RESEARCH ARTICLE

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# Myths and Misconceptions of Breast Cancer Causation among Female Population of Saudi Arabia

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## Abstract

**Introduction:** Breast cancer is the most commonly diagnosed malignancy among women in Saudi Arabia, yet public awareness remains limited. Given the significant influence of health beliefs on behavior, this study investigated the prevalence of myths surrounding breast cancer causation in the Western region of Saudi Arabia. **Methods:** A cross-sectional study was conducted using the modified Cancer Awareness Measure Mythical Causes Scale, a validated tool assessing misconceptions about breast cancer. Participants working in healthcare were excluded to better capture public perceptions. An online questionnaire collected socio-demographic data and assessed breast cancer myths. Univariate and multivariate logistic regression analyses assessed the associations between knowledge and socio-demographic factors, with p-values ≤ 0.05 considered statistically significant. **Results:** 470 adult women were included in the study. Only 13.2% demonstrated a good level of awareness, correctly identifying ten or more myths. In univariate analysis, young (p = 0.02), single (p = 0.01), and unemployed (p = 0.01) women or knowing someone with breast cancer (p = 0.04) were associated with higher awareness of breast cancer myths. Commonly unrecognized myths included psychological stress (63%), exposure to electromagnetic frequencies (47.7%), food additives or artificial sweeteners (46.8%), living in industrial cities (46.4%), and undergoing breast plastic surgery (46.2%). Notably, women with lower recognition of myths were more likely to believe mammograms could cause breast cancer (p < 0.001). **Conclusion:** This study highlights widespread misconceptions about breast cancer causation among our sample. Educational programs are essential to debunk myths and foster evidence-based awareness in clinical and public environments.

**Keywords:** Breast cancer- Saudi Arabia- myths and misconceptions- Public health perception- breast cancer risk factors

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## Introduction

Breast cancer is the most common cancer diagnosed among women and the leading cause of cancer mortality globally [1], with its incidence rising steadily since 2007 [2]. According to GLOBOCAN 2022, the overall estimated incidence of breast cancer is 2.3 million cases and a 660,000 mortality rate [1]. In Saudi Arabia, breast cancer is the most common cancer with an observed trend of rising prevalence over time [3]. In a study conducted from 2001 to 2017, there has been a dramatic increase in breast cancer incidence, with breast cancer incidence rising by 55% during that period [4]. This increasing trend has been proposed to be associated with social and lifestyle shifts such as higher body mass index (BMI) and declining birth rates among women globally [2].

Despite its high prevalence, awareness of breast cancer risk factors and screening practices remains inadequate across various regions of Saudi Arabia. For example, a cross-sectional study conducted in Madinah found that over half of the participants, particularly older women, were unable to accurately identify breast cancer risk factors [5]. Similarly, a study in Jeddah reported that only 34.2% of participants demonstrated good knowledge regarding breast cancer screening, with 90% exhibiting poor screening practices [6]. In the Northern region, while most participants recognized a family history of breast cancer as a risk factor, awareness of other factors—such as low gravida (46%), early puberty and late menopause (37%), and obesity or overweight (37%)—was limited [7]. In Hail City, it was reported that over 50% were unable to demonstrate good knowledge in terms of breast cancer risk factors and clinical features. Also, weak knowledge and practices about breast cancer screening methods were

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observed in the sample [8].

A recent systematic review aimed to investigate the overall awareness among Saudi women in the literature found that over 60% of studied samples exhibited a low level of awareness. The review strongly recommended robust public health implementation to improve knowledge and awareness [9].

According to the health belief model (HBM), preventive behavior is largely attributed to health beliefs. The perceived effectiveness and barriers were the strongest predictors of health behavior [10]. On the other hand, inaccurate beliefs may hinder the population from adhering to recommended cancer preventive measures (e.g. screening) and distract the public from paying attention to well-established cancer risk factors [11]. Rauscher G et al. (2010) found a strong correlation between misperceptions and delaying seeking medical attention in a cohort of breast cancer patients [12]. On the other hand, A Switzerland study involving females who are 40 years of age or older, revealed that women who believed on the efficacy of mammograms are more likely to plan to have an annual screening ($p < 0.05$) [13].

Therefore, The purpose of this community-based cross-sectional study is to evaluate the common myths and misconceptions related to breast cancer causation, that are widely spread among the Western region population of Saudi Arabia. Additionally, we aim to investigate the factors that are linked to a higher level of awareness. To our knowledge, this is the first study in the region to focus specifically on the intersection of breast cancer causation myths and misbeliefs. By shedding light on these misconceptions and their impact on health behaviors, our findings are expected to inform the design of tailored public health campaigns that effectively target and educate the intended audience refuting the misinformation, and ultimately contributing to improved breast cancer awareness and preventive health behaviors.

## Materials and Methods

*Study Design and Population*

An observational, questionnaire-based, cross-sectional study was conducted over a four-month duration from May to September 2024. The study included adult females aged 18 years or above who reside in the Western region (either Madinah or Makkah regions) and agreed to participate. Females who are less than 18 years or working in the healthcare field were excluded. Also, male participants and those who lived outside the western region were excluded.

*Sample size*

The Raosoft calculator for sample size calculation was used. The estimated sample size was n = 385. The following assumptions were adopted: (i) 50% prevalence of expected rate and perception among Saudi females (ii) 95% confidence interval (CI), (iii) 5% margin of error, and (iv) 10% non-response rate. To obtain higher external validity and greater generalizability of the study, we targeted collecting more samples than our calculated sample size.

*Data collection method and tools*

Based on a review of the literature for related studies [14-16], We utilized the Cancer Awareness Measure-Mythical Causes Scale (CAM-MYCS), a validated questionnaire with 12 items to assess the mythical causes of breast cancer was employed [17, 18]. Three broad-certified oncologists reviewed the survey for further validation. Their feedback led to the incorporation of seven additional myths with linguistic adjustments, which were validated in the final version approved by the experts. The following items were deemed relevant within our community were included in the final version; living in industrial cities, using deodorants, wearing tight bra, undergoing mammography, breast plastic surgery, or armpit laser, breast cancer only affects women, or older women or those with a family history of breast cancer. Following that, the authors developed an online questionnaire using Google Forms. We distributed the questionnaire online via WhatsApp groups and social media platforms with the assistance of data collectors. Regarding the ascertaining of not fulfilling more than one form, the subject should use her own email to complete the questionnaire. Also, in the beginning of the questionnaire, the subject was asked if they are female or male, and males were excluded immediately.

The questionnaire was designed in Arabic to accommodate the country's primary language. The first section contains the consent from the targeted participant. the second section is a closed-question asking particapnts if they were working in the healthcare field and if the answer was "yes" they were excluded immediately. After that, the third section contains the sociodemographic characteristics: (nationality, age group, region (western as Makkah province and Al Madinah province), educational level, marital to the participants, working in any field or not). The fourth section, the assessment of misconceptions and myths about breast cancer includes 18 items. The prefinal section had an open-ended optional question for participants to express their opinion in regard to breast cancer risk factors. Finally after the subject completed a questionnaire, a further section contains a video about the prevention of breast cancer was taken from the Ministry of Health of Saudi Arabia website to increase the awareness of participants for the sake of improving public health perception of breast cancer mammogram screening program.

*Statistical analysis*

Data analysis was performed using R Statistical Software (R version 4.4.1; R Core team 2024). Descriptive statistics were used to summarize data, with categorical variables presented as frequencies and percentages. The myths' knowledge and beliefs about the causation of breast cancer were assessed, analyzed, and compared by the studied subjects' characteristics using univariate logistic regression as appropriate. The analyzed characteristics included age group (18–35, >35–50, >50 years), nationality (Saudi vs. Non-Saudi), place of residence (Madinah vs. Makkah), educational level (secondary or below vs. university), occupation (unemployed vs. employed), marital status (single vs. married), knowing

someone with breast cancer, and the presence of chronic disease (yes vs. no). Multivariate logistic regression was then conducted, adjusting for age, nationality, marital status, place of residence, educational level, employment status, knowing someone with breast cancer, and having a chronic disease. P-values ≤ 0.05 were considered statistically significant.

Awareness of myths was assessed using 15 items. Participants were asked two types of questions based on the item: (1) "Do you decrease the frequency of using this [item] due to concern it may cause breast cancer?" or (2) "Do you believe this [item] causes breast cancer?". Responses were recorded as "yes," "no," or "do not know." Correct responses ("no") indicated recognition of the item as a myth, while other responses were deemed incorrect. Knowledge levels were categorized as poor (0–5 correct), fair (6–10 correct), or good (11–15 correct). Beliefs about breast cancer were assessed by three questions based on 3 level Likert scale (agree, neutral, and disagree).

## Results

*Characteristics of the sample*

A total of 470 women from the Western region of Saudi Arabia were included in this study. Table 1 presents their socio-demographic characteristics. The majority of the participants are between 18-35 years old (60.0%), with 27.2% in the 35-50 age range, and 12.8% over 50 years. Most are Saudi (88.1%). A higher proportion reside in Makkah (54.5%) compared to Madinah (45.5%). The majority of participants have a university education (72%). The distribution of marital status is nearly equal, with 51.1% single and 48.9% married. The majority are unemployed (69.4%), with 30.6% employed. Among the subjects, 42.6% know someone with cancer, and 18.7% have chronic disease.

Table 1. Characteristics of the Studied Subjects

| Characteristics | N= 470 (100) |
|---|---|
| Age in years | |
| 18-35 | 282 (60.0) |
| >35-50 | 128 (27.2) |
| > 50 | 60 (12.8) |
| Nationality | |
| Saudi | 414 (88.1) |
| Non-Saudi | 56 (11.9) |
| Place of residence | |
| Madinah | 214 (45.5) |
| Makkah | 265 (54.5) |
| Educational level | |
| Secondary or below | 132 (28.0) |
| University | 339 (72.0) |
| Marital status | |
| Single | 240 (51.1) |
| Married | 230 (48.9) |
| Occupation | |
| Unemployed | 326 (69.4) |
| Employed | 144 (30.6) |
| Knowing someone with breast cancer | 200 (42.6) |
| Having chronic diseases | 88 (18.7) |

*Data are presented by n (%).

*Distribution of mythical causes of breast cancer*

Table 2 displays the distribution of participants based on their awareness and beliefs about mythical causes of breast cancer. A notable portion of the subjects associated psychological stress (63%) and exposure to electromagnetic frequencies (47.7%) with an increased risk of breast cancer. Regarding environmental and lifestyle factors, 46.8% believed that foods containing additives and artificial sweeteners pose a risk, and 46.4% linked living in industrial cities with breast cancer risk. Other widely held misconceptions included wearing tight bras (43%), using microwave ovens (41.5%), drinking from plastic bottles (41.1%), using deodorants (36.4%), and using mobile phones (31.3%).

In terms of medical and cosmetic procedures, a significant number of participants believe that "undergoing breast plastic surgery" (46.2%) could lead to breast cancer. Armpit laser was also identified by 32.1% of the sample to be a risk factor for breast malignancy. In regard to mammography screening, participants expressed mixed perceptions of mammography screening, with 32.1% believing it poses a risk for breast cancer and 26.4% remaining uncertain.

Table 3 shows the distribution of participants' beliefs about breast cancer causation. Concerning gender, a substantial majority disagree with the belief that breast cancer only affects women (56.8%), while a smaller proportion agree with this view (32.3%), and 10.9% are neutral. Regarding family history, most participants disagree with the idea that breast cancer only affects those with a family history of the disease (67.0%), with fewer agreeing (18.7%) and 14.3% remaining neutral. On the topic of age, the majority disagree with the notion that breast cancer only affects older women (78.7%), with a small percentage agreeing (8.7%) and 12.6% being neutral.

*Factors correlated with a good level of knowledge about mythical causes of breast cancer*

Table 4 shows the univariate and multivariate analysis examining the association between good level of knowledge about the mythical causes of breast cancer and various characteristics of the studied subjects. Participants aged 18-35 were significantly more likely to have good knowledge compared to those over 50, with an odds ratio (OR) of 4.0 (95% CI: 1.20-13.3, p = 0.02). There was no significant difference in knowledge levels between the 35-50 age group and those over 50 (OR: 1.60, 95% CI: 0.45-6.07, p = 0.48). Nationality did not significantly impact knowledge levels, with Saudis having an OR of 0.90 compared to non-Saudis (95% CI: 0.40-2.01, p = 0.80). Similarly, place of residence (Madinah vs. Makkah) showed no significant association with knowledge levels (OR: 0.75, 95% CI: 0.42-1.25, p = 0.24). The educational level also did not significantly affect knowledge levels,

Table 2. Distribution of the Studied Subjects by Their Knowledge about Mythical Causes of Breast Cancer (n = 470)

| Myth Items | Agree n (%) | Not sure n (%) | Disagree n (%) |
|---|---|---|---|
| Psychological stress | 296 (63) | 94 (20) | 80 (17) |
| Exposure to electromagnetic frequencies | 224 (47.7) | 116 (24.7) | 131 (27.9) |
| Eating food containing additives and artificial sweeteners. | 220 (46.8) | 94 (20) | 156 (33.2) |
| Living in industrial cities | 218 (46.4) | 123 (26.2) | 129 (27.4) |
| Undergoing breast plastic surgery | 217 (46.2) | 113 (24) | 140 (29.8) |
| Physical injury (trauma to the breast) | 213 (45.3) | 103 (21.9) | 154 (32.8) |
| Wearing a tight bra (tight clothing) | 202 (43) | 73 (15.5) | 195 (41.5) |
| Using microwave ovens | 195 (41.5) | 105 (22.3) | 171 (36.4) |
| Drinking from plastic bottles | 193 (41.1) | 107 (22.8) | 170 (36.2) |
| 1. Using deodorants | 171 (36.4) | 89 (18.9) | 212 (45.1) |
| Undergoing mammography | 151 (32.1) | 124 (26.4) | 196 (41.7) |
| Undergoing Armpit Laser | 151 (32.1) | 127 (27) | 193 (41.1) |
| Using mobile phones | 147 (31.3) | 88 (18.7) | 236 (50.2) |
| Using cleaning products | 134 (28.5) | 99 (21.1) | 238 (50.6) |
| Using aerosol containers | 126 (26.8) | 105 (22.3) | 171 (36.4) |

Table 3. Distribution of the Studied Subjects by Their Beliefs about Breast Cancer Causation

| Beliefs items | Agree | Neutral | Disagree |
|---|---|---|---|
| Breast cancer only affects women. | 152 (32.3) | 51 (10.9) | 267 (56.8) |
| Breast cancer only affects those with a family history of breast cancer | 88 (18.7) | 67 (14.3) | 315 (67.0) |
| Breast cancer only affects older women. | 41 (8.7) | 59 (12.6) | 370 (78.7) |

with an OR of 1.15 for university education versus secondary or below (95% CI: 0.47-3.53, p = 0.62). Single participants were more likely to have good knowledge compared to married participants, with an OR of 2.25 (95% CI: 1.26-3.92, p = 0.01).

Unemployed participants had significantly higher odds of having good knowledge compared to employed participants (OR: 2.50, 95% CI: 1.25-5.16, p = 0.01). Participants who knew someone with cancer were less likely to have good knowledge compared to those who did not (OR: 0.55, 95% CI: 0.31-0.98, p = 0.04). Knowing someone with chronic diseases showed no significant association with good knowledge (OR: 0.70, 95% CI: 0.35-1.50, p = 0.36) (Table 5).

Although some factors were significantly associated with good knowledge in univariate analysis, these associations were not sustained in multivariate analysis, suggesting no independent correlations with good awareness of myth recognition.

Table 5 reported the correlation between knowledge and different beliefs regarding breast cancer and mammograms Overall, each misbelief were closly linked to lower rates of good awareness. It was found that women who perceived mammograms as a potential cause of breast cancer were less likely significantly less likely to display good knowledge in terms of breast cancer causation myths, with an OR of 0.15 (95% CI: 0.08 – 0.28, p < 0.001).. The multivariate analysis, adjusted for cofounders, also supported these results, yielded an OR of 0.14 (95% CI: 0.07 – 0.28, p = <0.001). Similarly, those who thought breast cancer affects only women demonstrated reduced awareness (univariate OR: 0.30, 95% CI: 0.16–0.58, p < 0.001; multivariate OR: 0.37, 95% CI: 0.19–0.71, p = 0.003). Additionally, belief that breast cancer occurs only in individuals with a family history was also linked to lower knowledge levels (OR: 0.19, 95% CI: 0.08–0.44, p < 0.001). Lastly, females who believed that breast cancer is a condition that only affects older women had reduced odds of accurately identifying breast cancer myths (univariate OR: 0.29, 95% CI: 0.11–0.74, p < 0.001; multivariate OR: 0.29, 95% CI: 0.11–0.75, p = 0.011).

*Opinion about the risk factors and potential causes of breast cancer*

Table 6 summarizes the opinions of the studied subjects regarding the risk factors and causes of breast cancer. A significant portion of the subjects, 288 (61.3%), did not respond, indicating a lack of knowledge or reluctance to answer, and 18 respondents (3.8%) explicitly stated they do not know the risk factors or causes of breast cancer. Thirty-five respondents (7.5%) identified family history, particularly in first-degree relatives, and genetic predisposition as significant risk factors, while 41 respondents (8.7%) pointed to stress and lack of sleep as contributing factors. Only 7 respondents (1.5%), mentioned lack of physical activity, smoking, and unhealthy diet, which are well-known lifestyle risk factors. Twenty-one respondents (4.5%) attributed the risk to consuming processed, canned foods, and industrial foods. Thirteen respondents (2.8%) highlighted hormonal

Table 4. Association of Good Knowledge Level about the Mythical Causes of Breast Cancer and the Studied Subjects' Characteristics

| Characteristics | Level of Knowledge | | Univariate | | Multivariate | |
|---|---|---|---|---|---|---|
| | Good (n= 62) | Fair and poor (n= 408) | OR (95% CI) | P value | OR (95% CI) | P value |
| Age in years | | | | | | |
| > 50 | 3 | 57 | Ref. | Ref. | Ref. | Ref. |
| 35-50 | 10 | 118 | 1.60 (0.45-6.07) | 0.48 | 1.64 (0.40 – 6.74) | 0.493 |
| 18-35 | 49 | 233 | 4.0 (1.20-13.3) | 0.02* | 2.5 (0.66 – 9.41) | 0.18 |
| Nationality | | | | | | |
| Non-Saudi | 8 | 48 | Ref. | Ref. | Ref. | Ref. |
| Saudi | 54 | 366 | 0.90 (0.40-2.01) | 0.8 | 1.28 (0.52 – 3.144) | 0.585 |
| Place of residence | | | | | | |
| Makkah | 38 | 218 | Ref. | Ref. | Ref. | Ref. |
| Madinah | 24 | 190 | 0.75 (0.42-1.25) | 0.24 | 1.28 (0.52 – 3.14) | 0.585 |
| Educational level | | | | | | |
| Secondary or below | 16 | 116 | Ref. | Ref. | Ref. | Ref. |
| University or higher | 46 | 292 | 1.15 (0.47-3.53) | 0.62 | 1.06 (0.55 – 2.03) | 0.869 |
| Marital status | | | | | | |
| Married | 20 | 210 | Ref. | Ref. | Ref. | Ref. |
| Single | 42 | 198 | 2.25 (1.26-3.92) | 0.01* | 1.44 (0.67 – 3.10) | 0.343 |
| Occupation | | | | | | |
| Employed | 10 | 134 | Ref. | Ref. | Ref. | Ref. |
| Unemployed | 52 | 274 | 2.50 (1.25-5.16) | 0.01* | 1.54 (0.69 – 3.46) | 0.294 |
| Knowing someone with breast cancer | | | | | | |
| No | 43 | 227 | Ref. | Ref. | Ref. | Ref. |
| Yes | 19 | 181 | 0.55 (0.31-0.98) | 0.04* | 0.70 (0.37 – 1.33) | 0.278 |
| Diagnosed with chronic disease | | | | | | |
| No | 53 | 329 | Ref. | Ref. | Ref. | Ref. |
| Yes | 9 | 79 | 0.70 (0.35-1.50) | 0.36 | 0.87 (0.38 – 1.99) | 0.738 |

*Significant

Table 5. Association between Good Knowledge of Myths of Breast Cancer Causation and Different

| | Univariate analysis | | Multivariate analysis* | |
|---|---|---|---|---|
| | OR (95% CI) | P value | OR (95% CI) | P value |
| Mammogram may lead to breast cancer | 0.15 (0.08 – 0.28) | < 0.001* | 0.14 (0.07 – 0.28) | < 0.001* |
| Breast cancer only affects women | 0.30 (0.16 – 0.58) | < 0.001* | 0.37 (0.19 – 0.71) | 0.003 |
| Breast cancer only affects those whom have a family history | 0.19 (0.08 – 0.44) | < 0.001* | 0.20 (0.08 – 0.48) | < 0.001* |
| Breast cancer only affects old women | 0.29 (0.11 – 0.74) | < 0.001* | 0.29 (0.11 – 0.75) | 0.011 |

Table 6. Opinion of the Studied Subjects about the Risk Factors and Causes of Breast Cancer

| Perceived Risk Factors of Breast Cancer (n = 159) | N |
|---|---|
| Stress and lack of sleep | 41 |
| Family history of breast cancer | 35 |
| Consuming processed foods | 21 |
| Being over 50 | 20 |
| Hormonal drugs and early puberty | 13 |
| Exposure to radiation | 10 |
| Not having regular health check-ups | 7 |
| Lack of physical activity, smoking, and unhealthy diet | 5 |
| Use of deodorants and chemical cleaners | 5 |

drugs and early puberty as risk factors. Five respondents (1.1%) mentioned the use of deodorants, cleaners, and other chemical substances. Ten respondents (2.1%) noted exposure to radiation and ultraviolet rays as potential causes. Twenty respondents (4.0%) recognized higher risk for women over 50. Finally, seven respondents (1.6%) pointed out the lack of regular health check-ups and using products without proper consultation as risk factors. Overall, the table results reveal a diversity of opinions, with a notable gap in awareness and understanding of well-established risk factors for breast cancer among the studied subjects.

## Discussion

This is the first study that was focused on the assessment of the prevalent myths and misconceptions of breast cancer causation in Saudi Arabia. In our study, the overall knowledge about mythical causes of breast cancer is considered low, with only 13.2% of the studied subjects showing a good level of knowledge. This is similar to a Palestinian study, which found that only 5.1% could identify 10 myths or more correctly [14]. In England, while the number is higher (36%), the majority still failed to accurately identify the mythical causes of breast cancer [16]. These studies suggest that these misbeliefs are a universal challenge to proper breast awareness and public health messages are necessary.

The lack of proper awareness regarding breast cancer risk factors was reported previously in the Madinah study as demonstrated, which assessed the level of knowledge among female residents in Madinah. It was found that more than 50% of participants showed a suboptimal recognition of the risk factors of breast cancer. Among those, the commonly failed identified risk factors were age > 70 (8.0%), early menarche (13.7%), cigarette smoking (17.6%), and late menopause (23.4%). The study also revealed that women who exhibited a low level of knowledge were higher among those who had never undergone a mammogram [5]. This may signify that the lower the level of knowledge compounded with inaccurate information about breast cancer causes, the lesser the possibility of attaining a mammogram and adhering to routine screening. Similar findings were shown in our study, as those who possessed more myths were more likely to perceive mammogram as harmful procedure with the potentiality of causing breast cancer (OR: 0.14, 95% CI: 0.07 – 0.28, p = <0.001).

The most significant determinants of knowledge about breast cancer misconceptions noted in our study were age, marital status, and occupation. Participants in the younger age group (18-35 years) demonstrated better knowledge about breast cancer myths compared to those in older age groups, with 17.5% of them exhibiting a good level of knowledge. Marouf A reported that younger participants were more likely to spot a myth compared to older adults, specifically the role of alternative medicine as curative and the microwave oven increases the risk of cancer [19]. It could be proposed that younger participants may have greater access to information through social media and are more likely to engage with educational campaigns on breast cancer awareness. In contrast, older individuals may rely on more traditional sources of health information, which may not provide the same breadth or frequency of exposure as the digital platforms used by younger generations.

In reference to the additions, we made to the original CAM-MYC scale as outlined in the methodology section, the evidence of the association between those factors and breast cancer remains weak and insufficient. For instance, Current research does not support a clear link between the use of deodorants or antiperspirants and an increased risk of breast cancer [20]. Also, the literature does not provide conclusive evidence that psychological distress directly causes breast cancer [21]. While psychological distress is a significant factor in cancer treatment and recovery, there is no strong evidence linking it as a direct cause of breast cancer [22]. Concerning brassiere wearing, a recent meta-analysis concluded that no sufficient evidence to support an association between either bra type or duration and breast cancer [23]. Despite breast implants being commonly recognized as a breast cancer risk factor, a meta-analysis of cohort studies failed to find a significant association [24]. The literature on the relationship between urban residency and breast cancer risk is conflicting. For example, a study in China showed that the incidence of breast cancer remains stable in urban areas compared to increased incidence in rural areas [25]. In contrast, a study in Egypt reported that women residing in urban areas had a three- to four-fold higher risk of breast cancer [26]. This comes in consistent with a French study, which revealed a weak risk of breast cancer among dwellers of urban areas [16]. Both studies attributed this risk to mainly air pollution. However, the higher incidence rates in urban population may also be explained by factors such as earlier screening access. A recent systematic review indicated that rural residents were more likely to be diagnosed at later stage compared to women living in urban areas [27].

When comparing our study with others, the results are diverse. For example, an England study utilized CAM-MYCS survey, showed that being younger or white was associated with a higher level of knowledge of breast cancer risk factors. The study also found that the most common misconceptions about breast cancer causation were stress, food additives, exposure to non-ionizing electromagnetic frequencies, and eating genetically modified food [16]. The Palestine study in 2023, showed that among 5,257, the most common myths among the sample were as follows: physical trauma, using aerosol containers, using cleaning products, stress, and exposure to electromagnetic frequencies such as Wi-Fi and TV frequencies. Among the food-related myths, eating burnt food and drinking from plastic bottles were the most common food-related misconceptions [14]. A study based on Pakistan 2022, found that the most correctly identified mythical items among the sample were "cancer is contagious" followed by using aerosol and powerlines. On the other hand, the items that were shown to be commonly incorrectly identified are receiving pestcide spray, microwave ovens and plastic bottles. Regarding the established modifiable risk factors, most participants failed to recognize the consumption of low fruit and vegetables (Low FV), low physical activity (Low PA), and old age as potential and well-known factors associated with the increasing risk of breast cancer [15].

The widespread myths and lack of knowledge about breast cancer may contribute to the negative health behaviors that are consistently observed among the public. The effects of socio-cultural and traditional beliefs may render the person in several ways. For example, delay seeking medical help [12], unnecessary anxiety and fear [28], and most importantly not being adherent to evidence-based interventions and information [5]. Therefore, it's important for future health campaigns concerning breast carcinoma, to not only provide the general population

with the correct information but also to include those misconceptions in the conversation to clear up the public ignorance about breast malignancy. Three strategies can be implanted to prevent these myths from prevail. 1) warning the public about the possibility of being misinformed either from erroneous sociocultural or social media-derived information and emphasizing the importance of relying exclusively on credible healthcare providers, 2) repeating and reinforcing the refutation of the myth to diminish the influence of strongly believed misconception effectively, 3) retraction should be accompanied by filling the gap with alternative evidence-based explanation that is scientifically plausible [29]. For instance, debunking the belief that "mammography leads to breast cancer" and fill that with the evidence-based benefits of mammogram.

This intervention may seem to be insignificant, but in long-term, these conversations would lead to positive outcomes including the confidence of the community in the healthcare system and providers, which in turn would facilitate public screening and adherence to healthcare providers' recommendations [30].

*Limitations*

A key limitation of our study is that we did not include the actual cancer causes to provide a valid comparison. This is because we aimed to keep the survey concise for participant convenience. To partially accommodate this, an open-ended question was included at the end of the questionnaire, inviting participants to share their thoughts on their perceived risk factors for breast cancer. Nevertheless, the majority of respondents did not provide input or share their opinions about the risk factors and causes of breast cancer. Furthermore, CAM-MYCS survey contains items that currently have no consensus and compelling evidence on their causal relationship with breast cancer, thereby, there is a possibility that future research may affirm a causal link for some items that regarded as myths. Moreover, excluding healthcare personnel enhances specificity but restricts insights into the general public's awareness since these people may act as powerful mediators of health information. Finally, The data was collected in an online questionnaire which may disproportionately reach younger, more tech-savvy individuals, thus underrepresenting older or less educated groups. This study was carried out in one region of Saudi Arabia, therefore, the sample doesn't represent the entire Saudi female population.

In conclusion, this study highlights that a significant female proportion of our sample, hold false beliefs regarding the underlying lifestyle and environmental causes of breast cancer. Among the common myths reported in our study, using deodorants, mobile phones, and cleaning products were the most prevalent myths identified by our population as potential causes of developing breast cancer. Notably, younger and single participants demonstrated a greater awareness of prevalent myths associated with breast malignancy. These findings signify the critical necessity for educational campaigns targeting the general population, which should focus on disseminating accurate and evidence-based information about breast cancer risk factors and, crucially the importance of routine screening.

## Author Contribution Statement

All authors have made substantial contributions as follows: DA: Conception, design, interpretation of the data, substantively revised the manuscript. ZK: Conception, design, data analysis, and interpretation, draft the work. MA: Conception, design, data interpretation, draft the work. NK: Data acquisition and interpretation, draft the paper. HA: Data acquisition and interpretation, draft the paper. LA: Data acquisition and interpretation, draft the paper. LHA: Data acquisition and interpretation, draft the paper. All authors have approved the submitted version and have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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*Ethical Approval and Informed Consent*

The research was approved by The Research Ethics Committee, College of Medicine, Taibah University with study ID "TU-24-028", on the 15th of May, 2024. The first section of the online survey contains the consent form where each participant have to choose either "agree to participate" or "disagree to participate". After the distribution of the questionnaire, the collected data were manipulated, cleaned, and checked for completeness, then entered into Microsoft Excel. Confidentiality is achieved by not using any names or identifiable data that to ensure the anonymity of the participants. The collected data were sorted, coded, and secured by password protection and

*Availability of data*

The data supporting the findings of this study are not publicly available but may be obtained from the corresponding author upon reasonable request, subject to necessary approvals.

*Conflict of interest*

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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