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Assessing Pakistan's Readiness for a National Mammography Screening Guideline Five Years After Intervention

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Abstract:
Cancer, notably breast cancer, is a significant health concern globally, with a substantial burden in Asia, particularly in Pakistan. Late diagnosis exacerbates mortality rates, emphasizing the importance of robust screening programs. This article examines the effectiveness of breast cancer screening initiatives and interventions five years after an initial pilot study that spanned from 2015-2019, exploring trends in screening activity from 2020 to 2024, along with the use of current health guidelines and studies, and using data from the Islamabad Federal Breast Cancer Screening Centre to assess readiness for national guideline implementation in Pakistan and beyond. **Methods:** This retrospective cross-sectional study, conducted at the Federal Breast Cancer Screening Center (FBCSC), involved 7,454 patients undergoing mammography screening over a five-year period from 2020 to 2024. The study examined patients' data, including Breast Imaging Reporting and Data System (BIRADS) categories through double reading mammography and complementary ultrasound (USG) findings. Demographic information, including age, ethnicity, education status, socio-economic factors, breastfeeding history, breast density, and family history, was recorded to analyze its correlation with breast cancer diagnosis and subsequent management. Data analysis was performed using SPSS 2023. **Results:** The study included a total of 7,454 patients who visited the Federal Breast Cancer Screening Centre from 2020 to 2024. The mean age of patients attending screenings from 2020 to 2023 was 48.7 ± 9.50 years, with the most common age group being 41-45 years 1,364 (24.4%), followed by 41-45 years 1,939 (26.0%). **Conclusion:** This study found a significant rise in patient visits to the Federal Breast Cancer Screening Clinic from 2020 to 2024. Key predictors of breast cancer included age, marital status, breastfeeding history, socioeconomic status, and family history. No significant links were found with ethnicity or education.

Keywords: breast cancer; screening mammography; cancer prevention; healthcare

Introduction

Cancer accounts for the second leading cause of death among non-communicable diseases (NCD) [1], with 20 million new cases in year 2022 one half of cases(49.2%) reported and deaths(56.1%)worldwide occurring in Asia, where globally breast cancer accounted for 2.3 million of the cases after lung cancer and mortality of 665,684 [2-5]. According to Global Cancer Observatory (GLOBOCAN)

Pakistan 2022, a total of 229,488,996 individuals suffered from cancer, with 185,748 new cases and 118,631 deaths reported. Among these cases, breast cancer ranked first with 30,682 new cases (16.5%) and the highest mortality of 15,552 (13.1%), emerging as the most prevalent and significant contributor, surpassing lung cancer[6]. Breast cancer annually affects approximately

2.3 million women, with 675 million deaths with a pronounced surge observed in South Asia, intensifying the region's NCD burden[7].

While the incidence of breast cancer in Asia remains lower compared to Western countries, its proportional contribution to the global burden of breast cancer is swiftly escalating in the modern era, expected to increase up to 2 million by 2030[8]. In South Asia, particularly in Pakistan, the escalating incidence of non-communicable diseases has thrust breast cancer to the forefront of women's mortality, with one in every nine women facing a lifetime risk of diagnosis[9, 4]. Pakistan exhibits one of the highest agestandardized incidence rates of breast cancer among Asian nations. A comprehensive analysis of past and projected trends in age-specific breast cancer incidence among women in Karachi reveals a notable increase in breast cancer rates among postmenopausal women, particularly those aged 55 to 59. Simultaneously, a steady rise in incidence is projected among the youngest age group of women (15–29 years) in Karachi [10, 11]. Unfortunately, the country also witnesses a higher incidence of breast cancer-related deaths, largely due to delayed diagnosis and referral to appropriate healthcare facilities [10].

The World Health Organization (WHO) defines two strategies for cancer early detection: early diagnosis, which recognizes symptomatic cancer at an early stage, and screening, which identifies asymptomatic disease [12]. Early-stage diagnosis significantly improves prognosis, while delays and lack of treatment availability contribute to advanced stages and low survival rates of breast cancer [13]. Awareness of the disease plays a crucial role in early diagnosis, helping individuals avoid associated risk factors and adhere to screening guidelines, facilitating early detection. The United States Preventive Services Task Force recommends clinical breast examinations by a healthcare provider every three years for women aged 20–30 and annually for women aged 40 and above [14]. A study at Pakistan Institute of Medical Sciences evaluated breast cancer Knowledge, Attitude, and Practice (KAP) among 1000 women. Results showed that while 75% of women recognized the disease, only 32% understood the disease process and prevention methods. Only 19.6% had undergone mammography, and 78.8% did not know the correct age for screening. Awareness of breast self-examination (BSE) and clinical breast examination (CBE) was also low, with only

28.7% knowing about BSE and 30.3% aware of CBE. The findings highlight the need for improved educational programs on breast cancer prevention and screening in Pakistan[15]. The Breast Health Global Initiative (BHGI) Summit developed a universal patient pathway for breast cancer management, focusing on timely detection, diagnosis, and treatment across all resource settings. Despite resource challenges, low-income countries must prioritize equitable access to high-quality breast cancer care, using frameworks set by the WHO, BHGI, and the American College of Radiology (ACR) [12]. Despite significant advances, less than half of breast cancers are screen-detected, underscoring the need for improved early diagnostic strategies, particularly for patients under 40-45 years. Early diagnosis, even without mammographic screening, can downstage invasive cancer and improve outcomes. The ACR provides comprehensive breast cancer guidelines encompassing screening, diagnosis, and tailored care plans [16]. They advocate regular mammograms for average-risk women starting at age 40, while emphasizing personalized screening for higher-risk individuals. This includes breast Magnetic Resonance Imaging (MRI) for those with genetic predispositions or early chest radiation exposure. Women with Breast Cancer (BRCA) gene mutations should start MRI surveillance at ages 25 to 30 and can delay mammograms until age 40 if annual MRI is performed. Women diagnosed with breast cancer before age 50 or those with dense breasts should have annual supplemental MRI, and those with personal histories or atypia should consider MRI if other risk factors are present. Genetic predisposition, accounting for 5% to 10% of breast cancers, significantly increases risk, especially in BRCA mutation carriers [17-19].

Screening mammography can reduce mortality by over 40%, but higher-risk women often have dense breasts and more aggressive tumors, necessitating additional screening methods. The Breast Imaging Reporting and Data System (BIRADS®), developed by the American College of Radiology (ACR), standardizes breast pathology reporting from mammograms, ultrasounds also known as double reporting and MRIs to ensure consistent communication between radiologists and physicians. The 5th edition classifies breast density into (A) almost entirely fatty, (B) scattered areas of fibroglandular density, (C) heterogeneously dense (possibly obscuring small masses), and (D) extremely dense (reducing mammography sensitivity). BI-RADS assessment categories are: 0 (incomplete, needs further imaging), 1 (negative), 2 (benign), 3 (probably benign, <2% malignancy risk), 4 (suspicious, 2%-95% malignancy risk, subdivided into 4A, 4B, and 4C), 5 (highly suggestive of malignancy, >95% risk), and 6 (confirmed malignancy). This system aids in risk stratification and management recommendations [17, 19].

In Pakistan, breast cancer incidence and mortality rates are rising rapidly in resource-limited areas, due to a lack of awareness and screening. Screening programs and clinical services are neglected due to insufficient equipment, funds, and quality standards, with breast cancer occurring at a younger age compared to affluent nations [20]. Financial barriers further hinder access to screening, diagnosis, and treatment [19]. This highlights the need for improved screening facilities and financial support to ensure timely detection and treatment in resource-limited settings [20, 21, 4].

Published literature confirms a strong correlation between increasing age and breast cancer incidence, advocating for regular mammography screening. Factors such as family history, reproductive and estrogen-related factors, and modern lifestyles with excessive alcohol consumption significantly contribute to breast cancer development. Women with a family history of breast cancer are more prone to developing the disease. Reproductive factors like early menarche, late menopause, late age at first pregnancy, and low parity also increase breast cancer risk [11, 14].

According to the National Cancer Registry (NCR) of Pakistan report for 2015 to 2019, 21% of all cancers reported were breast cancer among both the male and female population above the age of 40 years. This pioneering effort by the NCR, uniting all cancer registries and datasets across Pakistan under the National Institute of Health (NIH), Islamabad, and led by the Pakistan Health Research Council (PHRC) and directed by the Ministry of National Health Services Regulations and Coordination, aims to comprehensively analyze cancer patterns, compile patient registries to be shared within hospitals at both the provincial and federal levels, make cancer a notifiable disease, and employ frameworks and set policies to tackle this looming epidemic [22].

Until a few years ago, no public breast cancer facility existed in the Islamabad Capital Territory of Pakistan. However, with the establishment of the Federal Breast Cancer Screening Center (FBCSC), Islamabad, rigorous awareness campaigns and screenings for women aged above 40 were initiated, alongside interventions employing a six-tiered approach to strengthen the healthcare system. According to the pilot study, the FBCSC provided services to 4,337 patients from 2015 to 2019, witnessing an annual increase in the number of women seeking screening, categorized based on their BIRADS classification [23].

Breast cancer stands as a leading cause of cancer mortality in low- and middle-income countries (LMICs), primarily due to delayed presentation and limited access to healthcare. While survival rates vary globally, Western Europe boasts higher rates owing to superior screening and treatment facilities. Over the past four decades, heightened awareness and timely mammography in affluent nations have significantly reduced mortality rates [9, 4, 24]. Late diagnosis of breast cancer severely restricts treatment options and outcomes. Key factors contributing to delayed diagnosis, as observed in low-income African women and replicated in

Pakistan, include low socioeconomic status and education, limited awareness of early detection methods, symptom dismissal, fear of disease and treatment, reliance on traditional remedies, financial constraints, and restricted healthcare access due to distance or lack of transportation [21, 4].

In LMICs, breast cancer often manifests as locally advanced breast cancer , comprising 4060% of cases at diagnosis. Clinical stage at diagnosis significantly impacts survival rates [10]. Evolving risk factors and disparities in accessing early detection and treatment contribute to this trend. Factors such as age, race, ethnicity, menarche history, breast characteristics, reproductive patterns, hormone use, breastfeeding history, dietary habits, and lifestyle choices play significant roles [25]. Socioeconomic status notably influences a patient's ability to address these factors and access diagnostic facilities promptly. There exists a clear association between socio-demographic and clinical indicators and delays in reaching diagnostic centers [26-27]. Low-income countries like Pakistan serve as compelling settings to observe these dynamics. This study utilized data from 2020 to 2023 to specifically examine how variables such as age, race, breast composition, breastfeeding history, socioeconomic status, and education status contributed to the escalating incidence of breast cancer in Pakistan. The investigation also scrutinized the subsequent management steps patients received post-diagnosis, aligning with the guidelines set by the American College of Radiology (ACR). The focus was particularly on understanding the efficacy of these measures within advanced facilities like the Federal Breast Cancer Screening Center. In Pakistan, implementing breast cancer screening and intervention guidelines from both the American College of Radiology (ACR) and the World Health Organization (WHO) is underway. However, due to diverse ethnicities, evolving lifestyles, limited local data, and rising incidence, simply increasing health financing isn't enough. It's crucial to allocate funds towards strengthening the healthcare system, focusing on how effectively resources translate into improved access to quality care and developing tailored guidelines for the Pakistani population [28]. While it may be challenging for many nations to adopt effective breast cancer screening and treatment policies from high-income countries, upper-middle-income countries (UMICs) have experienced increased rates of early detection and improved survival through combined efforts in early detection and adjuvant systemic therapy [10]. Guidelines for breast cancer screening and management serve as fundamental pillars in combating this disease, streamlining processes, and ensuring standardized, evidence-based approaches crucial for early detection and intervention. The Federal Breast Cancer

Material and Methods

Screening Centre, Islamabad stands as a beacon, championing adherence to such guidelines, offering accessible and quality breast cancer screening services in the region. The aim of this study is to evaluate breast cancer screening practices at a well-established center in Islamabad, Pakistan, and to explore trends in breast health services and breast cancer prevalence.The initial data recorded at the Federal Breast Cancer Screening Centre, Islamabad from 2015 to 2019, along with five additional years of data spanning from 2020 to 2024, provides a unique opportunity to evaluate Pakistan's preparedness for implementing a national guideline on breast cancer screening and management. This research also aims to utilize insights derived from four years of data analysis to examine various demographic characteristics, including age, ethnicity, education status, socioeconomic factors, breastfeeding history, breast density, and family medical history, and their association with breast cancer diagnosis and subsequent management. The study seeks to determine whether the accumulated data and experiences support the foundations blocks for development of a comprehensive national guideline aimed at improving screening, management, and treatment strategies, not only in Islamabad but also for the Pakistani population.

Study Setting and Data Sources: This is a retrospective cross sectional study performed at

Federal Breast Cancer Screening Center, Islamabad. It was conducted from January 2020 to December 2024, over a period of five years. Data was collected from examination of yearly screening mammography records and demographic information from patient history sheets that was maintained by authors about patients presenting in the breast center. Demographic data was collected, and BIRADS III lesions were followed up with ultrasound in 3-6 months, as per ACR guidelines for patients with a family history or after six months for others. FNAC was offered for suspicious lesions, while BIRADS IV and V patients underwent Tru Cut biopsies, with confirmed cases classified as BIRADS VI.

Study Sample and Examinations: A total of 7,454 adult women were included in the study through consecutive sampling. The study received ethical clearance from the Institutional Research & Ethics Committee (Ethical Review Board at Shaheed Zulfiqar Ali Bhutto Medical University), No.
F.1-1/2015/ERB/SZABMU/1047, dated 26.10.2022, ensuring that all procedures adhered to ethical standards. Women visiting the center for screening purposes were referred by their primary physicians and screened for enrollment, with informed verbal consent obtained prior to their participation. Mammography was performed using 2-D Mammography Hologic equipment, following strict standard protocols, with trained radiographers conducting the procedures using standard medio-lateral oblique and craniocaudal views bilaterally. Additionally, ultrasonographic findings were assessed using B-mode, color Doppler, and elastography with the Aplio 500 machine. The imaging results were categorized based on the BIRADS classification, with double reading radiology reports provided by both junior and senior consultants to ensure accuracy.

Statistical Analysis: Data were managed and analyzed using SPSS version 23.0, with descriptive analysis performed. The chi-square test was employed, with a p-value of less than 0.05 considered statistically significant. Additionally, a logistic regression model was fitted to the data, which showed a good fit. Odds ratios were calculated, and correlations were performed to further explore the relationships between sociodemographic factors and breast cancer.

Results

During 2020 to 2024, the center saw 7,454 patients visiting FBCSC (Table 1) In 2020, the COVID-19 lockdown led to suspended operations from April to July, resulting in only 679 (12.2%) women visiting for screening . January and February had the highest numbers, 110 (16.2%) and 132 (19.4%) of the annual total, respectively. Visits dropped to zero from April to July but gradually increased, peaking in October at 161 (23.7%).

MONTH * YEAR Crosstabulation

Count

	YEAR					Total
	2020	2021	2022	2023	2024	
APRIL	0	45	118	107	112	382
AUGUST	28	114	174	158	157	631
DECEMBER	21	161	147	164	184	677

FEBRUARY	132	50	140	170	143	635
JANUARY	110	29	149	141	169	598
JULY	0	76	115	135	141	467
JUNE	0	113	144	139	120	516
MARCH	61	47	137	126	133	504
MAY	0	34	134	147	150	465
NOVEMBER	78	217	185	200	195	875
OCTOBER	161	174	233	237	214	1019
SEPTEMBER	88	124	166	151	156	685
Total	679	1184	1842	1875	1874	7454

Table 1 Annual and Month wise visitations for Breast Cancer Screening

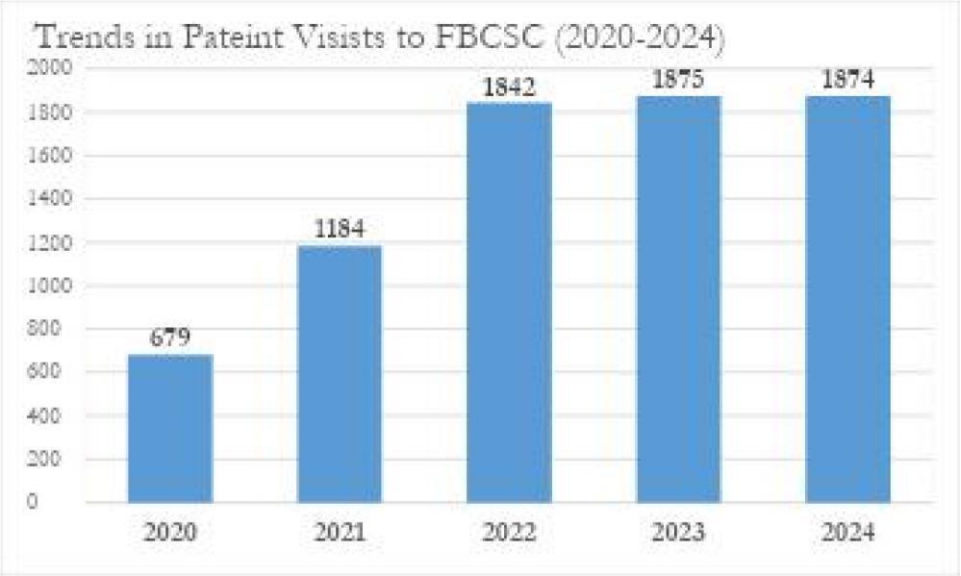

Figure 1 Trends in patient visits to FBCSC (2020-2023).

In 2021, a notable shift occurred where 1,184 (21.2%) women participated, as shown in Figure 1. The year began with lower numbers in January and February, representing 29 (2.5%) and 50 (4.2%) of the annual total, respectively. Summer months, particularly June and August, saw increased activity, with 113 (9.5%) and 114 (9.6%) of the year's total. The highest visitation occurred in November, comprising 217 (18.3%) of the annual total.

In 2022, participation further increased to 1,842 (33.0%) women. Monthly visits were more evenly distributed, with January, February, and March accounting for 149 (8.1%), 140 (7.6%), and 137 (7.4%) of the annual total, respectively. The autumn months experienced the highest visitation rates, particularly October with 233 (12.6%) of the total visits, followed by November with 185 (10.0%) visits.

By the end of 2023, participation reached 1,875 (33.6%) women. The highest visitation occurred in October, compared to 2023, with only a marginal decrease from 1,875 to 1,874 visits. Notable increases were observed during the winter months, particularly in January (169 visits), February (143 visits), and December (184 visits), suggesting a seasonal rise in patient influx. In contrast, a slight decline was recorded in June (120 visits) and July (141 visits), potentially reflecting seasonal fluctuations in patient volume. Overall, the data indicates an increasing trend of patient visits to the FBCSC, post lockdown from 2020 to

2024, highlighting the center's critical role in screening mammography intervention, as depicted by Figure

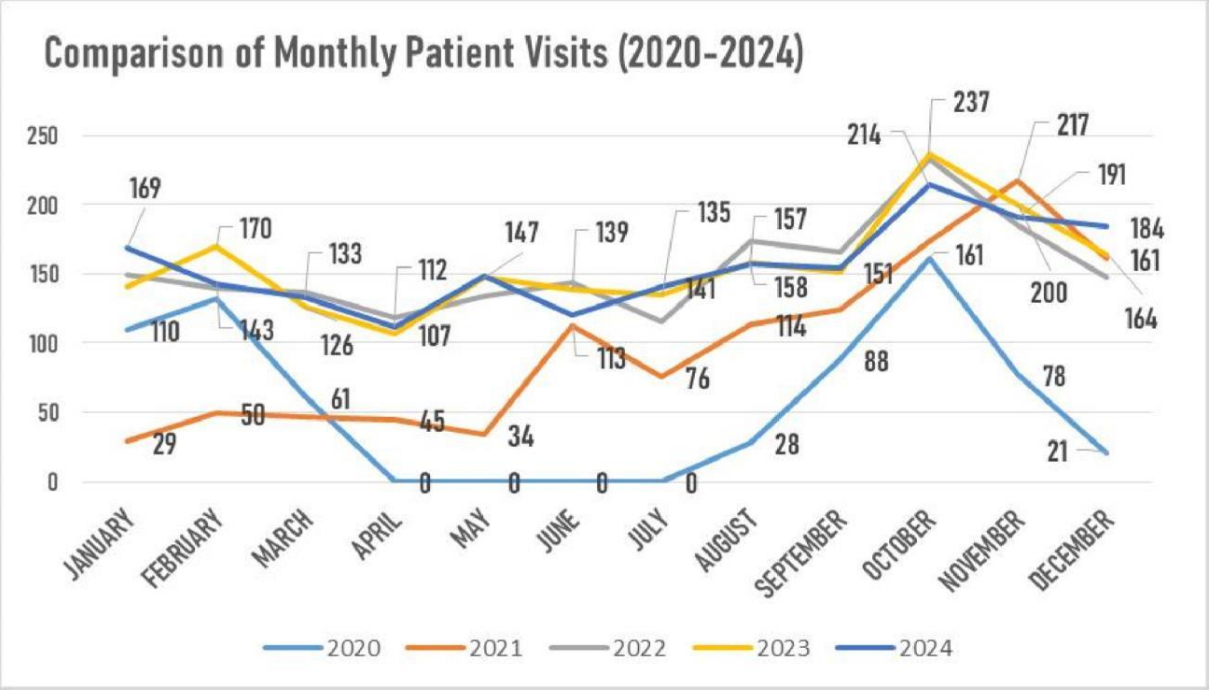

Figure 2 Comparison of monthly patient visits from 2020-2024.

This figure illustrates the monthly number of patient visits over four years, revealing fluctuations in patient traffic. Notably, visits were significantly lower in 2020, particularly during the pandemic's peak, before showing a gradual increase in subsequent years, with peaks observed in October 2022 (237 visits) and consistent activity through 2021 to 2024. These trends highlight the recovery of patient visitation numbers following initial pandemic disruptions.

Demographic characteristics of patients visiting for screening mammography, demonstrates the mean age of patients attending screenings from 2020 to 2024 was 48.78 ± 9.50 years, with the most common age group being 41-45 years 1,939 (26.0%), followed by 46-50 years 1,424 (19.1%). The ethnicity with the highest frequency was Punjabi 5,883 (79.2%) , followed by Pukhtoon patients 744 (10.0 %) and other ethnicities such as Gilgiti patients 148 (2.0 %) . When observing marital status, the majority of patients were married 7,207 (97.1%), with less than half of marriages being consanguineous 2,979 (40.1%). Most patients had a positive breastfeeding history 6,432 (86.6%). The socio-economic status of patients was observed as: lower 2,125 (28.6%), middle 5,213 (70.2%), and upper 84 (1.1%). The majority of patients received no formal education 2,747 (37.0%), followed by those with secondary education 2,203 (29.7 %), and 778 (10.4 %) completing an undergraduate degree.

The BIRADS category with the highest frequency was BIRADS I 2,538 (34.0%), followed by BIRADS II 2,375 (31.9%). Those screened for suspicion of malignancy included BIRADS V 526 (7.1%) and biopsyproven breast cancer BIRADS VI 168 (2.3%). When observing breast densities, Type B breast density was the most common, found in 3,584 (48.1%) of right breasts and 3,556 (47.7%) of left breasts. Type A density followed with 1,340 (18.0%) in right breasts and 1,336 (17.9%) in left breasts, while Type C and Type D densities were less prevalent. A minimal number of patients had implants or underwent modified radical mastectomy (MRM). Mammography was not performed in 12 cases (0.20%) on the right, and 7 cases (0.1%) on the left, likely because the prescribing doctor requested mammography only for the affected breast. Regarding the trend in the number of visits for breast screening, most of the patients

were first-time visitors 6,097 (82.1%), followed by second-time visitors 1,217 (16.4%), while third-time visitors made up 93 (1.3%) of the total. When observing signs and symptoms, patients presented with pain in the breasts 4,776 (64.1%), mass in the breasts 3,552 (47.7%), and nipple discharge 569 (7.6%). Breast cancer was diagnosed based on biopsy reports, where invasive breast cancer accounted for 780 (10.5%) patients , followed by cases suspicious for malignancy, 473 patients (6.4%), and benign breast disease, 468 (6.3 %) patients . Hence, the prevalence rate of invasive breast cancer during these four years was 10.46%. Among those who reported receiving treatment for breast cancer, 181 (2.4%) received chemotherapy, 332 (4.5%) received both chemotherapy and radiotherapy, and 6 (0.1%) received radiotherapy alone. Among those with a surgical history, 340 (4.6%) had a biopsy, and 144 (1.9%) had Fine Needle Aspiration Cytology (FNAC). Additionally, 227 (3.1%) underwent left MRM, 198 (2.7%) had a right MRM, and 247 (3.3%) had lumpectomies. Patients with history of other cancers were 29 (0.39%). A notable portion of patients, 1,112 (15.0%), reported a positive family history of breast cancer. Among those with a positive family history of breast cancer, the most common relations included sister 265 (3.6%), mother 257 (3.5%), and maternal aunt 194 (2.6%). This study identified significant associations between various demographic and clinical characteristics as well as breast cancer diagnosis. Age was strongly associated with breast cancer, particularly in older age groups. Among 238 patients aged 70+, 156 (65.5%) were diagnosed with breast cancer, yielding a chisquare test statistic of 163.793, with 9 degrees of freedom (df), and a p-value of <0.001. The Spearman correlation coefficient (ρ) was 0.104, indicating a weak but statistically significant positive correlation between age and breast cancer diagnosis.

Marital status also showed significant associations, with 1,340 married individuals, of whom 452 (33.7%) were diagnosed with breast cancer. This resulted in a chi-square value of 21.551, 1 df, and a p-value of <0.001.

Breastfeeding was protective against breast cancer. Among 803 women who breastfed, 287 (35.7%) were diagnosed with breast cancer, compared to 171 (48.3%) of 354 women who did not breastfeed.

The chi-square test yielded a value of 12.473, 1 df, and a p-value of <0.001.

Socioeconomic status demonstrated a protective effect, particularly in the upper socioeconomic group. Out of 654 women in this group, 93 (14.2%) were diagnosed with breast cancer. The chi-square value was 16.533, with 2 df and a p-value of <0.001.

Mammogram history emerged as a strong predictor of breast cancer, with 1,152 women having had at least one mammogram, of whom 517 (44.9%) were diagnosed with breast cancer. The chi-square value was significant ($\chi^2 = 592.983$, 3 df, $p < 0.001$) with a moderate effect size (Cramer's V = 0.326).

Family history was critical, with 278 women reporting a maternal history of breast cancer, among whom 155 (55.8%) were diagnosed. The chi-square value for this association was 8.833, 1 df, and a p-value of 0.003. Higher odds ratios were also found for maternal and paternal grandmothers.

Breast density showed significant associations with breast cancer, as 65.3% of the 274 women with high breast density were diagnosed with breast cancer. This association yielded a chi-square value of 51.174,

2 df, and a p-value of <0.001, with Cramer's V = 0.315 indicating a moderate effect size.

Regarding symptoms, 73.5% of women presenting with a breast mass (256 of 348) were diagnosed with breast cancer, with a chi-square value of 67.463, 1 df, and a p-value of <0.001. The absence of pain and nipple discharge showed weaker but still significant associations.

Conversely, ethnicity ($\chi^2 = 5.481$, $p = 0.360$), consanguineous marriage ($\chi^2 = 2.254$, $p = 0.133$), and education status ($\chi^2 = 5.116$, $p = 0.402$) did not show significant links to breast cancer, indicating that these variables are less predictive of breast cancer risk in this dataset.

To evaluate the relationship between various predictor variables and the likelihood of breast cancer diagnosis, a binary logistic regression analysis was conducted using SPSS. The model aimed to identify significant predictors of breast cancer and estimate their impact on the odds of diagnosis. The dependent variable in the model was the binary outcome of breast cancer diagnosis, which included those with BIRADS V and VI labeled as diagnosed and those with lesser BIRADS category labeled as not diagnosed with breast cancer (coded as 0 = not diagnosed 1 = diagnosed,). Independent variables included age groups, ethnicity, marital status, consanguineous marriage, breastfeeding history, socioeconomic status, educational attainment, and previous history of other cancers. The Omnibus Tests of Model Coefficients yielded a chi-square value of 2796.919 ($df = 20$, $p < 0.001$), indicating that the predictor variables collectively have a meaningful impact on the outcome variable. The logistic regression model was statistically significant, as indicated by the Omnibus Tests of Model Coefficients (Chi-square = 2799.823,, $df = 20$, $p < 0.001$), suggesting that the predictors collectively contribute to the model. The model's -2 Log Likelihood was 1675.054, and it explained a substantial amount of variance in the outcome variable, with a Cox & Snell R^2 of 0.394 and a Nagelkerke R^2 of 0.715. The Hosmer and Lemeshow Test (Chi-square =
13.552, $df = 8$, $p = 0.094$) indicated a good fit of the model to the data, with a p-value greater than 0.05. The classification table showed that the model correctly classified 96.2% of cases overall, with a high accuracy for 'NO' cases (99.9%) but lower accuracy for 'YES' cases (73.0%).

The regression coefficients revealed several significant predictors of breast cancer diagnosis. Age groups, particularly 31-35 ($p = 0.002$), 36-40 ($p = 0.037$), 41-45 ($p = 0.001$), 46-50 ($p = 0.005$), and 51-55 ($p = 0.074$), showed significant effects. Consanguineous marriage was associated with decreased odds of breast cancer diagnosis ($B = -0.497$, $p = 0.001$), while breastfeeding increased the odds ($B = 0.515$, $p = 0.009$). Lower socioeconomic status ($B = 1.564$ for LOWER, 1.150 for MIDDLE, $p = 0.017$) and lower educational attainment ($p = 0.021$ for no formal education, $p = 0.007$ for an undergraduate degree) were also significant predictors.

Discussion:

This study was conducted to evaluate breast cancer screening practices at a well-established center in Islamabad, Pakistan, and to explore trends in breast health services and breast cancer prevalence. The findings revealed significant variations in patient visits based on demographic factors such as age, education, marital status, ethnicity, and family history of breast cancer. The observed trends emphasize the importance of tailored interventions to enhance screening participation and early detection.

One of the key findings of this study is the significant fluctuation in breast cancer cases from 2020 to 2024. The number of cases rose steadily from 9.1% in 2020 to 25.1% in 2024, with a moderate standard deviation indicating variability in annual case distribution. The initial decline in screening visits in 2020 aligns with global trends observed during the COVID-19 pandemic, where lockdowns and healthcare service disruptions led to reduced screening rates [29]. However, the recovery in visitor numbers by 2024 highlights the resilience of the healthcare system and the effectiveness of public health campaigns in restoring screening activities post-pandemic. This recovery mirrors global trends, where screening activities resumed to catch up on missed cases [30].

The demographic analysis revealed that middle-aged women, particularly those between 41-50 years, are the most engaged in breast cancer screening. This is consistent with existing literature, which shows that this age group is at a higher risk for breast cancer and is more likely to participate in screening programs [31]. The data also highlights the ethnic diversity of the patient population, with a predominance of Punjabi individuals (79.2 %) and lower representation from other ethnic groups, underscoring the need for targeted outreach efforts to

ensure equitable access to screening services. Previous systematic literature highlights the multiple barriers faced by different ethnicities and low-income groups, which affect their participation in breast cancer screening [32].

Socio-economic analysis showed that 70.2% of patients came from middle-class backgrounds, with a standard deviation of 0.012, indicating moderate variability. This finding is consistent with existing research demonstrating socio-economic disparities in breast cancer screening participation. According to a study conducted in Punjab, Pakistan which explored fears and barriers towards seeking breast health services, the majority of interviewed patients were from lower socio-economic backgrounds and faced significant barriers to breast cancer treatment due to high costs and minimal government support, leading many to delay treatment and hide their pain [33]. Additionally, the educational status analysis revealed that 37.0% of patients were uneducated, with a higher standard deviation of 0.089, reflecting a broad spectrum of educational backgrounds. This variability may influence patient outreach and education strategies, suggesting a need for targeted educational interventions to improve screening uptake among less-educated populations [34-35, 27]. A study at Pakistan Institute of Medical Sciences evaluated breast cancer Knowledge, Attitude, and Practice (KAP) among 1000 women. Results showed that while 75% of women recognized the disease, only 32% understood the disease process and prevention methods. Only 19.6% had undergone mammography, and 78.8% did not know the correct age for screening. Awareness of Breast Self-Examination (BSE) and Clinical Breast Examination (CBE) was also low, with only 28.7% knowing about BSE and 30.3% being aware of CBE. The findings in this study exhibited lower screening rates among less-educated populations, suggesting that socio-economic disparities and educational differences significantly impact access to and utilization of breast cancer screening services. This demonstrates the need for targeted educational interventions to raise awareness and improve screening uptake [29].

Family history and BIRADS classification provided additional insights into the screening population. The majority of participants did not have a family history of breast cancer, yet they still utilized screening services, highlighting the role of current awareness campaigns in early detection for the broader population. The distribution of BIRADS categories demonstrated that a significant portion of patients had benign conditions, while a smaller percentage exhibited high suspicion for malignancy, underscoring the utility of mammographic screening in identifying a range of breast conditions.

The analysis of treatment and surgical histories revealed a preference for non-invasive management strategies, particularly for early-stage breast cancer. This trend is consistent with global shifts towards less aggressive treatment options when early detection is achieved, emphasizing the importance of timely screening [31].

Limitations: This study has several limitations that should be acknowledged. First, it is based on data from a single center in Islamabad, which may limit the generalizability of the findings to other regions of Pakistan or to other countries with different healthcare infrastructures. Second, the study's retrospective design may introduce biases related to incomplete or inaccurate data recording. Third, the reliance on self-reported demographic and clinical information may lead to reporting biases, particularly in areas such as family history and socio-economic status. Fourth, the study did not account for other potential confounding factors such as lifestyle, environmental exposures, or genetic predispositions, which may influence breast cancer risk and screening behavior. Lastly, the impact of the COVID-19 pandemic on healthcare access and patient behavior may have introduced additional variability that is difficult to fully quantify.

Conclusion:

This retrospective study examined data from 7,454 patients at the Federal Breast Cancer Screening Center (FBCSC) in Islamabad, Pakistan, from 2020 to 2024. Patient visits

significantly increased, particularly in 2021, with sustained growth through 2022-2024, reflecting the landscape five years after the implementation of screening mammography interventions that began in 2015.

Our analysis revealed significant variations in breast cancer incidence based on demographic factors, including age, marital status, breastfeeding history, socioeconomic status, and family history. Breastfeeding and higher education were linked to reduced breast cancer odds, while lower socioeconomic status increased them. A history of breast cancer emerged as the strongest predictor, with individuals lacking formal education facing notably higher odds of diagnosis. However, no significant associations were found with ethnicity, consanguineous marriage, or prior cancer history.

Significant correlations were established between BIRADS categories, breast density, and symptoms like pain, mass, and nipple discharge in relation to breast cancer diagnosis. Binary logistic regression identified key predictors, including age, consanguineous marriage, breastfeeding, socioeconomic status, and educational attainment.

In conclusion, this study explores the state of breast cancer screening in Islamabad, Pakistan, and highlights the need for ongoing research and data collection to inform policy decisions and refine screening programs. This will require collaboration between healthcare providers, policymakers, and community stakeholders to improve health outcomes for all individuals affected by this disease in Pakistan.

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