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# Knowledge and practice of self-examination among breast cancer patients in Tanzania: A cross-sectional study

Elizabeth F. Msoka [1,2,3✉], Bob C. Mulder [4], Frank B. Bright [2,3], Baraka Moshi[3], Autumn Beavers[5], Modesta Mitao[1,3], Gileard G. Masenga[2,3], Alem Gebremariam[6,7], Eva J. Kantelhardt [8,9], Maureen Joffe[10] & Blandina T. Mmbaga [1,2,3]

In Tanzania, breast cancer (BC) is the second most common cancer among women but is far less common in men. Late-stage diagnosis often occurring due to low levels of BC awareness and low compliance with practice of breast self-examination (BSE) for early BC detection. However, the factors related to BC awareness and performance of regular BSE in Tanzania are unclear. The present study aimed to examine the extent to which several dimensions of BC knowledge are associated with BSE. This was examined through a cross-sectional study of patients who received care at the cancer care centre in the Kilimanjaro region. Multivariable relationships were tested using hierarchical linear regression. A total of 219 BC patients participated in this study, of which 193 (88.1%) were women. The findings revealed limited knowledge of breast cancer among the participants. There were significant correlations between 4 of the 6 knowledge factors and BSE, ranging from $r = .16$ (knowledge of how to perform BSE) to $r = .26$ (knowledge of risk factors). In the regression model, significant predictors of performing BSE included knowledge of risk factors ($B = 0.06$), knowing how often to perform BSE ($B = 0.12$) and awareness of normal breast appearance ($B = 0.20$). Surprisingly, there was a negative association between knowledge of signs and symptoms and BSE ($B = -0.7$). Males were less likely to perform BSE than females ($B = 0.75$), and BSE performance decreased with age ($B = -0.1$). In conclusion, education should focus on teaching appropriate BSE methods, the optimal frequency of BSE, and awareness of the appearance of the breast and how a normal breast should feel and look during BSE.

**Keywords** Breast Cancer,, Risk Factor, Knowledge, Signs and Symptoms, Breast self examination,, Barriers,, Tanzania.

**Abbreviations**

| | |
|---|---|
| BSE | Breast self-examination |
| NORA | Network for oncology research in Africa |
| PO-RALG | President's office, regional administration and local government |
| BC | Breast cancer |
| MBC | Male breast cancer |
| IBC | Inflammatory breast cancer |
| IBM | International Business Machines |
| SD | Standard deviation |
| KCMC | Kilimanjaro Christian Medical Centre |

[1]Kilimanjaro Clinical Research Institute, Box 2236, Moshi, Tanzania. [2]Kilimanjaro Christian Medical Centre, Box 3010, Moshi, Tanzania. [3]KCMC University, Box 2240, Moshi, Tanzania. [4]Wageningen University, Strategic Communication, Wageningen, The Netherlands. [5]The University of Alabama at Birmingham, Birmingham, AL, USA. [6]Department of Public Health, College of Medicine and Health Science, Adigrat University, Tigray, Adigrat, Ethiopia. [7]Tigray Health Research Institute, Tigray, Mekelle, Ethiopia. [8]Global & Planetary Health Working Group, Martin-Luther-University Halle-Wittenberg, Halle(Saale), Germany. [9]Section Global Health, Institute for Hygiene and Public Health, University Hospital, Bonn, Germany. [10]Strengthening Oncology Services Research Unit, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. ✉email: e.fbright@kcri.ac.tz

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Breast cancer (BC) is the most common cancer diagnosed in women worldwide, with almost 2.3 million new cases and 666,103 fatalities reported in 2022[1]. While predominantly affecting women[2], breast cancer also occurs in men, accounting for approximately 0.6%–1% of all breast cancer cases and about 0.3% of all newly diagnosed cancers in men[3,4]. According to data from the Surveillance, Epidemiology, and End Results program, the age-adjusted incidence of invasive male breast cancer (MBC) was 1.11 per 100,000 during the period from 1975 to 2015 in the United States[5,6]. While breast cancer incidence in sub-Saharan Africa is relatively low compared to high-income countries, this low rate could be due to the unavailability of national screening programmes and national registries for data keeping in sub-Saharan Africa. Moreover, survival rates are poor, resulting in mortality rates that are as high as those in high-income nations[7].

In Tanzania, BC accounts for approximately 16% of all malignancies in women, and over 80% of them are diagnosed at a late stage, namely stage III or IV[8–10]. However, in 1992 MBC represented approximately 6.5% of all breast cancer cases in Tanzania, a figure that is notably ten times higher than those reported in many other parts of the world[11]. Additional studies have highlighted that these cases were also frequently diagnosed at advanced stages, indicating the potentially high prevalence of MBC[12]. Furthermore, in 2010, another study in Tanzania revealed that MBC accounted for 2.9% of all breast cancer cases, whereas, inflammatory breast cancer (IBC) accounted for 4.3–5.5% of cases, depending on the recorded diagnoses or established IBC criteria for cases lacking specific diagnoses in medical records[13]. Despite these findings, research on breast cancer in Tanzania has been sparse and was mainly on women's breast cancer over the past two decades, although there is agreement that diagnoses mainly occur in the advanced stage[13].

The factors contributing to this late-stage diagnosis are multi factorial, with one major factor being that patients are not aware of BC at all[10,14,15]. Indeed, an understanding of the early symptoms of BC and of the importance of seeking timely medical attention and treatment among women and men is crucial to improve the outcomes of patients with BC[9,10]. In a prior study of Tanzanian women diagnosed with BC, Ng'ida et al. (2019) reported that only 37.7% of patients were aware of the initial signs and symptoms of BC[16]. Several other studies have also shown that a lack of awareness of the signs and symptoms of BC leads to delayed presentation, diagnosis, and treatment[10,14,15]. Thus, understanding BC is crucial for enhancing awareness of the signs and symptoms of BC and promoting self-screening by breast self-examination (BSE)[17], as individuals with greater knowledge are more likely to perform BSEs[18–20]. Fortunately, acquiring BC knowledge through educational curricula positively influences attitudes towards BSE[21].

Although the aforementioned studies suggest that knowledge of BC affects the likelihood of target groups to self-screen by performing BSEs, few studies have directly evaluated the relationship between knowledge levels and self-screening. In addition, levels of knowledge, attitudes, and self-examination practices regarding BC are largely unknown for patients in Tanzania particularly among male patients, who are often overlooked in research.

Therefore, the aim of the present study was to assess knowledge with respect to BSE, BC risk factors, early symptoms and signs, and how these types of knowledge are associated with BSE among female and male participants in one Tanzanian cancer care center.

## Methods
### Study design
This hospital-based cross-sectional study conducted among BC patients from the Tanzanian cancer center in the Kilimanjaro region between November 2023 and April 2024. Participants were selected through purposive sampling, which involves selecting participants based on the basis of histologically confirmed breast cancer.

### Study setting
Moshi Urban district is one of the seven districts of Kilimanjaro region in Tanzania. According to the Tanzania national population census of 2022, the Kilimanjaro region was estimated to have a population size of 1,861,934 people, covering an area of approximately 15,100 square kilometers. In total, 125,912 (84.6%) people reside in the rural Kilimanjaro region, whereas 22,851(15.4%) lived in urban areas. A total of 76,606 (51.5%) are female and 72,157(48.5%) are male[22]. The Kilimanjaro region is also the eighth most densely populated region in Tanzania, with 124 people per square kilometer.

### Recruitment and sample
Between November 2023 and April 2024, data were gathered using a self-administered questionnaire distributed to a purposive sample of BC patients aged 18 years and older, who had histologically confirmation of their diagnosis and were attending their regular clinic. BC patients attending their scheduled appointments at the KCMC Cancer Care Centre were recruited by the clinic coordinator, who explained the study's objectives and gauged their interest. The clinic coordinator asked 230 BC patients to participate in the survey questionnaire. The probability proportional per size was used to draw a sample of 230 patients, which is a proportion of the total population of over 4,000 patients who attended the clinic within 1 year to ensure the representatives. This sample size allows for sufficient representation among the patients in the larger attendee group which enables us to draw conclusions that may be generalized to the broader population of BC patients at the clinic. Among the sample, 219 (95.2%) completed the questionnaires (26 males; 193 females).

### Survey questionnaire development
The survey questionnaire was developed on the basis of existing literature[23] and on the findings from a qualitative study conducted in 2021[24], as well as on input from experts, including oncologists, gynecologists, reproductive health nurses, and social scientists. While the questionnaire was developed in English in order to be used with patients who speaks the language as well, it was translated into Swahili to facilitate participant

understanding. This original version was pilot tested among 10 participants from a similar socioeconomic background in Kilimanjaro, and the results were used to refine the wording of subsequent versions for better comprehension. The findings from this pilot study offered valuable preliminary insights and assisted in making necessary refinements, such as rewording statements within the tool. This translated version was then revised and translated back to English by an experienced colleague to ensure translation accuracy.

### Data collection

Participants who consented in participating in the study were referred to the research assistant, who provided further details about the study and addressed any questions raised. Participants who agreed to participate were asked to sign the informed consent form and were then provided with the questionnaire in a private conference room near the cancer care centre waiting area. Research assistants underwent an 8-hour training session to familiarize themselves with the survey questions and interviewing methods. Data collection involved conducting face-to-face interviews with a total of 230 participants. To ensure data quality, a systematic back-check was performed on 15% of the interviews in the field. To ensure confidentiality, the questionnaires were anonymized with participant ID numbers.

### Measures

The questionnaire was organized into five sections: (a) socio demographic information, including age, education, religion, and marital status; (b) knowledge and practices related to BSE; (c) knowledge about risk factors for developing BC; (d) knowledge of BC signs and symptoms; (e) barriers to early detection and (f) barriers to treatment.

The primary outcome of the study was the frequency of BSE, which was measured with a single item, "How often do you examine your breast?", rated on a 4-point response scale from "weekly" to "monthly" to "every 6 months" to "rarely or never". Three items measured different knowledge dimensions of BSE. For the first item the respondent was prompted to select either "yes" or "no" if the participant knew how to perform a BSE. For the second item, the participant was asked to indicate how often a BSE should be done, which was rated on a 4-point scale, from "daily", "weekly", to "more than a month" and then "I don't know". For the final two items, the extent to which the respondent understands how the breasts normally look and feel and how confident the participant was in being able to notice a change in their breasts was measured. Both items were rated on a 3-point scale ("Very much"; "Quite"; "A bit/not at all").

With respect to knowledge of risk factors, each of the 18 items was a question about a risk for developing BC, for example, "Does breast cancer risk increase with advancing age?", "Can breast cancer be hereditary?", or "Is high-fat diet a risk factor for breast cancer?". Every item was scored on a 3-point scale comprising "yes", "no" and "unsure", with "yes" always being the correct answer.

Knowledge of signs and symptoms was measured with 12 statements about a BC sign or symptom, such as "Lump in the breast", "Discharge from the breast", or "Pain or soreness in the breast". As with the knowledge or risk factors, items were scored on a 3-point scale comprising "yes", "no" and "unsure", with "yes" as the correct answer.

Finally, two scales measured perceptions of barriers for detecting BC, as well as perceived obstacles to BC treatment. Both scales intended to capture participants' perceptions of the barriers and obstacles as faced by women in general. Fifteen barriers to detection were measured, on a 3-point scale ("yes", "no" or "unsure"); for example, "The lack of money to pay for clinical consultations", "Fear of finding something bad", or "Resistance from a male partner about being checked by a doctor". Example items of perceived obstacles to treatment (in total 5 items) are "Fear of treatment side effects" and "Lack of family support" (see Supplementary file S1: Survey questionnaire).

### Data analysis

The items for measuring BSE knowledge and practice were recorded such that a higher score on each item reflected an increase in knowledge or frequency. Specifically, for knowledge of risk factors and knowledge of signs and symptoms, responses were recorded such that 'yes' was given a value of 1 and 'no' or 'unsure' was given a value of 0. The total score for each scale were subsequently calculated as a simple sum.

### Statistical analysis

Means and standard deviations were calculated for each concept by averaging scale items. Categorical variables are summarized as frequencies and percentages. Additionally, bivariate correlations were computed to explore whether self-screening by BSE was positively or negatively associated with BSE knowledge and knowledge of risk factors and signs and symptoms. Descriptive analyses, including calculation of means, standard deviations, frequencies, and percentages, were performed using SPSS version 24 (IBM Corp., Armonk, NY). These analyses summarized participants' socio demographic characteristics and baseline knowledge variables. Bivariate correlations were conducted to explore associations between self-screening by breast self-examination (BSE) and knowledge factors, including awareness of BSE, breast cancer risk factors, and recognition of signs and symptoms. Interpretation of correlation coefficients was defined as: 0 – No correlation; <0.3 – Weak correlation; <0.7 – Moderate correlation; ≥0.7 – Strong correlation.

To determine factors associated with BSE, multivariable analyses were conducted using Stata version 18 (StataCorp LLC, College Station, TX). Hierarchical linear regression models were applied in three steps: Model 1 included core demographic characteristics (age, sex, and educational level); Model 2 added participants' knowledge and confidence related to BSE; and Model 3 incorporated additional knowledge based variables, specifically awareness of breast cancer risk factors and recognition of signs and symptoms, to assess their unique

contributions. This sequential modeling strategy enabled evaluation of the incremental influence of knowledge related factors while controlling for covariates. Statistical significance was defined as $p < .05$ for all analyses.

### Ethical considerations
Ethical approval was granted from the local ethical review board (ref: 2425), National review board (ref: NIMR/HQ/R.8a/Vol./X/3733) and from President's Office, Regional Administration and Local Government of Tanzania (PO-RALG) (ref: AB.307/223/01).

## Results
A total of 230 BC patients were enrolled in this study, of which 26 (11.9%) were males and 193 (88.1%) were females.

Eleven patients withdrew from the study due to insufficient time to complete the questionnaire, as a result of living in remote rural areas and the need to rush home after clinic visit. The ages of the participants ranged from 20 to 86 years, and the mean age was 56.3 years. The majority (77.7%) of the participants were aged above 30 years, with one participant aged 86 years. More than half (59.4%) of the participants had a primary school level education, and half of them (50.2%) were married (Table 1).

### Knowledge of breast self-examination
The goal of the analysis was to assess participants awareness of breast health and their practices related to BSE. Almost half (46.6%) of the participants rarely or never examined their breasts whereas only 9 (4.1%) did so weekly (Fig. 1). More than half (61.6%) reported that they did not know how to perform a breast self-examination. Furthermore, the majority of participants (67.1%) did not know the normal appearance or feel of their breasts, and a large majority (73.5%) had minimal or no confidence that they would notice a change in their breasts. These findings highlight significant gaps in breast health awareness and BSE practices.

### Knowledge of risk factors
The participants' knowledge of risk factors ranged from 0 to 11 (median = 5), with a maximum score of 18 (Table 2). Knowledge of signs and symptoms ranged from 1 to 10 (median: 4), with a maximum score of 12. Thus, knowledge of risk factors, and of signs and symptoms seemed limited.

### Knowledge of signs and symptoms of breast cancer
When examining the separate knowledge items, the most recognized symptoms of BC were ulceration of the breast (79.9%), swelling or enlargement of the breast (66.7%), and breast discharge (51.6%). The least recognized symptoms were a change in the shape of the breast (14.6%), weight loss (20.1%), and a lump under the armpit (21.9%). Of the risk factors, hereditary susceptibility was the most recognized (51.6%), while null parity was the least recognized (2.7%). Breast trauma was the second-best recognized risk factor (44.7%), while only 16.8% of participants knew that taking oral contraceptives increased the risk of BC (16.9%).

| Variables | N (%) |
|---|---|
| Age Mean [SD] | 56.3 [12.9] |
| Age (Maximum: Minimum) | (86, 20) years |
| Sex | |
| Male | 26 (11.9) |
| Female | 193 (88.1) |
| Marital status | |
| Single | 109 (49.8) |
| Married | 110 (50.2) |
| Educational level | |
| Non formal | 23 (10.5) |
| Primary | 130 (59.4) |
| Secondary level | 45 (20.5) |
| College/University | 21 (9.6) |
| Religion | |
| Christian | 176 (80.4) |
| Muslim | 41 (18.7) |
| No Religion | 0 (0.0) |
| Other | 2 (0.9) |
| Residence | |
| Urban | 76 (34.7) |
| Rural | 143 (65.3) |

**Table 1.** Socio demographic characteristic of the study participant ($N = 219$).
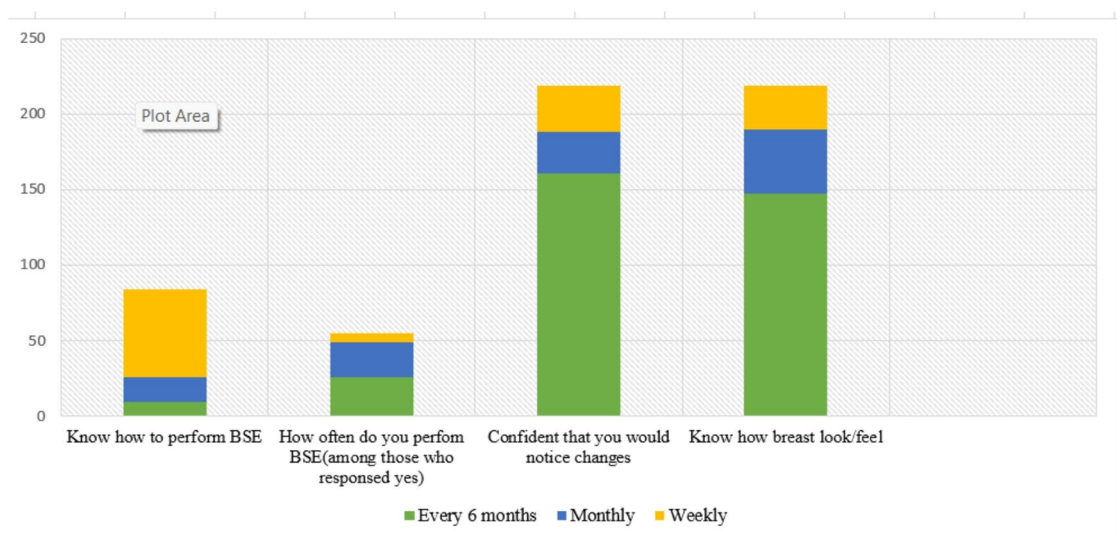
**Fig. 1**. BSE knowledge and practice of breast cancer patients (*N*=219).

| Measures | Knowledge of risk factors | Knowledge of signs and symptoms |
|---|---|---|
| Range | 0–11 (out of 18) | 1–10 (out of 12) |
| Mean | 4.84 | 4.70 |
| Median | 5.00 | 4.00 |
| Standard deviation | 2.44 | 2.15 |

**Table 2**. Knowledge of risk factors, signs and symptoms among breast cancer patients (*N* = 219).

| Item | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| 1. BSE frequency | 0.13 | 0.26** | 0.18** | 0.17* | 0.26** | 0.18** |
| 2. Knowledge on how to perform BSE | — | 0.46** | 0.43** | 0.11 | 0.09 | 0.32** |
| 3. Knowledge on how often to perform BSE | | — | 0.33** | 0.11 | 0.16* | 0.17* |
| 4. Confidence in noticing a change in breasts | | | | 0.38** | 0.17* | 0.22** |
| 5. Knowledge on how breasts normally look and feel | | | | — | 0.14* | 0.12 |
| 6. Knowledge of risk factors | | | | | — | 0.27** |
| 7. Knowledge of signs and symptoms | | | | | | — |

**Table 3**. Correlations between knowledge of risk factors for breast cancer and the practice of breast self-examination. \*\**p* < .01, \**p* < .05. Note: Hierarchical linear regression was used to analyse the associations, with BSE frequency as the dependent variable and risk factors signs and symptoms as independent variables.

To further understand the factors influencing BSE frequency, regression analysis was performed. The correlations analysis revealed that BSE frequency was positively correlated with 5 out of the 6 predictors. However, knowledge of how to perform BSE was not correlated with BSE frequency ($r$ = .13, *ns*); knowledge of how often to perform BSE ($r$ = .26, $p < .01$); knowledge of risk factors ($r$ = .26, $p < .01$) or knowledge of signs and symptoms ($r$ = .18, $p < .01$); and participants' confidence in noticing a change in their breasts ($r$ = .18, $p < .05$ ), and knowing how the breasts normally look and feel ($r$ = .17, $p < .05$) were all positively correlated, as expected the data for all correlations are presented in (Table 3).

### Regression analysis, barriers to early detection and treatment of breast cancer patients
The regression analysis shown in Table 4 seeks to determine the key predictors of BSE frequency, while controlling for potential confounding variables.

The regression analysis (Table 4) revealed that age and sex remained significant predictors of BSE in all the models, such that with increasing age was negatively correlated a decrease in BSEs performed ($B$ = -0.2, $p < .05$ in the full model). In terms of sex, males were less likely to perform BSEs than females ($B$ = 1.15, $p < .001$). Finally, the full model showed that among the variables, only knowledge of how often to perform BSE ($B$ = 0.14, $p$ = .01) was

|  | B | SE | β | t | p | R² | ΔR² |
|---|---|---|---|---|---|---|---|
| DV: BSE |  |  |  |  |  |  |  |
| Model 1: |  |  |  |  |  | 0.17 | - |
| Age | −0.02 | 0.01 | −0.19 | -2.95 | 0.004 |  |  |
| Sex | 1.35 | 0.25 | 0.34 | 5.37 | <0.001 |  |  |
| Educational level | 0.02 | 0.11 | 0.01 | 0.20 | 0.84 |  |  |
| Model 2: |  |  |  |  |  | 0.21 | 0.04 |
| Age | −0.02 | 0.01 | −0.19 | -2.54 | 0.01 |  |  |
| Sex | 1.29 | 0.26 | 0.32 | 4.89 | <0.001 |  |  |
| Educational level | 0.02 | 0.11 | 0.01 | 0.17 | 0.87 |  |  |
| Knowledge on how to perform BSE | −0.40 | 0.21 | −0.15 | -1.92 | 0.06 |  |  |
| Knowledge on how often to perform BSE | 0.14 | 0.07 | 0.16 | 2.15 | 0.03 |  |  |
| Confidence in noticing a change in breasts | 0.02 | 0.14 | 0.01 | 0.15 | 0.88 |  |  |
| Knowledge of how breasts normally look and feel | 0.14 | 0.12 | 0.08 | 1.15 | 0.25 |  |  |
| Model 3: |  |  |  |  |  | 0.22 | 0.01 |
| Age | −0.02 | 0.01 | −0.18 | -2.28 | 0.02 |  |  |
| Sex | 1.15 | 0.28 | 0.29 | 4.16 | <0.001 |  |  |
| Educational level | 0.01 | 0.11 | 0.01 | 0.12 | 0.91 |  |  |
| Knowledge on how to perform BSE | −0.38 | 0.21 | −0.14 | -1.79 | 0.08 |  |  |
| Knowledge on how often to perform BSE | 0.14 | 0.07 | 0.15 | 2.07 | 0.04 |  |  |
| Confidence in noticing a change in breasts | 0.00 | 0.14 | 0.00 | 0.02 | 0.98 |  |  |
| Knowledge of how breasts normally look and feel | 0.13 | 0.12 | 0.07 | 1.08 | 0.28 |  |  |
| Knowledge of risk factors | 0.06 | 0.04 | 0.11 | 1.64 | 0.10 |  |  |
| Knowledge of signs and symptoms | 0.02 | 0.04 | 0.03 | 0.42 | 0.68 |  |  |

**Table 4**. Linear regression analysis for predicting BSE in breast cancer patients.

positively associated with BSE frequency. Knowledge of how to perform BSE showed a non-significant negative association with BSE frequency ($B = -0.38$, $p = .08$). Finally, and in contrast to the correlations, knowledge of risk factors and signs and symptoms was not associated with BSE frequency, although the knowledge of risk factors approached significance ($B = 0.06$, $p < .10$).

Finally, participants perceived various barriers to early detection and treatment of BC for patients, illuminating both individual and systemic challenges (Fig. 2).

Barriers to early detection of breast cancer were classified into three major groups: individual, health system, and interpersonal and sociocultural. Many participants reported that they faced barriers, including 'Resistance from a male partner about being checked by a doctor' (53.4%) and 'Women do not know how to do breast self-exams' (100%). From a health system perspective, a lack of training among medical personnel to detect breast abnormalities (75.3%) was perceived as a barrier. Furthermore, fear of rejection (70.3%) was the most common interpersonal and sociocultural barrier.

With respect to barriers to treatment, 91.3% of the participants perceived that that the cost of clinical consultations posed significant challenges, whereas, 95% of transportation to healthcare facilities was an obstacle (Table 5). Additionally, cultural beliefs and stigma surrounding BC further complicated the situation, with many women expressing fear of seeking medical help due to societal perceptions of being a patient.

## Discussion

In Tanzania, BC is a growing major public health problem due to late-stage diagnosis, resulting in high mortality among women[14]. The present study aimed, first, to assess the level of knowledge of risk factors, signs and symptoms, and breast self-examination (BSE), and second, to examine which of these factors are associated with performing BSE. BSE is important for the early detection of BC, and can thus contribute to relieving the disease burden related to BC[21]. This study provides a comprehensive overview of the breast cancer burden among both females and males in Tanzania over the last fifteen years. To our knowledge, this is the first report detailing the regional burden of male breast cancer (MBC) 11.9%., thus offering significant insights for addressing this cancer on a national level.

Our study revealed limited knowledge of breast cancer. This confirms two similar studies[16,25,26] reporting that women in Tanzania, Ethiopia and India had very low knowledge levels on BC and BSE. In contrast, a study conducted in Saudi Arabia revealed that knowledge related to BSE was satisfactory[27].

In the present study, a significant proportion of patients had either never or rarely examined their breasts. Moreover, most patients reported being unfamiliar with the normal appearance and feeling of their breasts and lacked confidence in identifying any abnormal changes. Similarly, Chao et al. 2020 report that only 24% of women practiced BSE[16]. Furthermore, Kandasamy et al. 2024 find that most of their study participants had poor BC knowledge, and the majority even held negative attitudes towards and portrayed poor practice of BSE[28].
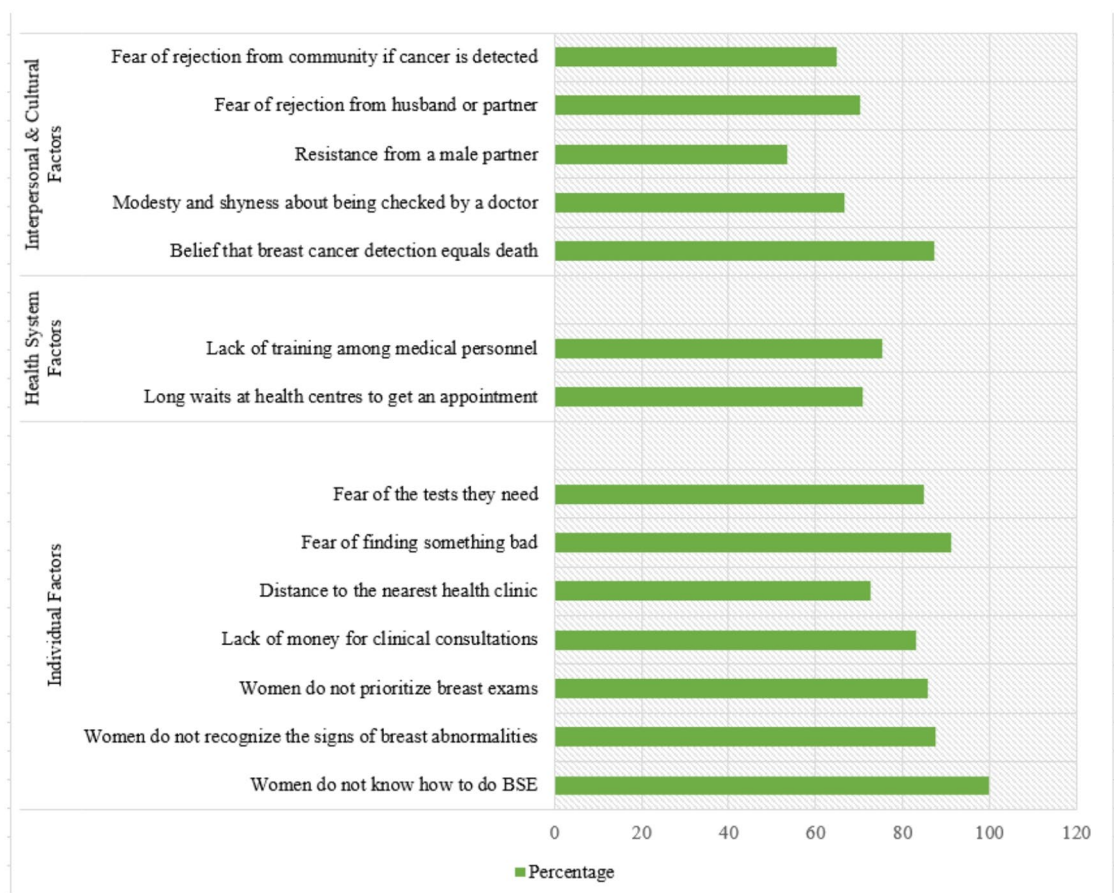
Fig. 2. Perceived barriers to breast cancer early detection ($N = 219$).

| Barriers to treatment | Yes N (%) | No or unsure N (%) |
|---|---|---|
| Fear of treatment side effects | 193 (88.1) | 26(11.9) |
| Lack of financial resources to pay for treatment | 200 (91.3) | 19(8.7) |
| Lack of money to pay for medicines | 201 (91.8) | 18(8.2) |
| Lack of money to pay for transportation and lodging at the city where treatment is received | 208 (95.0) | 11(5.0) |
| Lack of family support | 191 (87.2) | 28(12.8) |

Table 5. Perceived barriers to breast cancer treatment ($N = 219$).

Our findings specifically revealed that only knowledge of how often to perform BSE was associated with frequent BSE. Additionally, more than half of the patients in the present study were uncertain about how or when to perform a BSE. These results are consistent with prior studies showing a lack of knowledge as the main barrier to practicing BSE among Tanzanian and Bangladeshi women. Similarly, they reported that few women could conduct BSEs[20,23,28]. Kandasamy et al.2024 and Alanazi et al.2025 find that, despite good awareness and knowledge of BSE, still its practice remains low with majority of the participants unaware of proper techniques, timing and frequency[28,29].

While the association between knowledge of risk factors for BC and self-screening by BSE approached significance, knowledge of the signs and symptoms was not associated with BSE. These findings are comparable to those of Hasi et al.2025 who find that, although the majority of the participants had never performed BSE, those who knew it perform it regularly. Irregular performance was associated not knowing how to performed BSE, lack of time and interest and fear of a positive results[30].

To our knowledge, the relationships between various knowledge factors and BSE have not been directly tested in prior studies. The findings of our study provide novel insights into the factors that increase the likelihood of self-screening by BSE. First, knowledge appears to have limited associations with actual preventive behavior. Knowledge can thus be seen as a necessary but insufficient condition for maintaining behaviors or behavioral change, even though some studies show. that low prevalence of regular BSE practice is associated with forgetting

to perform it and not knowing how to perform a BSE[31–33]. Thus, knowledge with respect to performing the task, such as how often it should be done, may have more impact than knowledge factors underlying the motivation to perform it, such as risk factors. Similar findings were reported in Ethiopia, where fewer participants practised BSE regularly due to low family income and a lack of awareness about BSE, which was linked to poor knowledge[34]. These findings have important implications for educational interventions aimed at increasing preventive behaviors in at-risk populations.

In addition to the BC knowledge gap among BC patients and its associations with BSE, barriers to early detection and treatment were examined. From a health systems perspective, the finding that lack of training among medical personnel with respect to detecting breast abnormalities poses a barrier is consistent with similar findings in previous studies[23,35,36]. From a patient's perspective, the fear of losing a breast (40%) and fear of a poor disease prognosis (38%) were the most reported barriers for Tanzanian women[23]. Saeed et al. 2021 and Hussein et al.2021 reported that fear of abandonment by the husband also contributed to hiding symptoms or delaying BC screening[37,38].

Additionally, in this study many participants reported that the cost of clinical consultations and transportation to healthcare facilities posed significant challenges. Additionally, cultural beliefs and stigma surrounding BC further complicate the situation, with many women expressing fear of seeking medical help due to societal perceptions. These findings are consistent with that of Lambert and Saeed who report that a combination of factors contribute to delayed care-seeking, such as lack of BC awareness, dependence on spiritual healing, reluctance to accept social support, stigmatization, avoidance of male doctors, financial limitations, fear, emotional distress and dissatisfaction with the healthcare system[37,39].

### Strengths and limitations

This is the first documented study examining knowledge of the signs and symptoms, risk factors associated with BC detection, practice on BSE and barriers to treatment among both men and women from rural and urban areas in Tanzania. Importantly, the findings may be applicable to other urban and rural regions within the country.

This study has also several limitations. First, its cross-sectional design limits the ability to draw causal inferences between knowledge, barriers, and breast self-examination (BSE) practices. Second, participants were recruited through purposive sampling at a single tertiary cancer center, which may limit representativeness, particularly for patients who do not access tertiary care or who reside outside the Kilimanjaro region. Although both rural and urban perspectives were included, the findings may not fully capture the diversity of breast cancer patients across Tanzania. Third, the reliance on self-administered questionnaires and face-to-face interviews introduces potential recall and social desirability bias, while the use of a single-item measure for BSE practice may not fully reflect actual behaviors. Furthermore, although the questionnaire was translated and back-translated, subtle cultural nuances in interpretation cannot be excluded. Finally, while the sample size was sufficient for statistical analysis, subgroup comparisons (e.g., by age, sex, or stage of disease) were constrained, and the small number of male patients restricts generalizability of findings to men with breast cancer. Taken together, these factors suggest that the results should be interpreted with caution and validated in larger, population-based studies.

### Practical recommendations and future research

This study underscores the need for the Ministry of Health to strengthen community awareness of breast cancer through targeted, culturally tailored education on BSE, its technique, and frequency, supported by national guidelines aligned with WHO and ACS standards. Training healthcare providers and ensuring consistent messaging are critical, while stronger implementation of Tanzania's National Cancer Control Strategy with dedicated resources and funding will further promote early detection. Future research should expand to diverse regions of Tanzania to capture regional variations in knowledge, cultural norms, and access barriers, providing evidence for more precise and context specific interventions. National level studies and longitudinal research are particularly important to assess changes in awareness and practices over time, as well as to evaluate the effectiveness of community workshops, media initiatives, and existing cancer control measures. Such evidence will inform sustainable strategies that enhance early detection, reduce late-stage presentation, and ultimately lower breast cancer mortality in Tanzania.

### Conclusion

This study highlights that participants possess limited knowledge about breast cancer, with more than half unaware of how to properly perform a breast self-examination (BSE) and BSE practice was infrequent done within our sample. Importantly, a significant association was observed between BSE knowledge and BSE practice, suggesting that increased knowledge of how and how often to perform BSE may encourage actual BSE, which can facilitate early detection and help reduce breast cancer-related morbidity and mortality. Unfortunately, the majority of the participants did not know the normal appearance or feel of the breasts, and there was generally limited understanding of risk factors, signs, and symptoms. Future research should therefore focus on examining variations in knowledge and practices across different regions and social demographic groups in the country in order to identify specific gaps and tailor interventions accordingly. Moreover, culturally, socially, and demographically appropriate educational interventions should be promoted to raise awareness about breast cancer and improve BSE practices among women in Tanzania.

### Data availability

The datasets generated and/or analyzed during the current study are not publicly available because open data sharing was not included in the informed consent form or the approved ethical protocol for the study. Addition-

ally, there are confidentiality concerns regarding detailed quantitative data. Even so, the data are available from the corresponding author upon reasonable request.

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## Author contributions

The authors made substantial contributions to the manuscript in the following ways:E.F.M contributed to the study conception. E.F.M., L.G., B.T.M and B.M contributed to the study design. E.F.M and B.T.M. contributed to material preparation. B.M and E.F.M. collected the data and E.F.M., B.M. and M.M performed the analyses. The first draft of the manuscript was written by E.F.M. and B.T.M., B.M., F.B., M.M., B.M., A. B., A.G., G.M., M.J., E.K. & E.F.M. commented on subsequent versions of the manuscript. B.T.M. and E.K acquired the funding. E.F.M, B.T.M and G.M were responsible for the resources. B.T.M supervised the study. All the authors have read and approved the final manuscript.

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## Declarations

### Competing interests

The authors declare no competing interests.

### Ethics approval

This study was performed in accordance with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University Kilimanjaro Christian Medical University College (KCMUCo) ethical review board (ref: 2425/Prop No. 1179, 2024), the National Review Board (ref: NIMR/HQ/R.8a/Vol./IX/3773,2024) and the President's Office, Regional Administration and Local Government of Tanzania (PO-RALG-ref: AB.307/223/01 dated 27 November 2024).

### Consent to participate

Informed consent was obtained from all individual participants included in this study, with assurances of their right to withdraw at any time, anonymity and data confidentiality were maintained. No identifiable participant information was included in the manuscript.

### Consent to publish

The authors affirm that the research participants provided informed consent with respect to publishing their data.

### Additional information

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**Correspondence** and requests for materials should be addressed to E.F.M.

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