RESEARCH ARTICLE

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Analysing Breast Cancer Screening Trends in Rural Saudi Arabia: Vision 2030 Context

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Abstract

Introduction: Breast cancer ranks among the most prevalent cancers in Saudi Arabia. Despite this, screening rates are lower compared to other countries, especially in rural regions. Aim: To investigate the effect of the NHSTP on breast cancer screening and diagnosis among women attending healthcare clinics in Bisha, a rural area of Saudi Arabia. **Methods:** This study was a retrospective analysis of 2023 data retrieved from the Bisha Health Directorate and the breast cancer screening dashboard at the Ministry of Health (MOH) for both the Bisha region and national-level data. A frequency analysis for breast cancer screening and diagnosis in women attending healthcare clinics in Bisha was performed. Historical data from 2017-2023 were analyzed to compare pre- and post-NHSTP implementation periods. Secondary data on screening facilities, infrastructure improvements, and national screening benchmarks in the Bisha region were also analyzed. **Results:** In 2023, the Bisha health cluster had a monthly breast cancer screening goal of 668 women and a total of 8016 women for the calendar year. Aggregated services were provided to 7101 women, resulting in a coverage rate of 88.6% in 2023 compared to the annual goal. This is a significant increase from 2022, during which 3212 women were screened in the Bisha region. The number of diagnosed breast cancer cases increased from 45 in 2022 to 88 in 2023, though the prevalence of diagnosed cases decreased from 1.4% to 1.2% as screening expanded to include more lower-risk women. Infrastructure improvements included an increase from 3 to 6 mammography devices between 2021 and 2023. **Conclusion:** Substantial growth in breast cancer screening and early diagnosis has been observed in Bisha, Saudi Arabia. A rising trend in the proportion of women utilizing breast cancer screening services, following the establishment of new facilities, was observed in the Bisha region after the implementation of the NHSTP.

Keywords: Saudi Arabia- Breast Cancer Screening- Breast cancer prevalence- Saudi Vision 2030- Mammography

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Introduction

Breast cancer is a major global health issue; it is the most prevalent cancer among women and the second most common cancer in the general population worldwide [1]. Breast cancer has been linked to an estimated 685,000 deaths worldwide in 2020 alone [2]. Breast cancer can occur due to several risk factors, including family history or genetic predisposition; environmental risk factors [3]; hormonal exposure, such as early menarche and late menopause [4, 5]; fewer children; nulliparity; late age at first birth [6]; lack of breastfeeding, and prolonged use of hormone replacement therapy (HRT) [7].

Early diagnosis is crucial for early intervention [8]. Breast cancer screening and self-examination are important for early breast cancer detection [9]; access to early screening can assist in the early diagnosis of breast cancer. Early diagnosis of breast cancer has been linked to improved survival rates and reduced treatment costs [10]. Mammography is a highly effective method for screening women aged 40 and older to reduce the number of breast cancer-related fatalities [11, 12]. Nevertheless, it is imperative to acknowledge the potential adverse consequences of the procedure, including the emotional toll it may have on women and their apprehensions regarding the outcome. Due to these apprehensions, the importance of breast cancer screening is sometimes overlooked [13].

One of the countries seeking to improve access to breast cancer screening services is Saudi Arabia. Saudi Arabia is similar to other countries, with breast cancer ranking among the most prevalent cancers among Saudi women [14]. In Saudi Arabia, the aggregate population lifetime incidence rate of breast cancer was 14.8% in 2018, with a mortality rate of 8.5% in 2018 [15]. The primary risk factors for breast cancer in Saudi Arabia are age, genetic makeup, and family history [16]. However, a key limitation to improved outcomes within Saudi Arabia

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has been poor access to health care, particularly for rural populations.

In 2016, Saudi Arabia launched its reformation plan, Vision 2030, with the primary objective of improving access to healthcare for all residents. As part of the Vision 2030 plan, the government initiated a National Health Sector Transformation Program (NHSTP) to transform healthcare in Saudi Arabia. A strategic objective of NHSTP is to systematically restructure the healthcare sector over two phases from 2021 to 2030, each spanning five years [17]. Additionally, Vision 2030 seeks to promote the decentralisation of healthcare systems by empowering rural health clusters [18]. Health clusters were introduced by the Saudi government in 2022 and are integrated networks working under one administrative structure and focused on holistic, preventive care rather than curative approaches.

This overarching reformation program includes providing a new model of care (MOC) that focuses on a comprehensive and strategic approach to improving multiple aspects of the healthcare sector nationwide. Breast cancer screening and prevention form a strategic part of this MOC, delivering essential primary health care. As part of this MOC, improved provision of breast cancer screening services to rural regions is also a critical objective to strengthen health care provision throughout Saudi Arabia, thus providing screening programs that can identify individuals potentially at risk and provide early detection of breast cancer [19].

Historically, disparities between rural and urban populations have been recorded in terms of breast cancer screening, diagnosis, prevention, and available treatment services in Saudi Arabia [20, 21]. There is also a dearth of national data on the pooled prevalence of breast cancer in rural regions of Saudi Arabia [20]. These differences have been reported even in developed countries like the United States [22], and several initiatives have been undertaken to understand the factors that underlie these disparities so that they can be addressed [23-25]. However, there has been a dearth of knowledge to date that evaluates the differences between breast cancer screening services in rural Saudi Arabia in contrast to urban facilities for breast cancer screening across the country.

This study aims to investigate the effect of the NHSTP on breast cancer screening among women attending healthcare clinics in a rural area of Saudi Arabia, focusing on a rural region called Bisha. The Bisha Health Directorate, part of the Saudi government in charge of healthcare facilities in the Asir Province, is acknowledged as a rural region of Saudi Arabia. The population of this directorate was 199,613 individuals in 2007 and has increased to 388,055 individuals in 2017 [26]. There are 14 Ministry of Health (MOH) healthcare centres in this region, and breast cancer screening services using mammograms are primarily sourced by the Roshan Mall Clinic Healthcare Centre in this region [27].

Materials and Methods

Study Design

This study investigated the frequency of breast cancer screening and diagnosis in women attending healthcare clinics in the Bisha region, located in rural Saudi Arabia. The data were collected from multiple sources including the Bisha Health Directorate, MOH national dashboard, and infrastructure records before and after service changes under the NHSTP. This retrospective analysis included both regional and national comparison data spanning from 2017-2023.

Ethics Approval

The Human Research Ethics Committees (HRECs) and the Institutional Review Board from the University of Bisha in Saudi Arabia provided ethics approval to conduct this study (UB-RELOC H-06-BH-087/1302.24). Ratification was also achieved from the University of Queensland in Australia (2024/HE001171).

Participants

The study includes aggregate data of women who have undergone screening for breast cancer at the MOH facilities located in the Bisha region. Eligible women were aged between 40 and 69 years, younger women with a personal history of breast anomalies, family history of breast cancer, and/or positive for known genetic risk variants such as BRCA1 and BRCA2 (Heisey & Carroll, 2016). Residents of the Bisha region who underwent screening in centres outside the Bisha region were excluded from this study.

Data Collection

This study collected multiple types of data to comprehensively evaluate breast cancer screening in the Bisha region:

1. National comparison data: National screening rates for 2023 were obtained from the breast cancer screening dashboard at the MOH for all 22 health directorates in Saudi Arabia to provide benchmarking context for Bisha's performance.

2. Bisha screening and diagnosis data: Comprehensive frequency data of breast cancer screening and diagnosis in the Bisha region were retrieved from the breast cancer screening dashboard at the MOH from January to December 2023 for all women who underwent mammography. This included:

* Number of women screened monthly and annually
* Number of women referred for screening by healthcare professionals
* Number of positive breast cancer diagnoses
* Monthly and annual screening targets set by MOH for the Bisha region
* Coverage rates compared to established targets
* Diagnosis rates and prevalence calculations

3. Historical Bisha data: Longitudinal data from 2017-2023 were obtained from the Bisha Health Directorate to compare screening and diagnosis rates in both the pre-NHSTP implementation period (2017-2021) and post-implementation era (2022-2023). This historical analysis included:

*Annual screening numbers

*Annual diagnosis numbers
*Calculated prevalence rates over time

4. Infrastructure and capacity data: Information on healthcare infrastructure improvements was collected from Bisha Health Directorate records, including:
*Number and distribution of mammography devices in the region
*Number of screening facilities and clinics
*Staffing changes and capacity improvements
*Timeline of infrastructure developments under NHSTP

5. Referral and awareness data: Additional data describing the pathways to screening were collected when available, including:
*Reasons for screening (healthcare provider recommendation, self-referral, family recommendation)
*Referral patterns and follow-up rates
*Information about public awareness campaigns and their impact

Data Analysis

Data were extracted from dashboards and administrative records, then compiled into a Microsoft Excel spreadsheet. The recorded data underwent a process of validation and cleaning to ensure accuracy and completeness. The final cleaned data were analyzed using SPSS v.29 (IBM Corp.). Descriptive statistics were calculated including frequencies, percentages, and coverage rates. Comparative analysis was performed between pre- and post-NHSTP periods, and between Bisha regional data and national benchmarks. The tables and figures depict the distribution of categorical variables in both numerical and percentage formats, with trend analysis over the study period.

Results

Annual Breast Cancer Screening and Diagnosis across the Bisha Region: 2017–2023

Table 1 shows a nine-fold increase in the screening frequency and a 3-fold increase in detected cases between 2017 and 2023 in Bisha. Between 2017 and 2021, a smaller increase was observed in the number of screened cases (an estimated 70%), with the first major increase observed from 2021 to 2022. Notably, the number of diagnosed cases substantially increased between 2022 and 2023, along with the increase in screened cases.

Analysis of Diagnosis Trends: The diagnosis data reveals important patterns in detection rates over time. While the absolute number of diagnosed breast cancer cases increased consistently from 29 cases in 2017 to 88 cases in 2023, the prevalence rate (percentage of screened women with positive diagnoses) showed a declining trend. The prevalence decreased from 3.6% in 2017 to 1.2% in 2023. This pattern suggests that as screening expanded under the NHSTP, the program successfully reached lower-risk populations who were previously unscreened, resulting in a larger denominator of screened women but a lower overall detection rate.

Infrastructure Improvements and Their Impact

The expansion of screening infrastructure played a crucial role in the observed increases. During the first four years of this study's observation period (2017-2021), only three mammography devices were available at the Bisha Directorate, distributed among two hospitals. Following the implementation of the NHSTP in 2022, three additional machines were made available in three other regional facilities, doubling the available capacity.

Coverage Analysis Against Targets

In 2023, the Bisha health cluster operated with specific performance targets: a monthly breast cancer screening goal of 668 women and an annual target of 8,016 women. The region achieved coverage of 7,101 women, resulting in an 88.6% coverage rate against the annual goal. This represents a substantial improvement in both absolute numbers and target achievement compared to previous years when no formal targets existed.

Comparison with National Performance

The national data analysis provides important context for Bisha's performance. Across all 22 health directorates in Saudi Arabia in 2023, approximately 200,000 women met the criteria for breast cancer screening, with 160,675 women actually screened, resulting in an 80% national coverage rate. The mean annual target across directorates was 9,090 screenings per directorate. Bisha's target of 8,016 was slightly below the national average, reflecting its rural and smaller population base, but its achievement rate of 88.6% exceeded the national average of 80%.

Breast Cancer Screening in Bisha Region: January-December 2023

Figure 1 represents the frequency of breast cancer screening each month during 2023 compared to the women referred for screening. In 2023, the Bisha health

Table 1. Prevalence of Breast Cancer Cases Screened and Diagnosed in Bisha

Year	No. of screened cases	No. cases (diagnosed)	Prevalence of diagnosed cases (%)
2017	810	29	3.6
2018	1180	33	2.8
2019	1250	36	2.9
2021*	1380	39	2.8
2022	3212	45	1.4
2023	7101	88	1.2

*The data for 2020 is missing due to the COVID-19 pandemic

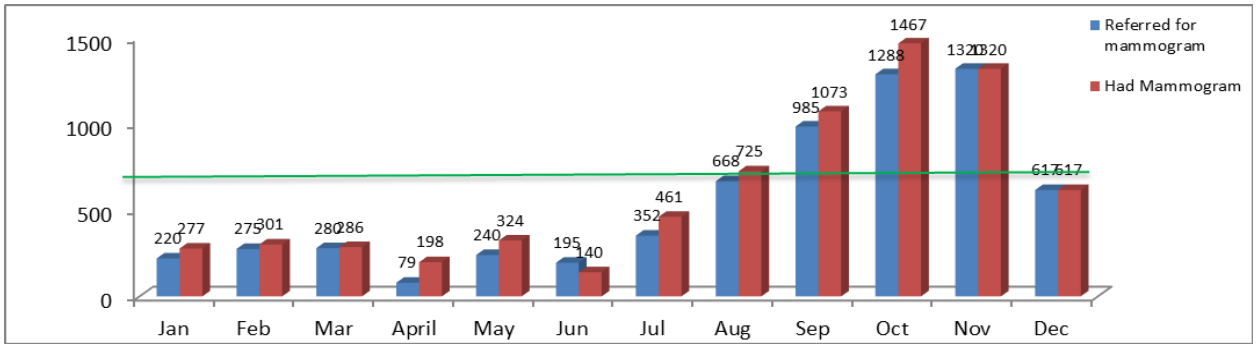

Figure 1. Breast Cancer Screening Frequencies for Each Month of 2023 in the Bisha Region. The green line represents the monthly target. The Red bars (▬) represent women who had mammograms in Bisha, and the Blue bars (▬) represent women referred for mammography (cluster data). (Source: MOH)

cluster had a monthly breast cancer screening goal of 668 women and a total of 8016 women across the calendar year. Aggregated services were provided to 7101 women, resulting in a coverage rate of 88.6% in 2023 compared to the annual goal. The increased frequency of screenings can be attributed to the stringent NHSTP implementation in Bisha, which was fully initiated by August 2023.

From January to July, monthly screening rates were well below the target. In contrast, monthly rates rose above the target from September to November 2023. Although the facilities were established earlier, their use was maximized post-July 2023. The hike in health practitioners' staffing with dual shifts in breast cancer screening can also contribute to this screening spike. In short, a combination of awareness and capacity building led to a sharp increase in breast cancer screening. Therefore, infrastructure, trained staff, and public awareness are necessary.

The number of women who underwent screening was higher than the number referred by the healthcare professionals. This can be attributed to the increased awareness about the risk of breast cancer due to family history, age, or other risk factors among the masses. However, as shown in Figure 1, the number of women who underwent screening during June 2023 was lower than the number of women referred. This signifies that all the women referred for breast cancer screening might not actually undergo screening.

Other observations relating to the expanded breast cancer screening services in the Bisha Region

During the first four years of this study's observation period (2017-2023), only three mammogram devices were available at the Bisha Directorate, distributed among two hospitals. However, starting in 2022, following the implementation of the NHSTP, three additional machines were made available in three other regional facilities.

Illustrating the expanded availability of breast cancer screening services, in 2022, only 4% of women aged 40–69 years were screened for breast cancer. However, with the introduction of the MOC and subsequent breast cancer screening services using mammograms in 2023, this quadrupled (n = 7101) to 16% of the women in the targeted age group. In 2024, a 0.5% increase each quarter is noted for their screening goals, thus further expanding availability to the target population.

Critically, the number of diagnosed cases of breast cancer approximately tripled from 29 in 2017 to 88 in 2023 (Table 1), representing a large number of women likely to have better long-term health outcomes from treatment

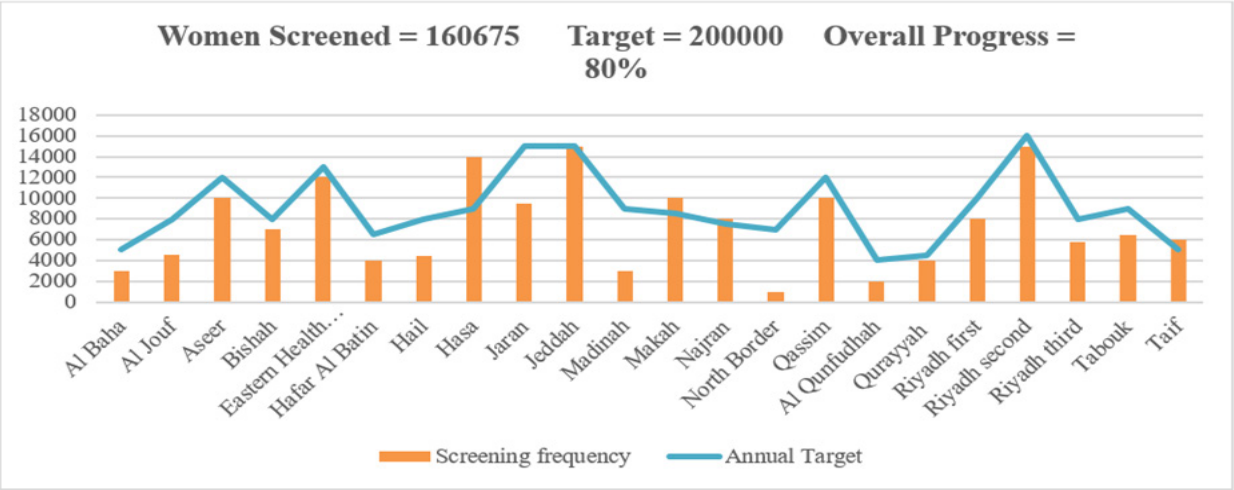

Figure 2. Number of Women who had Mammograms Compared with the Actual Target Number Across the Health Directorates in Saudi Arabia in 2023

following their diagnosis. However, it is also notable that the incidence rate of diagnosed cases tended to decrease as the number of screened cases increased (Table 1). From 2022–2023, the prevalence of diagnosed cases dropped to a mean of 1.3% compared with 3.6% in 20217, while the number of screened cases continued to rise steadily over these six years. This suggests that more lower-risk women were now being screened in 2022-23 as part of this service expansion.

An Overview of Breast Cancer Screening in Saudi Arabia: 2023

The data collected from all 22 health directorates in Saudi Arabia for 2023 showed that approximately 200,000 women met the criteria for breast cancer screening. A total of 160,675 women were screened, resulting in an 80% coverage of the targeted number of women. The mean annual target across the 22 health directorates in Saudi Arabia was 9,090 breast cancer screenings in 2023 per directorate. This target is determined by the MOH and sent to each directorate or cluster based on the city's population.

In the Saudi Kingdom, the Riyadh second cluster and the Jeddah health directorate were pioneers in conducting mammogram screenings for breast cancer, recording the highest number of screenings. The Riyadh second health cluster aimed to screen 16,000 women for breast cancer, which represented 8% of the country's total target for breast cancer screenings. However, almost 15,000 women received the service, resulting in a coverage rate of 94% annually. Similarly, the Jeddah directorate provided almost 100% breast cancer screening services, as depicted in Figure 2. The Northern Border Health Directorate had the lowest number of women screened for breast cancer, with approximately 400 women accounting for just 0.6% of its annual target of 7,000 mammograms.

Discussion

The Saudi Arabian government launched the NSTP in 2016 to achieve the objectives enumerated in the Kingdom's Vision 2030 [17], which included improved healthcare access and quality. The Vision 2030 seeks to replace the current public healthcare system, which is financed by the government, with one that is more varied, effective, and sustainable. Its main goal is to increase the private sector's contribution to healthcare. The new healthcare model involves implementing measures to prevent illness and improve the primary healthcare system [28]. The goal of Vision 2030 is to raise the standard of healthcare services and increase their accessibility for all residents, including those living in rural areas. This entails cutting wait times, enhancing the facilities for healthcare, and guaranteeing high-quality treatment. This study focused on evaluating the effect of the NHSTP on breast cancer screening and diagnosis during its rollout across Saudi Arabia, particularly in rural areas.

The analysis of the data from the Bisha region showed that the frequency of screening is higher than the referrals for breast cancer screening. People may opt for screening on their own or as a result of local health campaigns rather than waiting for a referral from a healthcare provider. This could reflect an increase in awareness and better access to screening programs. These findings may also indicate gaps in adequate and timely screening access and referrals provided by healthcare providers. This may be due to constraints in the workforce, cultural stigma and nuances, or lack of education and/or awareness.

Furthermore, the screening frequency increased each month and eventually reached the target in August 2023. The number of women in the target age group undergoing mammograms at the Bisha directorate increased significantly from 4% in 2022 to 16% in 2023. The case referral data over the six years indicated a steady increase from 2017 to 2022 and a steep increase during 2023. Our findings show a negative association between the frequency of screening and the percentage of breast cancer patients who test positive, though the number of positive diagnoses increased threefold. The introduction of screening mammography in the U.S. led to a significant increase in early-stage breast cancer diagnoses, from 112 to 234 cases per 100,000 women (reference). However, the rate of late-stage cancer diagnoses only marginally decreased from 102 to 94 cases per 100,000 women, indicating that while more cancers are detected early, this does not necessarily correlate with a substantial reduction in advanced disease cases [29]. Similarly, our findings indicate that screening frequency must be increased to improve the screening sensitivity and provide comprehensive coverage of breast cancer diagnosis.

From January to July, monthly screening rates were well below the target. In contrast, monthly rates rose above the target from September to November 2023. This can be owed to an increased focus on public awareness using mass awareness programs in clinics, schools, colleges, and public parks, as well as through social, print, and electronic media (reference?). More people are becoming aware of the BC screening programs, which may have accounted for the rise in the number of people utilizing the services. The effectiveness of screening varies widely, with high-income countries showing significant reductions in mortality rates due to organized programs. In contrast, low-income countries face challenges such as a lack of access to mammography and late-stage diagnoses, leading to poorer outcomes [30, 31].

The balance between the benefits of early detection and the potential harms from overdiagnosis and overtreatment must be carefully considered in public health policies and individual patient decisions [32, 33]. Coughlin et al. investigated global patterns and trends in the incidence and death of breast cancer. According to the study, breast cancer mortality has dropped in nations with better access to screening and treatment services, but incidence and mortality have grown in low- and middle-income countries with inadequate infrastructure. The implications of our findings are similar to those of the study [34]. As a result, the burden of breast cancer could be reduced by changing the Kingdom of Saudi Arabia's current breast cancer screening programs into coordinated programs similar to those run by the new Model of Care. The idea of transitioning the Kingdom of Saudi Arabia's breast cancer screening programs to more coordinated systems, akin to

those run by the new Model of Care (MoC)-like entity, has the potential to enhance efficiency, improve outcomes, and reduce the overall burden of breast cancer. The concept of a coordinated program would involve a more integrated approach to screening, diagnosis, treatment, and follow-up care instead of the current fragmented approach that may exist in some regions, like Bisha. Under a coordinated program, there would be seamless integration between primary care, screening centers, hospitals, and oncology clinics. The referral process would be standardized and transparent, and follow-ups would be more reliable.

In contrast, the current system in Bisha might have less communication between healthcare providers and specialized centers, which could create gaps in care, where women get screened but are not automatically referred for further tests or treatment. According to Katalinic et al.'s 2020 study, a systematic mammography screening program in Saudi Arabia produces a high yield. This shows that a more effective screening program could detect breast cancer early, leading to better disease management [35].

The analysis of national data suggests that in 2023, despite a significant increase in screening targets over the preceding years, following the implementation of the NHSTP, 80% of the target population was screened for breast cancer. The frequencies for different cities showed that the distribution of screening frequency did not follow any specific pattern. The lower screening frequencies were observed in developed and relatively less developed regions, including Madinah, Riyadh, Hail, and the northern border. Abulkhair et al. did a retrospective analysis on 1215 women who had received a screening at this centre between September 2007 and April 2008. The results of this analysis were published after the researchers had finished their investigation. A total of 1215 patients underwent mammography for screening for breast cancer. However, only 16 instances were diagnosed as positive for the disease [36]. The pilot study conducted in the Alqassim district in central Saudi Arabia was the primary focus of the initial report on the government's breast screening program [37]. These findings suggest that the Saudi breast cancer screening efforts were carried out by the private sector long before the introduction of Saudi Vision 2030.

The Saudi MOH initiated a nationwide campaign in 2015 to promote the National Program for Early Detection of Breast Cancer before service availability was expanded [38]. This campaign aimed to improve the public's awareness regarding the significance of early breast cancer detection. El Bcheraoui et al. investigated the extent to which Saudi Arabian women participate in breast cancer screening programs using data from the Saudi Health Interview Survey. El Bcheraoui et al. [39] found that 92% of 1135 women aged 50 and older had never had a mammogram. The reduced participation rate can be partially attributed to the severe lack of information regarding the accessibility of breast cancer screening programs [38]. The present study shows that the NHSTP and the Saudi MOH have made several efforts to improve the breast cancer screening infrastructure in the Bisha region, which is directly reflected in improved screening rates in this region. However, detection sensitivity still needs to improve by stratifying the patients on a risk basis. A total of 160,675 women were screened, resulting in an 80% coverage of the targeted number of women. The mean annual target across the 22 health directorates in Saudi Arabia was 9,090 ± 3,449 breast cancer screenings in 2023, per directorate.

Despite advancements in screening technologies, the need for tailored approaches that consider local contexts and healthcare capabilities remains critical for improving breast cancer outcomes. However, there is limited data available for the awareness campaigns, seminars, or any other steps taken to promote public awareness of the importance of breast cancer screening and the significance of early breast cancer detection. Analysis of data from Bisha Health authority and personal communication with data custodian at Bisha health directorate in January 2025 revealed that almost half of the participants learned about the program through community outreach initiatives like public health campaigns, posters, local media announcements; one-third reported learning through healthcare professionals i.e.: doctors, nurses, etc.; and the remaining were either informed by friends or family or discovered the program via online channels. This shows that community outreach programs are most important for raising awareness about health issues and promoting public awareness.

Many sectors, including the University of Bisha, conducted public awareness campaigns. Key messages emphasized the importance of early detection, the benefits of mammography, and the accessibility of screening services at MOC clinics. The information was disseminated through various channels, including social media campaigns, community events, and educational materials distributed in schools, healthcare facilities, and on international days [40, 41].

The present study has a few limitations based on the current study design and the data availability. First, we analysed secondary data that limits the analysis of various variables that can influence patient access behaviour. For instance, education can play an important role in the awareness among the masses and the intent for screening, as shown in a previous study conducted on Bisha University students [42]. Secondly, introducing breast cancer screening in the new health clusters was a policy decision. Therefore, evaluating the effect of such interventions requires further qualitative research that can provide a comprehensive overview of the facts and figures. Third, a significant limitation of this study is the absence of data on diagnostic outcomes stratified by age. Specifically, we lacked information on the percentage of screenings resulting in a positive diagnosis for each age group (40–49, 50–59, 60–69). This data would have enabled a more thorough evaluation of the program's sensitivity and effectiveness at different ages. This critical information would allow for a more refined risk-stratified approach in future screening initiatives. Lastly, it is not known whether other demographic differences contributed to who accessed services – for example, it may be that lower socio-economic status was associated with reduced access.

Conclusion and Future Prospects

Substantial recent growth in breast cancer screening has been observed in rural Saudi Arabia, and screening coverage has significantly improved in rural areas after the implementation of the NHSTP. Bisha is a rural area located in a region with a high incidence of breast cancer. The facilities in this region have transformed significantly over the past few years as part of the NHSTP and Saudi Vision 2030 goals. The present study shows the impact of NTP policies on breast cancer screening utilisation in Saudi Arabia. The present study shows the trends in screening that can, in turn, be used to design future policies to improve breast cancer screening frequencies across different regions in Saudi Arabia. This has led to a significant increase in the screening frequency against breast cancer. A combination of awareness and resource build-up led to a spike in breast cancer screening. Hence, infrastructure, increased trained staff, and public awareness are crucial. The increase in breast cancer allows for early detection and decreases mortality rates. Furthermore, awareness among the masses and improving facilities can significantly increase screening frequency in low-resource settings.

Author Contribution Statement

All authors contributed significantly to the study's draft, reviewing and editing.

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