education level   |           |              |       |
| Secondary   | -1.57     | -3.13, -0.00 | 0.05  |
| Tertiary  | Reference |              |       |
| Employment  |           |              |       |
| Employed  | -1.56     | -3.82, 0.70  | 0.176 |
| Student   | 2.59      | 0.05, 5.14   | 0.046 |
| Unemployed/ Housewife   | Reference |              |       |
| Income  |           |              |       |
| Bottom 40 (<RM4387)   | -0.58     | -2.94, 1.78  | 0.627 |
| Middle 40 (>RM4387 - <RM9695)   | 3.14      | 0.64, 5.64   | 0.014 |
| Top 20 (>RM12586)   | Reference |              |       |
| Residential area  |           |              |       |
| Urban   | 2.04      | -0.99, 5.06  | 0.185 |
| Sub-urban   | 3.38      | 0.23, 6.53   | 0.035 |
| Rural   | Reference |              |       |
| Having first degree relative with breast cancer   |           |              |       |
| Yes   | 1.31      | -1.67, 4.28  | 0.388 |
| No  | Reference |              |       |
| Having second degree relative with breast cancer  |           |              |       |
| Yes   | 1.72      | 0.23, 3.22   | 0.024 |
| No  | Reference |              |       |
| Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening |           |              |       |
| Yes   | 1.97      | 0.47, 3.4    | 0.01  |
| No  | Reference |              |       |
| Experience of personalized risk-stratified screening  |           |              |       |
| Yes   | 1.95      | 0.17, 3.73   | 0.032 |
| No  | Reference |              |       |

to the experience of participating in health education programs about breast cancer and risk-stratified screening. These findings highlight the necessity for personalized strategies to enhance breast cancer screening knowledge among Malaysian women. Various studies have shown that tailoring educational approaches can effectively raise awareness and knowledge about breast cancer screening [20]. By focusing educational efforts on suburban and rural areas, as well as individuals engaged in health education programs, we can ensure a more comprehensive understanding that empowers informed decision-making regarding to uptake screening [21].

The majority of the respondents in our study (96.7%) considered that personalized risk-stratified screening is important. Moreover, 72.5% reported that personalized

Table 7. Factors associated with Knowledge on Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Demographic characteristics   | B         | 95%CI       | P      |
|---|-----------|-------------|--------|
| Age   |           |             |        |
| ≤ 39 years  | -0.11     | -0.79, 0.57 | 0.743  |
| 40 years and above  | Reference |             |        |
| Ethnicity   |           |             |        |
| Malay   | -0.19     | -0.65, 0.27 | 0.412  |
| Chinese   | Reference |             |        |
| Marital Status  |           |             |        |
| Married   | -0.61     | -1.24, 0.01 | 0.055  |
| Unmarried   | Reference |             |        |
| Education level   |           |             |        |
| Secondary   | 0.43      | -0.10, 0.95 | 0.108  |
| Tertiary  | Reference |             |        |
| Employment  |           |             |        |
| Employed  | 0.04      | -0.71, 0.80 | 0.91   |
| Student   | 0.44      | -0.41, 1.29 | 0.312  |
| Unemployed/ Housewife   | Reference |             |        |
| Income  |           |             |        |
| Bottom 40 (<RM4387)   | -0.19     | -0.98, 0.59 | 0.629  |
| Middle 40 (>RM4387 - <RM9695)   | 0.6       | -0.24, 1.44 | 0.158  |
| Top 20 (>RM12586)   | Reference |             |        |
| Residential area  |           |             |        |
| Urban   | 0.24      | -0.77, 1.25 | 0.64   |
| Sub-urban   | 0.32      | -0.74, 1.37 | 0.555  |
| Rural   | Reference |             |        |
| Having first degree relative with breast cancer   |           |             |        |
| Yes   | 0.12      | -0.87, 1.12 | 0.809  |
| No  | Reference |             |        |
| Having second degree relative with breast cancer  |           |             |        |
| Yes   | -0.16     | -0.65, 0.34 | 0.528  |
| No  | Reference |             |        |
| Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening |           |             |        |
| Yes   | 0.95      | 0.45, 1.45  | <0.001 |
| No  | Reference |             |        |
| Experience of personalized risk-stratified screening  |           |             |        |
| Yes   | -0.18     | -0.78, 0.41 | 0.544  |
| No  | Reference |             |        |

risk-stratified screening is a good idea. Similar findings were reported among women in England in that 85% of women considered that breast cancer risk assessment and screening was a good idea [22]. The majority of women in our study showed their favourable attitudes to provide information, blood, saliva samples, and to access breast density. This finding is in line with the findings among Canadian women where they reported comfortable to provide personal and genetic information for BC risk assessment [15]. Generally, women are willing and accept for the risk assessment. However, a reduction in screening frequency or no screening for women with lower than average risk was seemed to be less acceptable. Therefore, it is essential to have effective risk communication

Table 8. Factors associated with Attitudes towards Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Demographic characteristics   | B         | 95%CI       | P      |
|---|-----------|-------------|--------|
| Age   |           |             |        |
| ≤ 39 years  | -0.53     | -1.24, 0.18 | 0.141  |
| 40 years and above  | Reference |             |        |
| Ethnicity   |           |             |        |
| Malay   | 0.24      | -0.24, 0.71 | 0.33   |
| Chinese   | Reference |             |        |
| Marital Status  |           |             |        |
| Married   | 0.05      | -0.61, 0.70 | 0.892  |
| Unmarried   | Reference |             |        |
| Education level   |           |             |        |
| Secondary   | -0.48     | -1.02, 0.07 | 0.087  |
| Tertiary  | Reference |             |        |
| Employment  |           |             |        |
| Employed  | -0.37     | -1.16, 0.42 | 0.352  |
| Student   | 0         | -0.89, 0.88 | 0.994  |
| Unemployed/ Housewife   | Reference |             |        |
| Income  |           |             |        |
| Bottom 40 (<RM4387)   | 0.35      | -0.47, 1.17 | 0.407  |
| Middle 40 (>RM4387 - <RM9695)   | 0.59      | -0.28, 1.46 | 0.18   |
| Top 20 (>RM12586)   | Reference |             |        |
| Residential area  |           |             |        |
| Urban   | 0.3       | -0.75, 1.35 | 0.576  |
| Sub-urban   |           |             |        |
| Rural   | Reference |             |        |
| Having first degree relative with breast cancer   |           |             |        |
| Yes   | 0.02      | -1.02, 1.05 | 0.978  |
| No  | Reference |             |        |
| Having second degree relative with breast cancer  |           |             |        |
| Yes   | 0.98      | 0.46, 1.49  | <0.001 |
| No  | Reference |             |        |
| Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening |           |             |        |
| Yes   | 0.69      | 0.16, 1.21  | 0.01   |
| No  | Reference |             |        |
| Experience of personalized risk-stratified screening  |           |             |        |
| Yes   | -0.25     | -0.87, 0.37 | 0.43   |
| No  | Reference |             |        |

between healthcare provider and women and to provide support women with low risk regarding their screening frequency [23].

Our study found that women who had participated in health education programs about breast cancer screening and risk-stratified screening, having second degree relatives with breast cancer were more likely to have a positive attitude towards personalized risk-stratified screening. This finding could be explained that by previous study, the changes in attitudes and behaviour for breast cancer prevention and screening were found in the relatives of breast cancer diagnosed patients [24]. Therefore, personal experiences with breast cancer or

Table 9. Factors associated with Perception towards Personalized Risk-Stratified Breast Cancer Screening (n=201)

| Demographic characteristics  | B         | 95%CI        | P      |
|--|-----------|--------------|--------|
| <b>Age</b>   |           |              |        |
| ≤ 39 years   | -1.32     | -2.36, -0.28 | 0.013  |
| 40 years and above   | Reference |              |        |
| <b>Ethnicity</b>   |           |              |        |
| Malay  | -0.38     | -1.08, 0.32  | 0.288  |
| Chinese  | Reference |              |        |
| <b>Marital Status</b>  |           |              |        |
| Married  |           |              |        |
| Unmarried  | Reference |              |        |
| <b>Education level</b>   |           |              |        |
| Secondary  | -0.59     | -1.39, 0.21  | 0.144  |
| Tertiary   | Reference |              |        |
| <b>Employment</b>  |           |              |        |
| Employed   | 1.47      | 0.31, 2.63   | 0.013  |
| Student  | 2.1       | 0.80, 3.40   | 0.002  |
| Unemployed/ Housewife  | Reference |              |        |
| <b>Income</b>  |           |              |        |
| Bottom 40 (<RM4387)  | -1.24     | -2.44, -0.03 | 0.044  |
| Middle 40 (>RM4387 - <RM9695)  | -0.68     | -1.96, 0.60  | 0.294  |
| Top 20 (>RM12586)  | Reference |              |        |
| <b>Residential area</b>  |           |              |        |
| Urban  | -2.69     | -4.23, -1.14 | <0.001 |
| Sub-urban  | -3.26     | -4.87, -1.65 | <0.001 |
| Rural  | Reference |              |        |
| <b>Having first degree relative with breast cancer</b>   |           |              |        |
| Yes  | 1.13      | -0.40, 2.65  | 0.146  |
| No   | Reference |              |        |
| <b>Having second degree relative with breast cancer</b>  |           |              |        |
| Yes  | 60        | -0.16, 1.35  | 0.122  |
| No   | Reference |              |        |
| <b>Experience of participating in health education programmes about breast cancer and personalized risk-stratified screening</b> |           |              |        |
| Yes  | 1.41      | 0.64, 2.18   | <0.001 |
| No   | Reference |              |        |
| <b>Experience of personalized risk-stratified screening</b>  |           |              |        |
| Yes  | 0.28      | -0.64, 1.19  | 0.552  |
| No   | Reference |              |        |

family history of breast cancer might contribute to the attitude towards personalized risk-stratified screening [25].

According to our study, we found out that there is a significant difference between women's perception on risk-stratified breast cancer screening in different age groups. Mean perception score of younger respondents (≤ 39 years) were less compared to respondents with age of 40 years and above. Previous study revealed that various factors could influence on women's perceptions about their breast cancer risk based on their health beliefs and personal experiences [26]. A study conducted in two states in Malaysia reported that awareness of breast

cancer is higher among women 40 to 49 years of age [27] as mammogram and screening measures usually targeted to women 40 years and above. Personal experience on screening, exposure to health education materials in specific age group may influence towards their perception related to risk stratified breast cancer screening.

In this study, employed women and student's perception towards the personalized risk-stratified breast cancer screening were significantly higher compared to unemployed women. The findings might be related to the fact that employed women reported to have higher knowledge on cancers in other countries, such as in Kenya [28] and in Swaziland [29]. Higher knowledge might influence on their perception towards risk classification and provision of appropriate screening measures.

Income is also found to be an influencing factor on perception towards the personalized risk-stratified breast cancer screening in this study. High income women have significantly higher perception towards risk-stratified screening. This finding is similar to a study conducted among Canadian women in which they were comfortable to provide their information for risk-stratification and more likely to be in favour of risk-stratified screening [15]. Income level might be attributed to the women access to healthcare services, screening, and gaining breast cancer related information.

Interestingly, women from rural area have more favourable attitudes towards risk-stratified breast cancer screening compared to urban and sub-urban women in this study. A study conducted among women in rural areas of two states in Malaysia found out that they had good awareness of breast cancer and more than half of them practiced breast self-examination and had clinical breast examination [27]. Further studies should be explore to women in urban and sub-urban areas to have a better understanding on their unfavourable with attitudes towards personalized risk-stratified breast cancer screening.

Implementing personalized screening requires a well-developed healthcare infrastructure, including access to genetic testing, risk assessment tools, and specialized clinics [30, 6]. Discussions should focus on how Malaysia can build and improve its infrastructure to support this approach effectively. Discussions must address ethical issues related to personalized screening, such as informed consent, data ownership, and potential psychological impacts of knowing one's elevated risk [31]. Ensuring that individuals understand the implications of personalized screening is vital. Developing effective communication strategies is important to convey the benefits and limitations of personalized screening to the public. This includes raising awareness about the potential benefits of early detection while being transparent about the limitations associated with risk prediction [32].

To sum up, personalized risk-stratified breast cancer screening offers the potential to improve the effectiveness of breast cancer detection and prevention in Malaysia. However, discussions should encompass cultural, ethical, technological, and access-related considerations to ensure that the approach is feasible, equitable, and well-received by both healthcare providers and the public.



To the best of our knowledge, this is the first study exploring women's knowledge, attitudes, and perception on personalized risk-stratified breast cancer screening. It provided insight for the future consideration and planning for breast cancer risk-stratification and provision of screening based on the individual's risk category. Data was collected with content-validated questionnaire, and therefore the questionnaire contain relevant items that could be used to identify women's perspective on risk-stratified breast cancer screening.

There are some limitations in our study. The sample was recruited by convenience sampling method which might limit the generalizability of the findings to Malaysia population. Although the initial sample size estimation was 247, only 201 women responded the survey. Therefore, it might lead to the under representative of the target population. Since the data was collected by self-administrative questionnaire, there was possibility of self-reporting bias, social desirability bias, and recall bias. The majority of the study respondents are from urban areas. Therefore, the findings may not represent the knowledge, attitudes and perceptions towards personalized risk-stratified breast cancer screening among rural women. To address some of the limitations identified in our investigations, we propose that future researchers do relevant studies using a sample population that is more representative of the Malaysian public, with a focus on rural population and across different age groups. We would also like to recommend future researchers to investigate the attitudes and perceptions of healthcare providers in regard to personalized risk-stratified breast cancer screening in Malaysia.

In conclusion, the general population's awareness of individualized risk-stratified breast cancer screening was insufficient despite their favourable attitude towards the disease. A multimodal strategy may be used to improve women's knowledge, attitude, and perception of individualized risk-stratified breast cancer screening. This includes organizing community education programmes, collaborating with healthcare providers to disseminate information, providing specialized training for carers, engaging media and influencers to raise awareness, promoting cultural sensitivity and multicultural understanding, partnering with advocacy groups, supporting research initiatives, and fostering innovation in breast cancer and research. Implementing these measures can result in increased women's education, good attitudes, and the formation of a more inclusive society that provides necessary care and support towards individuals with breast cancer and their families.

### Author Contribution Statement

JAPS, TRX, AMGNA, and HALR conceptualized the study. JAPS, TRX, AMGNA, and HALR collected data. MNNH and SM analyzed the data. JAPS, TRX, AMGNA, and HALR prepared the first draft of manuscript. MNNH, MU, and SM edited and revised to prepare the final manuscript. All authors contributed to, reviewed, and approved the final manuscript.

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#### *Approval for research report publication*

We would Like to declare that this research belongs to students' research project for their partial fulfilment for achieving required eligibility for professional examination in M.B., B.S programme. Approval for publication is duly granted by Research Ethics Committee of Manipal University College Malaysia (MUCM) to conduct research and publication.

#### *Ethical consideration*

The ethical approval to conduct this study was granted by the Research Ethics Committee, Faculty of Medicine, Manipal University College Malaysia (MUCM/ Research Ethics Committee – 040/2023).

#### *Availability of data*

The data of this study are available from the corresponding author upon reasonable request.

#### *Conflict of interest*

All authors declare that they have no conflicts of interest.

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