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Performance and territorial governance assessment of the National Breast Cancer Screening Program in Taza Province, Morocco (2022–2024)

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ABSTRACT

Introduction and aim. Breast cancer is one of the leading causes of cancer-related mortality among women in Morocco. This study assessed the performance of the National Breast Cancer Screening Program (NBCSP) in Taza Province from 2022 to 2024. focusing on screening coverage, participation, detection indicators, and territorial equity.

Material and methods. We analyzed Health Information System data from 74,269 women aged 40–69 years eligible for screening. Temporal trends and rural–urban differences in screening participation and diagnostic completion were assessed using appropriate statistical models.

Results. Screening participation among the women contacted was between 54.8% and 82.0%, while overall coverage remained around 50% of the eligible population. The breast cancer detection rate was raised from 1.35 to 2.12 per 1,000 women screened. Clinical breast examination positivity was almost unchanged and low (≈2.4%). After adjustment, rural residence was associated with lower odds to participate in the screening, to complete referral and biopsy, and to get timely diagnosis within 60 days.

Conclusion. While positive changes were made in screening activities and detection indicators, there are still gaps in program quality and equity. The absence of systematic stage-at-diagnosis data limits interpretation of clinical impact and underscores the need for integrated data systems to improve breast cancer screening evaluation in Morocco.

Keywords. breast cancer screening, early detection of cancer, health information systems, patient compliance, public health programs, screening programs

Introduction

Breast cancer (BC) is the number one killer of women with cancer worldwide.[1] In developing countries, including Morocco, BC has been on the rise in recent years because of better reporting and more exposures to risk factors linked to modernization and urbanization and lifestyle transitions.[2,3] In Morocco, BC represents approximately 39% of all new cancers in women and has become one of the major public health problems. However, most patients with BC are diagnosed at an advanced stage, reflecting persistent delays in diagnosis and suboptimal screening uptake.[4]

Even though all difficulties are overcome at the national level, a large proportion of Moroccan women are still diagnosed at advanced stages, limiting the effectiveness of therapy and survival compared to high-income settings.[5] The burden continues to be exacerbated by problems such as delayed diagnosis, low participation rate, and inequities in access to quality services, particularly in rural areas.[6]

In an attempt to reduce this load, the Moroccan Ministry of Health and Social Protection established a National BC Early Detection Program in 2010.[7]

This program focuses on Clinical Breast Examination (CBE), and diagnostic mammography for BC early detection for BC survival.[8] But obstacles remain, especially access to care, the involvement of women and the quality of screening – particularly in rural areas.[6,9,10]

Where appropriate, the effect of the program should be monitored using performance measures; some examples would include participation rates, BC detection rates and time to diagnosis.

This study was initiated to evaluate the BC screening program in Taza, and comparisons were made using these performance measures compared with national and international standards. The goal is to pinpoint successes and obstacles in program implementation and offer suggestions for improvement.

Aim

To assess the practice of the national BC early detection program in Morocco focusing on the Taza province for 2022-2024 by studying performance indicators.

Material and methods

Study design

This is a retrospective descriptive and evaluative study based on institutional data, evaluating the efficacy of National BC Screening in the Taza province. The examination is based on Key Performance Indicators (KPIs) between 2022–2024.

Data sources and quality control

The present study utilized data derived from the Moroccan National HIS, an official national electronic registry utilized in Morocco for the routine monitoring of screening, diagnosis and cancer detection pathway which is a real time report from the primary health care facility, provincial diagnostic center and hospital image units.

According to the audit indicators SIS period in the province, the completion of the indicators for breast cancer screening in the Taza province 2022-2024 shows a grade ≥98%. The Regional Directorate for Health conducts monthly verification of registered screens, ensures consistency (for example, whether CBE was linked to a referral), checks for extreme values, and addresses duplicate or inconsistent entries.

There was very little (roughly 2%) missing data across all variables. Missing data was therefore managed using listwise deletion in accordance with STROBE recommendations. No missing value imputation procedures were necessary which may be related to their low proportion and random distribution.

Target population

The target population consists of 74,269 females in the age group of 40-69 years for whom the screening is eligible under the program. The inclusion criteria will include all women living in the Taza province,

who are older than the defined age in need for screening having experienced at least one CBE during the study period.

Rural–urban classification and population-adjusted rate calculation

Rural–urban classification and population-adjusted analyses

Administrative geographic classification used by the Moroccan Ministry of Health and Social Protection served as a basis for separating health facilities and their catchments areas as either rural or urban.

The number of women aged 40–69 years, considered as the eligible female population, was taken separately for rural and urban areas based on the provincial demographic estimates from the HIS.

The screening performance indicators accounted for population-adjusted rates and included:

- The screening coverage rate is the number of women who have been screened divided by the total number of eligible women in each geographical area.
- Breast cancer detection rate is the number of breast cancers diagnosed per 1,000 women screened
– Referral and diagnostic completion rates, which are the fractions of screened women.

Chi-square tests were used to initially analyze the differences between rural and urban areas. Afterwards, multivariable logistic regression models were employed to compute adjusted odds ratios (ORs) with 95% confidence intervals (CIs), while also adjusting for the year and the type of healthcare facility.

This method made it possible to evenly compare the different aspects of screening performance and its results between both rural and urban areas considering the fact that the population was different.

Statistical method

These two indicators show the different aspects of the program's performance population coverage and the responsiveness (participation) of the women contacted. To prevent any confusion, the two indicators have been presented separately throughout the document.

Statistical analysis

Descriptive statistics were employed to describe screening activity, delayed diagnosis, and outcomes throughout the study period (2022-2024). The categorical variables were presented as proportions while the continuous variables were presented as medians with interquartile ranges (IQR) due to non-normal distributions.

The differences in screening participation rates and HBS positivity rates over time were tested for trends using chi-square tests (Cochran-Armitage).

It was also checked if there was a correlation between the number of screenings and the number of HBS positive cases through the Spearman correlation coefficient which is a nonparametric measure that accounts for the skewed distribution of numbers.

Geographical differences and changes in delayed diagnosis over the years were investigated using the Kruskal-Wallis test.

The comparisons between rural and urban areas were made based on population-adjusted rates. Also, multivariable logistic regression models were used to obtain odds ratios (ORs) with 95% confidence intervals (CIs) while controlling for the variable's year and type of facility.

The significance level was determined at $p<0.05$. The entire analysis was performed using the SPSS version 21 software (IBM, Armonk, NY, USA).

Data availability and methodological limitations

The HIS that was the source of data for this assessment lacks a systematic recording of the stage of breast cancer diagnosis (TNM classification or early versus advanced stage). Therefore, no stage distribution, stage shift, or survival outcomes analyses were carried out.

The limitation points to the present lack of data sharing and integration between the screening, diagnostics, and oncology care units in the provincial health system. Without stage-at-diagnosis information, it is quite challenging to strictly measure the real clinical implications of screening beyond the use of intermediate performance indicators.

Performance indicators

Definition of key performance indicators

To ensure conceptual clarity and consistency, separate operational definitions were applied to the screening performance indicators.

Screening coverage rate was defined as the proportion of women aged 40-69 years residing in the province of Taza who underwent at least one clinical breast examination (CBE) during the study period, as a proportion of the total eligible female population.

The participation (attendance) rate was defined as the proportion of women who participated in screening among those who were reached or mobilized through community campaigns, awareness-raising activities or outreach actions carried out by health facilities.

These two indicators reveal different sides to the performance of the program: the extent of population coverage and the responsiveness of the women contacted (participation). To prevent any confusion, the two indicators are shown separately through the document.

Although the design of this evaluation took into account a number of internationally recommended indicators, it was not possible to include some of the main outcome measures, e.g. stage at diagnosis, treatment initiation intervals, survival, and breast cancer–specific mortality, because there is no systematic linkage between screening, pathology, and cancer registry data. Consequently, the KPIs chosen mainly indicate program performance, quality, and equity rather than direct potential clinical impact. This choice

is in line with the initial evaluations of screening programs in areas where monitoring and evaluation infrastructure is gradually emerging. These KPIs could not be assessed due to the absence of integrated cancer registry data.

The program was assessed based on the following routine and implications indicators:

- Process indicators:
  Participation Rate: The women participating rate in screening among those eligible.
  Delay in Diagnostic Confirmation: The time from the initial CBE to time of diagnostic confirmation.
- Impact indicators:
  Detection Rate: Number of recorded BC cases per 1,000 women screened.
  CBE Positivity Rate: Proportion of women referred for additional diagnostic testing among those with a positive CBE.

As per the World Health Organization (WHO) and IARC guidelines, all performance indicators were defined. These include participation rate, CBE positivity rate, detection rate per 1,000 women screened, mammography-to-biopsy delay, and referral-to-biopsy delay.

Results

Baseline population characteristics

The female population eligible for this investment stayed stable over the 3 years (n=74,269). The screening participation rates varied significantly over the years: from 66.97% to 58.83% between 2022 and 2023 before shooting up to 82.01% in 2024. Baseline characteristics of the eligible female population aged 40–69 years in the Taza Province over the study period are summarized in (Table 1). The increase observed in 2024 coincided with intensified community mobilization efforts. However, the up and down rates (in other words fluctuation) reiterate that we still need a more orderly system of invitation.

Table 1. Baseline characteristics of the target female population aged 40–69 years in the Taza Province (2022–2024)

Characteristic	**2022**	**2023**	**2024**
Total eligible women (n)	74,269	74,269	74,269
Screening participation (%)	68.73%	54.84%	82.01%

Although the number of women screened remained virtually constant over the three years, there were significant annual variations in participation rates. Annual screening coverage and participation rates are

presented in (Table 2). These variations reflect the intensity and extent of community mobilization rather than changes in screening capacity.

Table 2. Coverage and participation rates of breast cancer screening in the Taza Province (2022–2024)*

Year	Eligible women (n)	Women screened (n)	Coverage rate (%)	Participation rate (%)
2022	74,269	37134	50%	68.73
2023	74,269	37134	50%	54.84
2024	74,269	37134	50%	82.01

* Coverage rate – women screened/total eligible population, participation rate – women screened/women reached or mobilized (Note: the total number of women screened seems the same throughout the study years because the data is aggregated and reported at the provincial level. The variation of participation rates from year to year shows the changes in the number of women that were reached or mobilized through community-based screening activities, not the changes in the screening capacity, the identical number of women screened across years reflects aggregated provincial reporting, while annual variations in participation rates are driven by differences in the number of women reached or mobilized rather than unchanged screening activity)

Process indicators

Participation rate (2022–2024)

The screening program showed varied uptake rates in the three years 2022, 2023, and 2024 with the values of 68.73 %, 54.84 %, and 82.01 % respectively (Fig 1A). After a significant increase in 2024, the data still reflects the fluctuations of the years with noticeable peaks in October during the national 'Pink October' campaign.

Global participation was stable monthly from 2022 to 2024, averaging 40% to 60% for most months. In October, participation increased markedly during October, coinciding with the national Pink October campaign, which is celebrated worldwide. Hence, the activity reached the highest value at this time. Outside of this time frame, the monthly movements were contained, showing a constant but muted screening throughout the year (Fig. 1B).

Fig. 1. Participation indicators, A: Annual participation rate in the breast cancer screening program (2022–2024), B: Monthly participation rate trends (2022–2024)

CBE positivity rate (2022-2024)

The positivity rates for CBE stayed at the same level: 2.59% in 2022 and 3.25% and 3.13% in 2023 and 2024, respectively. The results for different years show that there is no significant difference (Cochran–Armitage trend test; p=0.23) (Fig. 2A).

Relationship between screening volume and positive CBE cases

The analysis done by the Spearman rank correlation method showed that the relationship between the two variables is almost perfectly positive and linear (ρ (rho)=0.98) between screening volume and the number

of positive CBEs. Hence, it can be concluded that the more the screening activity, the more the detection of clinical abnormalities (Fig. 2B).

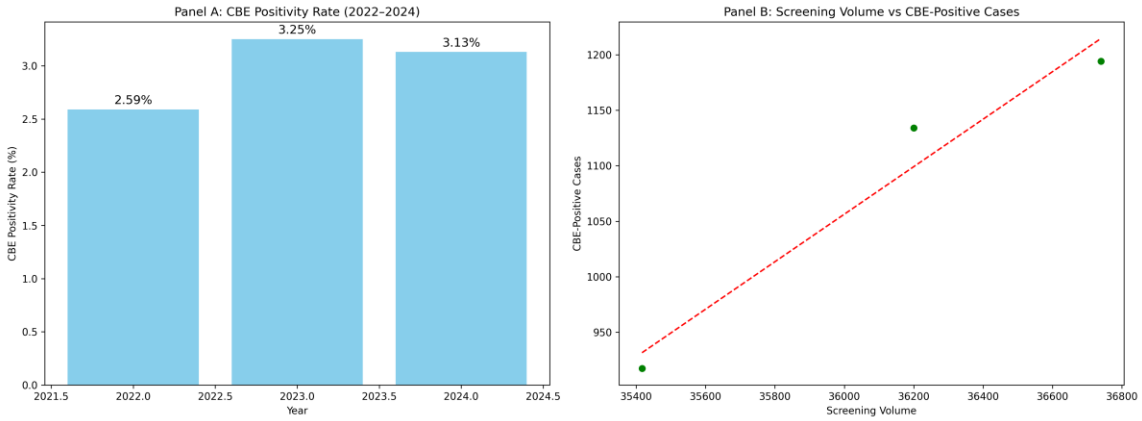

Fig. 2. Screening quality indicators, A: Clinical breast examination positivity rate (2022–2024), B: Association between screening volume and number of CBE-positive cases (Spearman correlation, ρ=0.98, p<0.001; n=36 months, CBE – clinical breast examination)

Mammography-to-biopsy delay (2022–2024)

The time between mammogram and biopsy diagnostics was significant, reduced from a 23.04-day difference in 2022 to 10.5 days in 2024. While the greater variation was recorded in 2023, it achieved a marked reduction in 2024 (Fig 3A).

Referral-to-biopsy delay (2022–2024)

The time from health center referral to biopsy rose from 61 days in 2022 to 84.5 days in 2024, with large outliers in 2024. The year-wise difference was statistically significant (Kruskal–Wallis, p<0.001) (Fig. 3B).

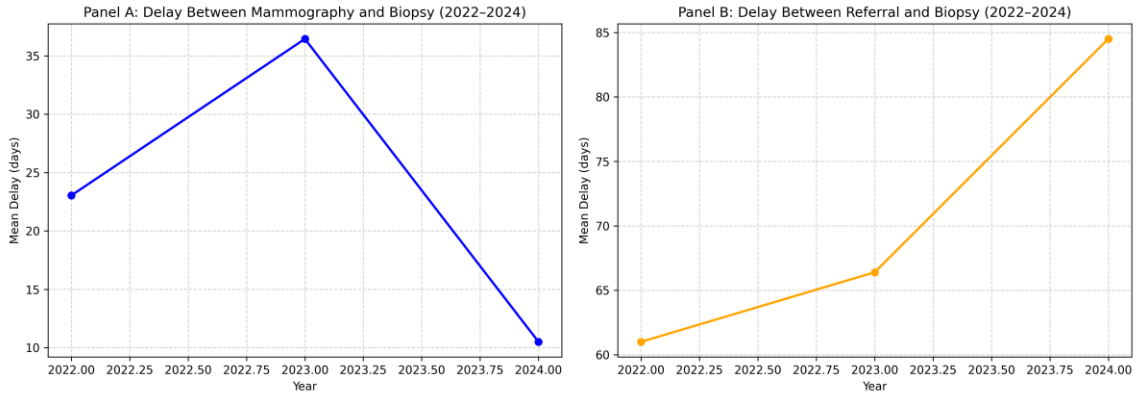

Fig. 3. Diagnostic delays, A: Delay between diagnostic mammography and biopsy (2022–2024), B: Delay between referral from health center and biopsy (2022–2024), rural–urban differences in population-adjusted screening performance

Rural-urban differences in population-adjusted screening performance

The percentage of people who got screened was almost the same for rural and urban areas (49.6% vs. 50.8%, $p<0.05$). Population-adjusted screening coverage, detection, referral completion, biopsy completion, and diagnostic delays by area of residence are detailed in (Table 3). Nevertheless, there were fewer cancer detections per 1,000 screened women in rural areas than in urban areas (2.12 vs. 3.46, $p<0.05$) Of the women who had clinical breast examinations and were found to have abnormal results, those living in rural areas were much less likely to have referral and biopsy procedures completed (62.0% vs. 78.0% and 58.0% vs. 74.0%, respectively; $p<0.01$ for both). What is more, the median diagnostic delay in rural areas was very long (82 days, IQR 60–105) compared to that in urban areas (54 days, IQR 38–72; $p<0.001$).

Table 3. Population-adjusted screening and diagnostic indicators by area of residence*

Indicator	**Rural areas**	**Urban areas**	**p**
Eligible women (40–69 yrs), *n*	123,879	98,925	–
Women screened, *n*	42,429	33,881	–
Coverage rate (%) *	49.6	50.8	0.08
Detection rate (per 1,000 screened women)	2.12 ‰	3.46 ‰	<0.05
Referral completion (%)†	62.0	78.0	<0.01
Biopsy completion (%)†	58.0	74.0	<0.01
Median diagnostic delay, days (IQR)	82 (60–105)	54 (38–72)	<0.001

* Coverage rate – number of women screened/eligible population, † – among women with abnormal clinical breast examination findings, detection rates are expressed per 1,000 screened women. p-values were calculated using χ^2 tests for proportions and the Mann–Whitney U test for diagnostic delays, note: rural and urban eligible population figures represent cumulative demographic estimates over the study period derived from HIS-based catchment data and do not correspond to annual provincial totals

There were strong rural–urban differences in breast cancer screening performance after normalizing the data to the size of the eligible population. While the absolute figures for screenings were higher in the urban contexts, population-normalized rates showed that rural areas received less of the screening services. Similarly, breast cancer detection rates per 1,000 women screened in rural areas were significantly below those in urban areas, likely reflecting lower screening coverage and diagnostic throughput.

Urban areas had consistently higher referral completion and biopsy completion rates; on the other hand, rural areas were characterized by longer median diagnostic delays. These variations were still statistically significant even after the adjustment for calendar year and facility type.

Adjusted odds ratios for rural versus urban residence across key screening and diagnostic outcomes are shown in (Table 4). Based on multivariable logistic regression analyses, a rural location had an independently negative association with the next steps of the diagnostic pathway after a positive screening test. It refers to the completion of referral (adjusted OR=0.58, 95% CI 0.44 0.76), biopsy (adjusted OR=0.55, 95% CI 0.39 0.77), and the receipt of a timely diagnosis within 60 days (adjusted OR=0.41, 95% CI 0.28 0.60).

Table 4. Adjusted odds ratios for rural vs. urban screening outcomes

Outcome	**Adjusted OR (rural vs urban)**	**95% CI**	**p**
Screening participation	0.72	0.60–0.86	<0.05
Referral completion	0.58	0.44–0.76	<0.01
Biopsy completion	0.55	0.39–0.77	<0.01
Timely diagnosis (<60 days)	0.41	0.28–0.60	<0.001

Rural–urban differences in screening activities (2022–2024)

Important rural–urban disparities were noted. Averaged over all CBE first-time women screened, these oscillated at 791 in respect of the rural and urban 942. Conversely follow-up CBE mostly occurred in the rural area (230 vs. 161). Urban areas had higher referral rates (39.50 vs. 20) (Fig. 4A).

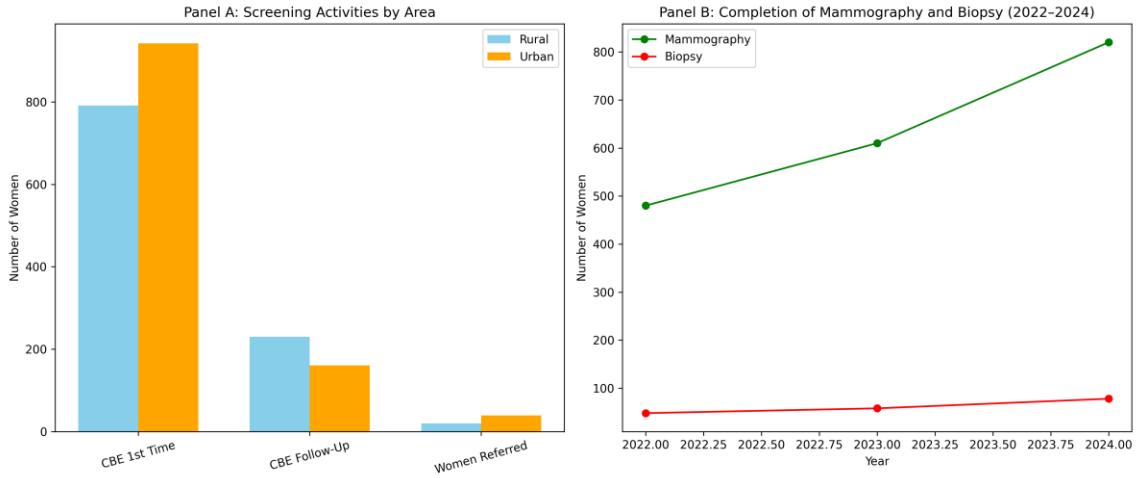

Fig. 4. Rural–urban screening disparities, A: Comparison of initial and follow-up CBE activities in rural vs. urban areas, comparison of initial and follow-up CBE, expressed as total number of examinations (n), in rural and urban areas, B: Trends in mammography and biopsy completion rates (2022–2024)

Impact indicators

Breast cancer detection rate (2022–2024)

The detection rate has increased from 1.35 in 2022 to 2.12 per 1,000 women screened in 2024 which suggests that the program's operation was associated with the (Fig. 5A).

Correlation between CBE-positive cases and confirmed cancers

There was a weak, yet statistically significantly positive correlation (r=0.33; $p<0.05$) indicating that the numbers of CBE-positive cases are usually higher when the number of cancers detected is higher (Fig. 5B).

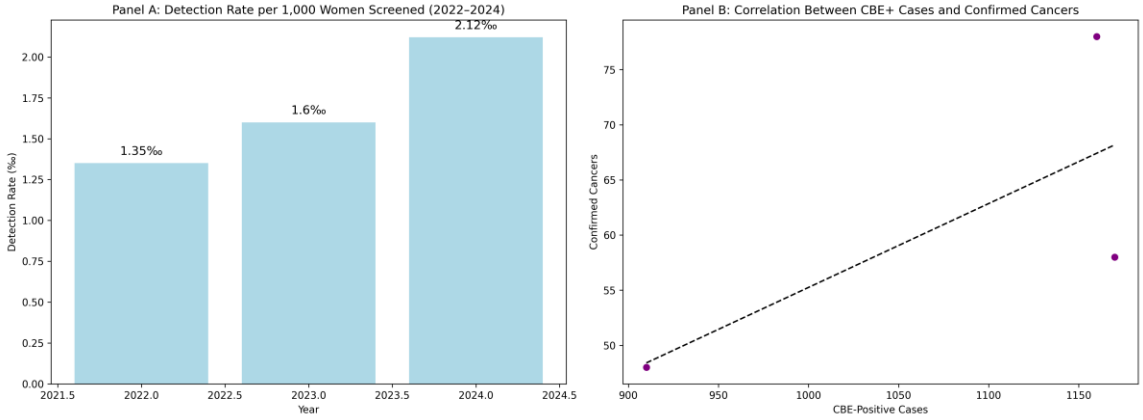

Fig. 5. Detection and confirmation indicators, A: Breast cancer detection rate per 1,000 women screened (2022–2024), B: Correlation between positive CBE cases and confirmed cancers, benign-to-malignant biopsy ratio (2022–2024)

The Benign-to-malignant biopsy ratio rose from 50.5% in 2022 to 56.25% in 2024, indicating that there were more benign lesions among the biopsied cases (Fig 6A).

Average age at breast cancer diagnosis (2022–2024)

There was an increase in the diagnosis mean age from 51 years in 2022 to 55 years in 2024. The trend may represent variations in the different age group participation rather than real epidemiological change

(Fig. 6B).

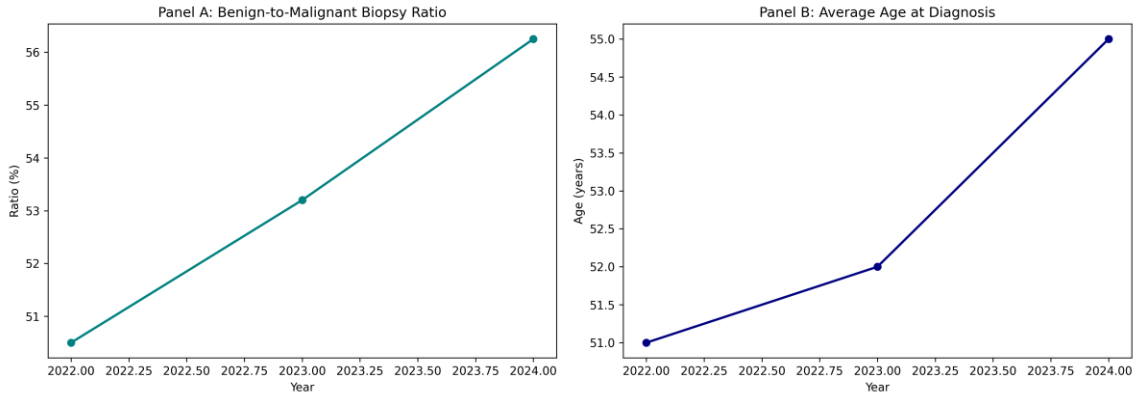

Fig. 6. Biopsy and diagnosis indicators A: Benign-to-malignant ratio of biopsies (2022–2024), B: Average age at breast cancer diagnosis (2022–2024)

Discussion

The NBCSP evaluation findings for the Taza Province were interpreted through the perspective of systemic-level deficiencies which limited the performance, equity, and potential clinical impact of the program, rather than looking at individual indicator results.

Suboptimal population coverage and participation sustainability

Evolution of participation rates

The rates of participation in BC screening in Taza province have shown significant interannual variability over the years 2022, 2023 and 2024, respectively, 68.73% (2022), 54.84% (2023) and 82.01% (2024). Even though there was a downward curve at times, 2024 shows an upward improvement. The bigger standard deviations found, especially in 2024, would indicate that there are large seasonal variations, likely resulting from stronger awareness campaigns in "Pink October." No statistically significant temporal trend was observed in CBE positivity rates across the three years (Cochran–Armitage trend test, p=0.23).

According to European guidelines, a minimum membership of 70% is necessary for a substantial decrease in BC mortality.[1]

The Taza program exceeded this limit in 2022 as well as 2024, nevertheless, the 2023 rate was slightly below this standard. Furthermore, the Program continuously exceeded the IARC suggestion of 60% participation over two years on a continual basis. [11] The observed participation levels were consistent with international thresholds commonly cited as desirable for organized screening programs.

Nonetheless, participation rates in high-income countries are more than 70%, showing a large discrepancy. For example, the participation rates for France, Norway and Italy which have organized screening programs are 76.8%, 75% and 72%, respectively. [12–14] In comparison, the rates in Taza are far greater than Tunisia's

17.3% and Iran's 21.5% [15,16] and other MENA countries, showing some differences in the uptake of screening.

The limitation of the Moroccan current screening approach is that it is passive recruitment. This means that participants are recruited not through personal invitation, but rather through actively getting women to show up to camps through a community campaign. Evidence from around the world provides strong validation for the efficacy of organized invitation systems, which are superior to alternative methods in achieving sustainability of participation and improvements in early detection.[2] The WHO recommends such a structured approach for middle-income countries to maximize screening coverage and minimize BC deaths.[2]

Low clinical breast examination positivity rates – a critical quality concern

One of the most striking findings of this evaluation is the persistently low clinical breast examination (CBE) positivity rate, which remained between 2.4% and 3.2% throughout the 2022–2024 period. This level is substantially below the national reference range of 10–13% established by the Moroccan National Cancer Prevention and Control Plan, as well as below benchmarks reported in comparable CBE-based screening programs in low- and middle-income countries.

CBE positivity rate is not merely a descriptive indicator; it is widely recognized as a key quality marker of screening performance, reflecting the combined effects of examiner skill, adherence to examination protocols, referral thresholds, and underlying population risk. Persistently low CBE positivity rates raise concerns regarding the clinical sensitivity of primary screening and warrant further investigation.

Comparison with similar CBE-based programs

Based on international experience, it is known that CBE screening programs generally report between 8% and 15% positivity rates which largely depend on the level of examiner training, standardization of protocols, and characteristics of the target population.

In Morocco, previous national evaluations have reported CBE positivity rates ranging from 3% to 5% in earlier years, suggesting that the low rates observed in Taza are not isolated but reflect a broader structural challenge within the national screening approach.

Potential explanatory factors

There is a variety of closely related factors that could explain a low CBE positivity rate. These include differences in the training and experience of the examiners, the use of strict referral thresholds, time constraints in busy primary care settings, and, to a lesser extent, documentation practices. Population risk differences may be one of the reasons for varying positivity rates. However, this explanation itself does not seem to be enough to justify the large and consistent gap that has been observed.

Implications for program performance

Low CBE positivity has direct implications for the performance of the screening program. A screening strategy that fails to identify a sufficient proportion of clinically abnormal cases risks missing opportunities for early diagnosis, thereby limiting potential stage shift and mortality reduction.

Moreover, the observed weak correlation between CBE-positive cases and confirmed cancers suggests that linkage between primary screening and diagnostic confirmation may be suboptimal, further attenuating the potential benefits of screening.

Quality improvement recommendations

From these results, there is an immediate need for a multilayered quality improvement plan.

Immediate (0–6 months)

- Standardize CBE protocols across all primary health care facilities
- Introduce refresher training focused on practical CBE skills
- Circulate unambiguous referral standards that are in line with the national guidelines

Medium-term (6–18 months)

- Implement routine supervisory audits and peer review of CBE practices
- Use CBE quality indicators as a comprehensive tool for regular performance monitoring
- Improve communication systems between diagnostic centers and frontline health care providers

Long-term (≥18 months)

- Create continuous professional development programs with certification options
- Submit decision-support tools in digital health platforms
- Probe slow integration of imaging modalities gradually, if guided by available resources

These suggestions align perfectly with the WHO, the International Agency for Research on Cancer (IARC), and the Global Breast Cancer Initiative recommendations that emphasize that the quality of screening is as important as the coverage of screening.

Broader policy and system implications

The data from the Taza Province reveals the problem that many middle-income countries have to face how to increase the early detection programs without lowering the clinical quality. CBE is still a viable and quite affordable screening method in resource-limited areas, but currently, it is very dependent on human resources, supervision, and system integration.

Therefore, improving CBE quality should not be merely a technical fix, but a key management issue within the national cancer control strategy.

Weak linkage between screening and diagnostic services

It is worth mentioning that although breast cancer screening coverage was similar in rural and urban areas, differences were always seen at the subsequent stages of the screening pathway, especially regarding the detection, diagnosis, and time aspects.

According to this research, rural-dwelling women were significantly less frequently going to a specialist and having a biopsy, and the delays in diagnosis were even longer after the adjustment for age, year, and type of facility. So, these findings indicate that disparities between regions are not so much a matter of getting the first screening as they have to do with lacking further steps of care after abnormal results.

Diagnostic delays: from referral to mammography to biopsy

Taking a closer look at these indicators, some progress was noted but so were challenges. The time interval from diagnostic mammography to biopsy date was significantly reduced from 23.0 days 2022 to 10.5 days in 2024 ($H=64.58$; $p<0.001$). A reduction in mammography-to-biopsy delay was observed over time; however, the observational design precludes attribution to specific coordination mechanisms.

However, the total delay from the original health service referral to the completion of the biopsy remains an issue, increasing from 61.0 days in 2022 to 84.5 days in 2024, with significant outlying delays notably in the most recent year. The timeline for confirmed diagnoses is well over 60 days. The WHO states this is the maximum allowable period, from an abnormal finding to histopathological. This delay raises issues with disease progression at this time and the patient outcomes that follow.

The delays are common to issues faced by middle-income countries where centralized diagnostic services, underdeveloped pathological infrastructure, and logistical challenges create a bottleneck in care.[20,21] The advantages of decentralized services, digital infrastructure and integrated care pathways are demonstrated.

Trends in mammography and biopsy utilization

Between 2022 and 2024, the rates of mammography and biopsy will progressively rise indicating further maturation and enhancement of the diagnostic capacity of the program.is The substantial increase in screening volumes, particularly in 2024, can be attributed to enhanced public awareness and prevention messaging for cancer in Taza, as well as the enhanced training of healthcare providers, enhanced referral systems, and improved local diagnostic capacity. The national cancer control policies in Egypt and Jordan had similar effects in expanding their mammographic coverage.

The WHO considers that an increasing utilization of diagnostic tests in the incoming decades is a major marker of successful screening programs if it is coupled with correspondent quality assurance will be clinically relevant. [8] According to the IARC, the best way to optimize the potential benefits of screening is to shorten the intervals between screening, diagnosis and initiation of treatment. [19] The increases seen in

Taza are in line with the objective of the National Cancer Control and Prevention Plan in Morocco which covers screenings while guaranteeing care continuity.

Private sector engagement and loss to follow-up

During the later study period, there was increased participation of the private sector in opportunistic screening. Simultaneously, the loss to follow-up was also rising. The increasing engagement of the private sector in the health care area is positive. The increase of access points as well as service delivery points reflect greater awareness and demand. This is in alliance with the recommendations of the WHO, where studies reflect that the private sector capacity should be aligned with the national screening process [2].

But the concurrent rise in the number of women getting lost to follow-up after initial positive findings is a major program weakness that counteracts the potential benefits of early detection. Evidence collected show inconsistencies and anomalies. They reflect the challenge of care coordination, shortcomings in tracking systems (for example EHRs) and possibly the accessibility of diagnostic services. The IARC identifies this as a main obstacle to screening performance in low-resource settings.[5]

The Ministry of Health of Morocco is aware of these difficulties and is implementing strategies to enhance community follow-up and full registry. These initiatives link together detection and treatment, creating a closed-loop system.

Breast cancer detection rate and program performance

Screening programs have been implemented, and they have been accompanied by a better detection rate in 2023 and 2024. In 2022, the detection rate was 1.35 cases per 1,000 women screened, while in 2024 it was at 2 per 1,000 women. Detection rate differences may reflect variations in screening modality and population characteristics. According to a report, their detection in Morocco without systematic mammography screening appears to be in the order of that of Japan in a CBE-based program, phrased another way, clinical examination can deliver reasonable implementation when done properly. The discrepancy between positive cases reached by CBE and confirmed cancers (histopathologically) point at the need for better reach to diagnosis.

Benign-to-malignant biopsy ratio

The ratio of benign and malignant biopsy was even better – 50.5% in the year 2022; 56.25% in the year 2024. There is a rising proportion of benign findings in the biopsied lesions. This trend likely reflects improved identification of benign breast conditions or lower referral thresholds, or an increasing detection of low-suspicion lesions with rising screening volume.

It is inevitable and acceptable for degrees of benign biopsies to occur in screening programs, but monitoring this ratio is important for optimization of the ratio sensitivity (true cancers) and specificity (do not have

invasive procedures). Biopsy positive predictive values (PPV) from international studies should be greater than 25 to 40% so that the cost benefit and patient burden do not outweigh the advantages.

Territorial inequities in access and diagnostic completion

Urban-rural disparities in screening access

There were huge differences in screening in urban and rural populations. In urban areas, the rates of first screening (CBE 1st time) were higher because of better access to health infrastructures, higher exposure to awareness campaigns, and probably higher health literacy. On the other hand, follow up CBE rates were better in rural areas. Thus, once engaged rural women seem strongly committed to future participation. This is a positive finding and may mean community-based strategies are effective.

Higher referral rates were observed in urban areas, which may be related to more established referral networks and proximity to diagnostic centers. Such a disparity has also been observed in Morocco.[4] The WHO observed that the diagnostic capacity of health facilities in middle-income countries is concentrated in urban centers.[2]

Inadequate monitoring and evaluation infrastructure: absence of stage-at-diagnosis data

One of the biggest structural weaknesses of this assessment is that the Health Information System used by the National Breast Cancer Screening Program (NBCSP) lacks systematically recorded stage-at-diagnosis data. Tumor stage at diagnosis is the main key-link between screening activity and the ultimate clinical goal of breast cancer screening, which is morbidity and mortality reduction. Without stage data, it is not feasible to examine stage distribution, stage shift over time, or follow-up outcomes such as survival, which in turn limits the interpretation of the program's potential clinical impact.

An essential goal of breast cancer screening for the population is not simply to increase the number of cases detected but to detect cancers at early stages when treatment is less invasive, and prognosis is better. Evidence from international studies consistently has shown that stage I and II cases are the ones that have been shifted in the diagnostic distribution by screening programs resulting in mortality reduction after a long period. Hence, stage-at-diagnosis is generally accepted as a main indicator for assessing screening effectiveness and thus, it is an absolute requirement for program maturity.

Because such data is missing, this analysis had to resort to intermediate performance indicators such as participation rates, detection rates, clinical breast examination (CBE) positivity, and diagnostic delays. Those measures, while informative of program organization, quality, and equity, are clinical benefit proxies at best. Therefore, even if changes in detection rates, or diagnostic intervals, notwithstanding the fact that they are changes in the direction of improvement, should not be expected to lead to better outcomes without proof of earlier-stage diagnosis.

Lacking staging data is a barrier to identifying and evaluating biases that are related to screening and well-documented in the literature. A lead-time bias can result in an increase in the observed survival time that does not represent an actual extension of the life of the patient both of which concepts can simply confuse the public if it is not well explained, whereas length-time bias allows the preferential detection of slow-growing tumors which are less aggressive. Overdiagnosis is yet another issue especially in cases where there is an increase in screening volume without a corresponding change in clinically meaningful stage shifts. Not having stage-at-diagnosis data makes it impossible to quantify these phenomena, hence the need for cautious interpretation of observed performance trends.

Similar difficulties were encountered in the initial assessments of screening programs in many low and mid-range income countries where fragmented information systems hamper long-term patient follow-up. On the other hand, programs that have gone through the maturity stage have had the benefit of integrated registries that can link screening data with pathology, oncology, and population-based cancer registries, thus continuously staging distribution and outcomes assessment. The lessons drawn from these programs explain that data integration is not only a nice-to-have but the very base of screening governance effectiveness that the programs have benefited from.

In the Moroccan situation, the lack of standardized TNM stage reporting is therefore just one of several symptoms of the split between screening and care resulting from the fragmentation of the health system in the two different specialties. A well-functioning screening system addresses more than the detection and referral to diagnosis, staging, treatment initiation, and outcome monitoring. So it is crucial to build a strong collaboration between screening services, pathology laboratories and oncology units to allow a comprehensive evaluation of the screening program and holding the program accountable for its deliverables.

In the meantime, interim evaluations should be done in such a way that they are designed to continuously monitor whichever performance indicators that are available and to be upfront about their limitations. The NBCSP could do a lot more if audit mechanisms were strengthened, data completeness was improved, and gradually, stage-at-diagnosis reporting was incorporated. It would be a huge step toward an eventual transition from activity-based monitoring to impact assessment that matters. Closing this huge data gap should be seen as a requisite not only for the program to be on par with international standards but most importantly for it to deliver clinical benefits that are the very justification for expansion of its activity.

Relevance to healthcare management and governance

The lack of reported TNM (tumor, node, metastasis) stage-disposition in each of the four screening visits represents a key disconnect between screening and downstream clinical care processes. In order to have a positive implication on population health, an effective screening model must include not just detection and

referral but also the strategic linkage to diagnostic confirmation, staging, initiation of treatment, and monitoring of treatment outcomes.

To eliminate the gap created by the lack of communication between the two systems, we must work as partners to do the following:

1) Develop an integrated system that connects the screening data with the oncology and pathology databases.

2) Develop a standardized method for the reporting of TNM stage at the time of diagnosis; and

3) Create a method to establish longitudinal follow-up at different levels of care.

Integrating these systems will strengthen the NBCSP's ability to assess its performance and assist in developing future improvements, and it will also increase the alignment of NHLBI/NBCSP's standards with those of other countries providing cancer screening (i.e., WHO).

Alternative evaluation approaches in the interim

Improving the way that diagnostic information is gathered will be essential to assess whether screening is translating into meaningful potential clinical impact.

However, without the use of comprehensive information, no accurate conclusions regarding how breast cancer screening has impacted the Taza Province can be drawn at this time.

Methods that could be used to collect diagnostic information include:

- Comparison of various In-Kind grants across the province.
- Collecting, by way of routine audits, data pertaining to benign and malignant biopsies and the potential benefits to healthcare providers; and
- Using auditory sampling to determine the extent to which certain types of breast cancer have been detected at particular healthcare facilities.

It is necessary to establish methods for collecting complete information that will ultimately be used to develop reliable conclusions about the potential benefits to patients of breast cancer screening. Data systems that gather complete information require investment in the methods of integration of cancer registry data and the integration of first-time cancer cases with existing cancer registry data.

Supporting observation

Age distribution of diagnosed cases

The average age at diagnosis has increased by four years from 2022 to 2024, from 51 years to 55 years at diagnosis. This trend likely reflects increased participation among older women rather than a true epidemiological shift. This trend is consistent with what has been seen in other middle-income countries, leaving open the question of targeting for the program. As the incidence of BC rises with age, the trend

towards older diagnoses suggests missed opportunities for earlier diagnosis of younger women, particularly those with family history or other risks.

Limitations of causal inference

The analysis relied exclusively on data collected through health systems in the past (retrospective) and did not intend to indicate causal relationships for this reason; therefore, the relationship between screening activities, diagnostic information and outcomes must be approached with a very general level of caution. There was no comparison group and no randomization; therefore, the presence of incomplete downstream outcome data (especially about what stage of disease individuals were diagnosed) does not allow attributing the trends observed to the screening program itself. The findings should be viewed as descriptive, as well as associational, and reflect patterns of program implementation/performance versus definitive evidence of performance. This cautious interpretation of data supports the general recommendations provided by many organizations for evaluating population-based screening programs using an observational approach to collect data through routine sources.

Study limitations

The results of this research should be interpreted keeping in mind the limitations. Firstly, the data for the analysis was taken from routine HISs and was retrospective in nature. This might have some residual data quality problems even though the data is mostly complete and is regularly verified.

Secondly, the short period of the study (2022–2024) restricts the ability to see long-term trends and does not allow for downstream effects such as breast cancer mortality to be evaluated.

Thirdly, the lack of a control group of non-screened women and the absence of randomization mean that one cannot causally attribute the trends to the screening program. Therefore, the findings are to be interpreted as descriptive and associational indicators of how the program was performed.

Also, the research ignored the consideration of personal factors for participation like socioeconomic status, education, or health-seeking behaviors that could influence the take-up of screening and outcomes. Lastly, differences in clinical breast examination techniques and the possibility of variation in observations among doctors could not be formally checked as there were no standardized methods for measuring examiner technique and reliability.

Conclusion

This paper has evaluated the National Breast Cancer Screening Program (NBCSP) in the Taza Province by conducting a full appraisal of the program's performance, fairness, and the implementation dynamics over the years 2022–2024. Instead of enumerating individual intermediate indicators, the results were viewed

from a system-level perspective, which brought to the fore the structural gaps that determine the effectiveness of screening in a middle-income environment.

In general, the program was moderately to highly successful as most people enrolled in two of the three years of the study reaching or going beyond the thresholds internationally referred to as the minimum requirements for an organized screening initiative. Nevertheless, the participation patterns were noted to have extreme fluctuations from year to year and to have a strong seasonality attributed to the fact that the program depends on community-based campaigns for recruitment rather than a sustainable invitation-based recruitment strategy.

This limits the program's capacity to ensure stable and equitable population coverage over time.

A second major finding concerns the quality of primary screening. Despite increasing screening volume, CBE positivity rates remained persistently low and substantially below national reference ranges. These findings raise concerns regarding the clinical sensitivity of CBE at the primary care level and suggest that expansion of screening activity has not been matched by proportional reinforcement of examination quality, training standardization, and quality assurance mechanisms.

The evaluation also identified weaknesses in the continuity of the screening-to-diagnosis pathway. Specific diagnostic interval improvements were noted; however, in general, delays from the first referral to histopathological confirmation still regularly surpassed the set thresholds. The increased utilization of diagnostic services such as mammography and biopsy went hand in hand with a growing number of patients lost to follow-up, especially in situations where the coordination between public and private providers is still incomplete. The above findings, in a way, highlight the existence of a care pathway fragmentation problem that could be reducing the effectiveness of early detection.

Severe territorial disparities put the program performance even more at risk. Differences between urban and rural areas in terms of access to screening, referral, and diagnostic completion remained after adjusting for population differences, and these disparities reflect the underlying inequities of the health infrastructure, service availability, and geographical accessibility. Although community-based approaches seem to be successful in encouraging follow-up among rural women who are already engaged, initial access and diagnostic referral are still very much uneven.

Most importantly, the lack of systematic stage-at-diagnosis data stands as a significant obstacle in evaluating the potential clinical benefits of the NBCSP. The distribution of stages at diagnosis is the crucial intermediate outcome that links screening to better survival, yet the existing data systems are not adequate for the assessment of stage shift or the subsequent outcomes. It is vital for the progress from mere performance monitoring to potential impact evaluation that this gap be filled by, among other things, better integration between screening services, cancer registries, and pathology databases.

Summarizing those findings, one can say that the NBCSP in the Taza province has indeed contributed to the expansion of screening and diagnostic capacity; however, its overall efficiency is hampered by the

presence of structural system gaps that are associated with participation sustainability, screening quality, care continuity, territorial equity, and monitoring infrastructure. Merely the further enlargement of coverage cannot be considered an effective approach to yield proportional gains unless it is supplemented with targeted investment in quality assurance, organized invitation systems, integrated care pathways, and powerful data systems.

These findings should be interpreted as an assessment of health system performance and equity rather than evidence of direct clinical effectiveness of breast cancer screening.

In order to have a most pronounced effect in policy and practice terms, the NBCSP must be enhanced in a way that involves a transformation from a mostly activity-based model to a quality- and equity-oriented approach that is in line with international recommendations. The next stage of research should be the longitudinal studies that involve stage-at-diagnosis data, comparative studies with non-screened populations where the situation allows, and mixed-methods studies that delve deeper into the factors affecting participation and follow-up. Such endeavors will facilitate that the increased screening activity is not just an end in itself but leads to tangible progress in early detection and patient outcomes in Morocco and other similar environments.

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Author contributions

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Conflicts of interest

No conflict of interest was declared by the authors.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval

Ethical clearance for this study conducted at the Taza Medical Delegation for Health and Social Protection was granted from the Regional Directorate for Health and Social Protection of the Fès– Meknes Region, in coordination with the Moroccan Ministry of Health and Social Protection. Permission to access programmatic data from the NBCSP was approved by the National Health Information System (HIS).

Due to the retrospective nature of this study, secondary use of coded, de-identified anonymized data; informed consent from individual patients was waived. The study followed ethical principles of the Declaration of Helsinki and national regulations for use of health data in public health research in Morocco.

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