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Kuwait National Mammography Screening Program: outcomes of 5 years of screening in Kuwaiti women

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BACKGROUND: Breast cancer is the most common malignancy among women in Kuwait, representing 39.8% of all female cancer cases.

OBJECTIVES: Report the data of the Kuwait National Mammography Screening Program (KNMSP) for a 5-year period.

DESIGN: Prospective data collection.

SETTING: Population-based screening.

SUBJECTS AND METHODS: We included mammography screens done for Kuwaiti women (age 40 years and older) who attended the KNMSP from 2014 to 2019 to screen for breast cancer. A full-field digital mammography system was used to acquire the mammographic images in craniocaudal and mediolateral oblique projections. Independent double-blind reading of the mammograms was performed by two radiologists.

MAIN OUTCOME MEASURE: Early detection of breast cancer.

SAMPLE SIZE: 14773 asymptomatic women met inclusion criteria (mean [SD] age, 51.8 (8.2).

RESULTS: Lesions were detected in 551 women (3.7%). These included 233 malignant lesions (233/551, 42.3%), 57 high-risk lesions (10.3%) and 261 benign lesions (47.4%). The participation rate was 7.8% of the target population of women 40-69 years of age. The majority of breast cancer cases were reported in the age group 45-49 years (23.2%). The KNMSP study recall rate for 5 consecutive years was in a range of 11.9-16.5% (mean, 14.3%). The detection rate of ductal/lobular carcinoma in situ and invasive breast cancer were 2.5 and 13.6 per 1000 screened women, respectively. Invasive ductal carcinoma was the most common type. Only 4314 women followed up within 12-15 months of the first mammography for a retention rate of 29.2%.

CONCLUSIONS: Screening mammography improves early detection of breast cancer in women older than 40 years but poor participation is a limitation. We are aiming to increase the participation rate to 70% of the population.

LIMITATIONS: Lack of participation by women.

CONFLICT OF INTEREST: None.

Breast cancer is the most prevalent malignancy in women and one of the leading causes of cancer-related deaths in the world, so it is crucial to diagnose it early for successful treatment.[1,2] In Kuwait, more than 800 breast cancer cases were reported in 2018, thus accounting for approximately 39.8% of the total female cancer cases reported across the country.[3] Breast cancer is also Kuwait's leading cause of cancer deaths among women, leading to an estimated 222 fatalities in 2018.[3] When age-standardized, the mortality of breast cancer ranges from 94.4 to 233.3 per 100 000 among women aged 40-85+ years in Kuwait. Women from 70-75 years of age present with the highest mortality of 267 per 100 000.[4]

The key to prevention of breast cancer death remains early detection. The only method of screening for breast cancer that has been effective in detecting occult breast lesions is mammography, of which full-field digital mammography (FFDM) is the most common breast cancer screening technology in use today.[2,5] Mammography in countries with good health systems that can afford a long-term coordinated population-based screening program is very expensive but it is cost-effective and feasible.

The Kuwait National Mammography Screening Program (KNMSP) was announced in April 2014. The program offers a nationwide, integrated breast screening program to provide high-quality breast screening services for women aged 40-69 years every year, but we also accept women more than 69 years old if they are referred by their health care provider. This screening program complies with international guidelines for the identification of small cancers. To reduce the harm associated with screening, the Ministry of Health in Kuwait has made an agreement with Memorial Sloane Kettering Cancer Center, New York, USA, to train 5 radiologists, 6 technologists, and 1 quality assurance technologist on breast imaging and screening mammography. The curriculum was supervised for 2 years (2014-2016). The screening facilities are available at five medical centers, one in each of the five health regions in Kuwait. Their first investigation was reported in 2019.[6] The goal of the present study is to report the outcomes of asymptomatic Kuwaiti women who have undergone screening mammography for the 5-year period 2014-2019.

SUBJECTS AND METHODS

Women attending the KNMSP were asked to participate in this prospective study during the period from April 2014 to March 2019. The exclusion criteria were women with breast augmentation (injections/fillers), women with a previous history of breast cancer, women with breast symptoms, women who were pregnant and women who were actively lactating. The Ethical Committee of the Ministry of Health, Kuwait, has accepted the study protocol (660/2017). The women who participated in this research received informed consent. A total of 81 932 FFDM images of 14 773 women who had completed the 4-view exam were available for analysis. The majority of additional mammography projections included magnification compression, spot compression, and spot magnification. In addition, imaging modalities were performed as required, including ultrasound (US) and/or magnetic resonance imaging (MRI).

Kuwait National Mammography Screening Program

Screening monitoring systems require precise, reliable, full and structured information comparable to national and international breast screening programs through screening centers. To track and measure the success of breast cancer screening in structured systems, data were collected and analyzed on risk factors for breast cancer, medical screening history, screening outcomes, diagnostic tests and final diagnosis. In this study, data from opportunistic screening at mammography facilities were not included.

Screening services were offered at five medical centers, one in each of the five health regions of Kuwait. These breast units, staff and equipment have been continuously monitored by the main center located in the Al-Sabah health area in Kuwait to ensure the delivery of high-quality mammograms as part of the screening program. Women were invited for screening mammography by several methods such as referral from a health care worker, advertisements from social media, television, radio, or through breast cancer awareness campaigns and events. Invitation letters were not sent. The women in the appropriate age groups of the program were provided with a KNMSP mobile application or a direct phone number to arrange an appointment through a call center. The calls were picked up at the KNMSP center, following which the women were registered and appointments scheduled at the most convenient medical health centers. The following medical health centers were included within the program: Egaila Unit of Al-Ahmadi Health region, Zahra Unit of Hawally Health region, Al Naeem Unit of Al-Jahra Health region, South Khaitan Unit of Al-Farwania Health region, and the Al- Surra Unit of Al-Asima (Capital) Health region. On the day of the appointment, the patient visited the medical health center with her details already sent via the electronic network to the modality worklist. A qualified mammography technologist performed the mammogram. An electronic questionnaire was completed by the patient detailing the information such as name, age, address, medical history, previous imaging history, medications and family history of breast cancer for a first-degree relative. These details were available to the radiologist(s) who read the exam. After completion of the exam, the study data were sent to the Picture Archiving and Communication System (Carestream, PACS 11.4, RIS v 11.4.0.1253 build, USA) located at the KNMSP center for image assessment.

Both patient and test information were archived at the KNMSP center and used for documenting and reporting purposes, providing immediate access for reporting radiologists to the prior, as well as access to all documentation and image data. The program examined women of Kuwaiti nationality who complied with the regulations of the Ministry of Health-Kuwait. As a centralized cancer screening network, the KNMSP offers recall screening notification, notifies women of the results of their screening, and facilitates all women with abnormal screens to proceed through the diagnostic stage and arrange any potential further imaging or tissue sampling. Once the woman was registered in our system and had her first mammogram performed, an annual SMS reminder was sent to her at least 2 weeks prior to her expected next annual mammography examination. This enabled us to schedule an appointment in advance. In addition, a 24-hour reminder was sent prior to the exam, a reminder was sent if the women missed the appointment to reschedule another appointment, and a reminder was sent to pick up examination results. All information was imported into the system beforehand and updated yearly. This was subject to getting the information from the Kuwait Public Authority of Civil Information identification (KPACID). KPACID was used as a primary ID.

Full-field digital mammography image acquisition

A dedicated FFDM unit (Hologic, Selenia, USA) with 24×29 cm silicon/caesium iodide detectors, 70 μmm pixel pitch, dual-track molybdenum/rhodium (Mo/Rh) or rhodium/rhodium (Rh/Rh) target/filter hybrid X-ray tube and 4:1 anti-scatter grid was used for FFDM imaging system. The device underwent frequent quality control programs relating to technical aspects, dosimetry and image quality. To allow the system to determine exposure parameters such as combinations of X-ray tube voltage (kV)/tube-current-time product (mAs) and target/filter combinations, all FFDM tests were performed using conventional configuration and fully automatic exposure control. The breast compression force was applied at a level that was dependent on the pain tolerance of each patient. In the craniocaudal and mediolateral oblique projections, the FFDM images were obtained using the same breast compression.

Full-field digital mammography image and tissue analysis

For assessment of the screening images, two radiologists with more than 15 years of experience in breast imaging read the case independently (double-blind reading) recording their impressions. The system checked for conflicting cases and those were resolved by a third and final reader. In case of either positive or negative findings, the KNMSP center needed to advise the patient and, if necessary, arrange for a future visit. FFDM images were independently tested on dedicated workstations with two high-resolution display monitors (Barco, 5MP, Belgium) to determine the presence or absence of any suspicious findings. During the interpretation sessions, no reference examinations or other clinical information about the subjects was provided. The Breast Imaging-Reporting and Data System (BI-RADS)-based scale of the American College of Radiology (ACR) characterized all lesions detected was followed.[7,8] Focal density, architectural distortion, ill-defined margins, cluster of microcalcifications or a mix of these, were the malignant features. The radiological findings were contrasted with the histopathological findings of each lesion. The final diagnosis was identified by histopathological analysis of core biopsies, vacuum-assisted stereotactic biopsy, or surgical excision of the specimen. Histopathological analysis was performed at the pathology department of Kuwait Cancer Control Center.

Statistical analysis

All data was entered into a computerized spreadsheet Excel 2013 (Microsoft, Redmond, WA, USA). All statistical analyses were performed for the 5-year screening period using Windows version 27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). Characteristics and demographic data were analyzed. The sample size, the number of cases diagnosed with breast cancer, characteristics of screened women diagnosed as breast cancer, disease extent at diagnosis, and histological features of breast lesions were analyzed. The findings of the FFDM were contrasted with the histopathology study. The data was monitored for logical data entry errors and cleaned. All categorical variables were summarized into frequencies and percentages. Continuous variables were categorized, cut-off points were created to make the categories representative, and summarized using the mean and standard deviation. Pearson's chi-square test was used to test the associations between the categorical variables. The ANOVA table (F test) was used to test for the mean differences between more than two groups and continuous normally-distributed variables. The Kruskal-Wallis test was used for median differences between more than two groups and continuous, not normally distributed variables. The significance level was set at a *P* value of ≤.05.

RESULTS

The population of women over 40 years of age in Kuwait was 188618 at the time of study. Of those, 14773 (7.8%) were screened using FFDM from April 2014 to March 2019. The majority of screened women were 45-49 years old (23.2%); a minority were 70 years of age and older (3.3%) (**Table 1**). The youngest was 40 years old and the oldest was 87.7 years old with a mean (SD) age of 51.8 (8.2). The majority had a postgraduate education degree. Most were from Al-Asima (Capital) governorate (36.9%) and the fewest were from Al-Jahra governorate (6.2%). The majority were referred to the program by their health care worker (39.0%). Out of 14773 screened, only 4314 women had a follow-up annual mammogram within 12-15 months of the first mammography for a retention rate of 29.2%.

Women screened for breast cancer

Analyses were performed per 1-year screening period as well as for the whole 5- year period (**Table 2, Table 3**). Out of the 20 483 screens for 14 773 women, 551 women had an abnormal mammography that required invasive workup . Of the 551, 233 (42.3%) had malignant lesions, 57 (10.3%) had high-risk lesions and 261 (47.4%) had benign lesions according to histopathology findings. Three cases were considered missed cancer cases. The interval cancers detected for women with negative mammography were 34 cases (0.23%) on follow up. The detection rate of ductal carcinoma in situ (DCIS) and lobular carcinoma in situ (LCIS) was 2.5 per 1000 women screened. The detection rate for invasive breast cancer was 13.6 per 1000 women screened. 223 (1.6%) were diagnosed with screen-detected breast cancer after a full work-up. The breast cancer extent at the time of diagnosis according to the tumor node metastasis classification (TNM) stage I was 39.1 %, (n=91); TNM stage II was 27.4 %, (n=64); TNM stage III was 14.2 %, (n=33); and TNM stage IV was 6.4 %, (n=15). There were 3 cases unknown and lost to follow-up (**Table 2**).

Positive predictive values, negative predictive val-

Table 1. Characteristics of the study population (n=14773).

Age	
40-44	3309 (22.4)
45-49	3425 (23.2)
50-54	3013 (20.4)
55-59	2275 (15.4)
60-64	1462 (9.9)
65-69	798 (5.4)
70 and above	491 (3.3)
Educational level	
Illiterate	462 (3.1)
Primary school	803 (5.4)
Secondary school	1605 (10.9)
High school	2448 (16.6)
College degree	4644 (31.4)
Postgraduate education	4768 (32.3)
Unknown	43 (0.3)
Governorate of residency	
Al-Asima (Capital)	5448 (36.9)
Hawally	4269 (28.9)
Al-Farwanyia	1573 (10.6)
Al-Ahmadi	1197 (08.1)
Mubarak Al-Kabeer	1338 (09.1)
Al-Jahra	921 (6.2)
Unknown	27 (0.2)
Invitation method	
Referred from health care worker	5765 (39.0)
Brochure, banner, events or campaign	4578 (31.0)
Informed by a relative or friend	2215 (15.0)
Advertisement on television, radio, magazine and newspapers	1447 (9.8)
Social media	148 (1.0)
Others	620 (4.2)

Data are number (%).

ues, sensitivity and specificity were calculated for each scanning period (**Table 3**). The cases with positive mammograms referred to biopsy are denoted with PPV1, PPV3, PPV5, PPV7, and PPV9, whereas cases with positive mammogram among all abnormal mammography that required additional imaging were denoted with PPV2, PPV4, PPV6, PPV8, and PPV10. The recall rate fluctuated between 11.9% and 16.5% (mean of 14.3%) .

Invasive ductal carcinoma was the most common type among malignant lesions (**Table 4**). The malignant lesion size ranged from 5-86 mm with a mean (SD) size of 19.5 (14.3 mm). **Figure 1** showed a typical case of breast cancer as seen by FFDM and confirmed by histopathology report.

Women diagnosed with breast cancer

Characteristics of screened women diagnosed with breast cancer (n=233) obtained at initial screening for the coverage year 2014-2019 are summarized in **Table 5**. The majority of cancer cases were in the age group 45-49 years (50/233 cases, 21.5%). The mean age (SD) was 55.3 (9.0) (range, 40.2-81.2 years). The majority had a postgraduate degree (30.0%). The majority were from Al-Asima (Capital) governorate (34.3%) and the minority were from Al-Jahra governorate (4.7%). In addition, the majority were referred to the program by the health care worker (43.4%). 36.4 % had a positive family history of breast cancer in a first-degree relative.

Statistical comparison of women with lesions determined by histopathology

Age differed among women with benign, malignant and high-risk tumors (P<.001) (**Table 6**). Post-hoc tests found specific differences in age between benign and malignant cases, and also between high-risk and malignant cases but no difference between benign and high-risk cases. There were no significant differences between governorates of residency (P=.248). Breast density in 6082 (41.2%) of 14773 of screened women were of category ACR C and ACR D (**Table 7**). There was a significant association between breast density and type of lesion (P=.011).

DISCUSSION

There are numerous global screening programs worldwide with structured screening services for women, according to IARC Handbooks of Cancer Prevention.[5] There is no global standard, however, on how screening should be carried out. The services are typically introduced either nationally or at the level of the state/province/region. Mammography is still the gold standard modality in diagnosing malignant breast lesions. The advantage of mammography is that it can detect an aggressive cancer earlier in its natural history, ideally while still localized to the breast, and with earlier treatment, arrest the natural history of progression from a localized cancer to a systemic cancer, thereby averting a premature death and preventing death from breast cancer.[5] Compared to ultrasound, lesions are easier to discern in mammography, and margin analysis is also more effective. Improved mammography sensitivity and precision is due to enhanced image quality in terms of spatial and contrast resolutions. An outstanding amorphous silicon detector material madewith a cesium iodide scintillator, a pixel size of 100 μm, and a voxel depth of 14 bits of gray shades on the imaging device are factors

Table 2. Outcomes of all screened women for mammography over the 5-year period (2014-2019) (n=14733).

Total number of screens done in 5 years	20483
Normal screens	17533 (85.5)
Abnormal screens	2950 (14.5)
Women with abnormal screens that proved negative with additional imaging	2378 (11.6)
Women with abnormal screens who required intervention	551
Screen detected breast cancer	233 (42.3)
Screen detected high-risk lesions	57 (10.3)
Screen detected benign lesions	261 (47.4)
Invasive cancer detection rate per 1000 women screened	13.6
In-situ (DCIS & LCIS) detection rate per 1000 women screened	2.5
Screen detected breast cancer rate	1.6
Interval cancers	34/14733 (0.23)
Tumor stage (TNM)	
Stage 0	27 (11.6)
Stage I	91 (39.1)
Stage II	64 (27.4)
Stage III	33 (14.2)
Stage IV	15 (6.4)
Stage NA	3 (1.3)

Data are number (%).

DCIS: ductal carcinoma in situ; LCIS: lobular carcinoma in situ; TNM: tumor node metastasis; N: number; and NA: none available

Table 3. Screening results at 5 consecutive 1-year screening periods.

Screening period	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	Total
Total number of screening mammograms	2974	3959	4203	4147	5200	20 483
Normal screens	2461 (82.7)	3455 (87.2)	3703 (88.1)	3464 (83.5)	4450 (85.6)	17 533
Abnormal screens recalled for additional imaging and recall rate	513 (17.2)	504 (12.7)	500 (11.9)	683 (16.5)	750 (14.4)	2950
Women with abnormal screens that proved negative with additional imaging	434 (84.6)	359 (71.2)	361 (72.2)	577 (81.5)	667 (88.9)	2398
Women with abnormal screens that were not resolved with additional imaging and required intervention	79 (18.2)	145 (40.4)	139 (38.5)	105 (18.2)	83 (12.4)	551
Screen detected breast cancer	26 (33.0)	60 (41.3)[a]	56 (40.2)	45 (42.8)	46 (55.4)	233
Screen detected high-risk lesions	0	25 (17.2)	12 (8.6)	20 (19.0)	2 (2.4)	59
Screen detected benign lesions	53 (67.0)	61 (42.0)	71 (51.0)	40 (38.0)	36 (43.3)	261
Cancer detection rate (invasive cancer and ductal carcinoma in situ) per 1000 women screened	8.7	15.2	13.3	10.9	8.8	
PPV for positive mammogram referred to biopsy	PPV1 (33)	PPV3 (40)	PPV5 (40)	PPV7 (43)	PPV9 (55)	
NPV for positive mammogram referred to biopsy	NPV1(100)	NPV3 (99)	NPV5 (100)	NPV7(100)	NPV9 (100)	
Sensitivity of positive mammogram referred to biopsy	100	95	100	100	100	
Specificity of positive mammogram referred to biopsy	98	98	98	98	99	
PPV for a positive mammogram among abnormal mammograms that required additional imaging	PPV2 (5)	PPV4 (12)	PPV6 (11)	PPV8 (7)	PPV10 (6)	
NPV for a positive mammogram among abnormal mammograms that required additional imaging	NPV2 (100)	NPV4 (99)	NPV6 (100)	NPV8 (100)	NPV10 (100)	
Sensitivity for a positive mammogram among abnormal mammograms that required additional imaging	100	95	100	100	100	
Specificity for a positive mammogram among abnormal mammograms that required additional imaging	84	89	89	84	86	
Tumor stage (TNM)						
Stage 0	2 (7.7)	6 (10.0)	7 (12.5)	5 (11.1)	7 (15.2)	27
Stage I	12 (46.2)	23 (38.3)	23 (41.1)	19 (42.2)	14 (30.4)	91
Stage II	6 (23.1)	14 (23.3)	13 (23.2)	13 (28.9)	18 (39.2)	64
Stage III	5 (19.2)	11 (18.4)	7 (12.5)	6 (13.4)	4 (8.7)	33
Stage IV	1 (3.8)	6 (10.0)	5 (8.9)	0 (0.0)	3 (6.5)	15
Stage NA	0 (0.70)	0 (0.0)	1 (1.8)	2 (4.4)	0 (0.0)	3

Data are number (%). [a]Three cases were missed cancer; TNM: tumor node metastasis; PPV: positive predictive value; NPV: negative predictive value that improve spatial resolution. In addition, the use of breast compression has been used to achieve immobilization and further minimize the dose of radiation by reducing breast thickness. However, the use of a proper range of 25-30 kV during the operation, a Mo/Mo and/or Rh/Mo target/filter material, 5:1 anti-scatter grid, and breast compression have achieved contrast resolution.[1,2] Sensitivity and precision were also improved due to the basic mammography concept, which eliminates

Table 4. Histopathology findings of detected breast lesions for the 5-year period (2014-2019) (n=551).

Malignant (n=233, 42.3)	
Invasive ductal carcinoma	162 (69.5)
Invasive lobular carcinoma	15 (6.4)
Invasive tubular carcinoma	1 (0.42)
Mucinous carcinoma	6 (2.5)
Mix Invasive ductal and lobular carcinoma	4 (1.7)
Invasive mammary carcinoma	10 (4.2)
Invasive cribriform carcinoma	2 (0.8)
Invasive micropapillary carcinoma	1 (0.42)
Ductal carcinoma in situ	32 (13.7)
High-risk (n=57, 10.3)	
Atypical ductal hyperplasia	8 (14.0)
Fibroepithelial lesion	10 (17.5)
Lobular carcinoma in situ	5 (8.7)
Papillary lesion	28 (49.1)
Phyllodes tumor	6 (10.5)
Benign (n=261, 47.4)	
Mastitis	6 (2.3)
Adenosis	48 (18.3)
Benign breast tissue +/- calcifications	79 (30.2)
Fibroadenoma	92 (35.2)
Fibrosis	14 (5.3)
Hamertoma	3 (1.1)
Lobular hyperplasia	2 (0.7)
Psuedo angiomatous stromal hyperplasia (PASH)	2 (0.7)
Usual ductal hyperplasia	15 (5.7)

Data are number (%).

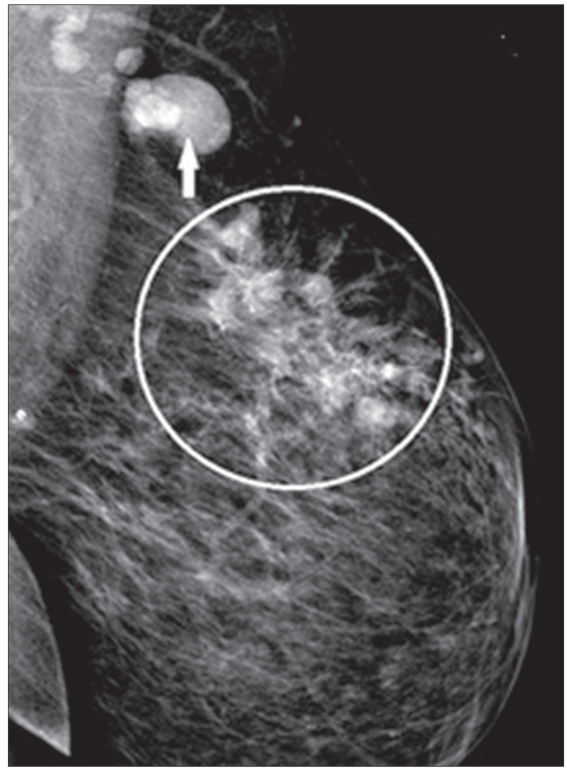

Figure 1. A full-field digital mammography mediolateral oblique projection of the left breast on a 49-year-old screened patient showing a large irregular dense mass with calcification involving the whole upper outer quadrant (circle), classified as BI-RADS 4 (also note the calcified fibroadenoma in the left upper outer quadrant [arrow]). Histopathology confirmed this to be invasive ductal carcinoma.

anatomical noise, so the lesions were better visualized and more reliably classified according to the ACR BI-RADS criteria. While the standard screening technology in all countries is mammography, some supplement mammography with ultrasound, digital breast tomosynthesis (DBT) or magnetic resonance imaging (MRI), as well as contrast-enhanced mammography.[9,10]

Most breast cancer screening programs offer mammography to normal- risk women beginning at age 40-50 years and ending at age 69-74 years, typically at 2-year intervals.[11] In Kuwait our target population was 40-69 years old and the target screening interval is 1 year. Our analysis using ANOVA showed a significant difference in age between the three lesion groups (P<.001). Post-hoc tests found differences in age between benign and malignant cases, and also between high-risk and malignant cases but no difference between benign and high-risk cases.

Data from the Kuwait cancer registry suggest that since 1974, the age-standardized incidence rate of

Table 5. Characteristics of women diagnosed with breast cancer (n=233).

Age	
40-44	25 (10.7)
45-49	50 (21.5)
50-54	49 (21.0)
55-59	36 (15.4)
60-64	33 (14.2)
65-69	23 (9.90)
70 and above	17 (7.30)
Educational level	
Illiterate	10 (4.0)
Primary school	18 (8.0)
Secondary school	33 (14.0)
High school	46 (20.0)
College degree	55 (24.0)
Postgraduate education	71 (30.0)
Governorate of residency	
Al-Asima (Capital)	80 (34.3)
Hawally	63 (27.0)
Al-Farwanyia	28 (12.0)
Al-Ahmadi	24 (10.3)
Mubarak Al-Kabeer	23 (10.0)
Al-Jahra	11 (4.70)
Unknown	4 (1.70)
Invitation method	
Referred from health care worker (HCW)	101 (43.40)
Brochure, banner, events or campaigns	69 (29.6)
Informed by a relative or friend	35 (15.0)
Advertisement on television, radio, magazine, and newspapers	22 (9.40)
Social media	0 (0.0)
Others	6 (2.60)
Family history of breast cancer in first-degree relative	
Yes	85 (36.40)
No	148 (63.60)

Table 5 (cont.). Characteristics of women diagnosed with breast cancer (n=233).

Current use of estrogen	
Yes	21 (9.0)
No	212 (91.0)
Age at first birth including stillborn	
<20yrs	63 (27.0)
≥20yrs	153 (65.70)
No children	17 (7.30)
Number of children including stillborn	
<3	32 (13.70)
≥3	184 (79.0)
None	17 (7.30)

Data are number (%).

breast cancer has increased fourfold, possibly due to changing lifestyle factors, such as dietary changes, reduced physical activity, and increasing obesity.[12,13] Early breast cancer detection is important; mammography screening reduces mortality from breast cancer.[13,14] The Kuwait cancer registry information confirms the availability of treatment, with 77% of breast cancer patients undergoing surgery, 66% receiving chemotherapy, 47% receiving radiation therapy, and 39% receiving hormonal treatment.[15]

KNMSP was introduced in 2014. The goal was to provide high-quality mammography that meets international criteria for early detection of invasive asymptomatic breast cancer, leading to a reduction in mortality. Previously, screening for breast cancer was solely at the request of the patient or physician, which was encouraged after KNMSP was introduced. The present study demonstrates that KNMSP has been successful with an appropriate yearly sensitivity range of 95-100% and specificity range of 98-99% as established by the Mammography Quality Standard Act and timely detection of early-stage breast cancers. The limited population of Kuwait encourages the centralization of facilities, offering resources to ensure that women undergo extra imaging and biopsy if appropriate. Notably, in this 5-year period, only three patients were lost to follow-up, and a prompt diagnosis was observed, with 80% of patients receiving a diagnosis meeting a program target within 4 weeks at most from the initial screening.

In our previous 2-year report analysis the recall rate was 14.7% with a PPV1 of 8.2% and PPV3 of 37.1%,

Table 6. Age at time of examination and governorate of residency of all screened women with analysis by number of women with benign, high risk or malignant lesions (n=551).

	All	Benign	High-risk	Malignant	*P* value
Age (years)	20480 (100)	261 (100)	57 (100)	233 (100)	
Mean (SD)	51.8 (8.2)	51.6 (8.5)	51.0 (8.4)	55.3 (9.0)	<.001[a]
Median [IQR]	51.0 [12.0]	50.4 [12.6]	49.6 [13.9]	54.0 [14.0]	<.001[b]
Governorate	20456 (99.8)	260 (99.6)	57 (100)	229 (98.3)	
Hawalli	6084 (29.7)	75 (28.8)	15 (26.3)	63 (27.5)	
Al-Farwaniya	1985 (9.7)	22 (8.5)	5 (8.8)	28 (12.2)	
Al-Ahmadi	1507 (7.4)	25 (9.6)	4 (7.0)	24 (10.5)	.248[c]
Al-Jahra	1134 (5.5)	18 (6.9)	9 (15.8)	11 (4.8)	
Al-Asimah (Capital)	7867 (38.5)	89 (34.3)	21 (36.8)	80 (34.9)	
Mubarak AlKabeer	1879 (9.2)	31 (11.9)	3 (5.3)	23 (10.1)	

Data other than age are number (%). [a]ANOVA F test (benign vs high-risk vs malignant); [b]Kruskal-Wallis test; [c]Chi square test. In post-hoc tests age between benign and malignant cases and between high risk and malignant cases diifered, but the difference between benign and high risk cases was not statistically significant.

Table 7. Breast density of all screened women with analysis of women with benign, high-risk or malignant lesions.

Characteristic	All	Normal	Benign	High-risk	Malignant	*P* value
Breast density	14773	14222	261	57	233	
Entirely fat (ACR A)	1957 (13.2)	1910 (13.4)	25 (9.6)	3 (5.3)	19 (8.2)	
Scattered fibro-glandular densities (ACR B)	6734 (45.6)	6499 (45.7)	106 (40.6)	27 (47.4)	102 (43.8)	.011[a]
Heterogeneously dense (ACR C)	5460 (37.0)	5216 (36.7)	115 (44.1)	25 (43.8)	104 (44.6)	
Extremely dense (ACR D)	622 (4.2)	597 (4.2)	15 (5.7)	(3.5)	8 (3.4)	

Data are n (%). [a]Chi-square test comparison of benign, high risk and malignant by characteristic breast density.

and the detection rate was 10.7 invasive cancers per 1000 women screened.[6] In our current study the recall rate fluctuated between 11.9% and 16.5% (mean of 14.3%) which is in the same range as the previous study.[6] In addition, the PPV range for a positive mammogram referred for biopsy was 33-55% and of a positive mammogram among all abnormal mammography cases that required additional imaging was 5-12%. The performance benchmarks for mammography among American Radiologists were lower than our results, including a 9.8% recall, 4.8%, PPV1 and 33.8% PPV3.[16] The ductal carcinoma in situ and lobular carcinoma In situ detection rate was 2.5 per 1000 women screened. In addition, the detection rate for invasive breast cancer was 13.6 per 1000 women screened, which is higher than the American rate of 4.6 per 1000.[16] After completion of diagnostic workup, 1.6% of screened women were diagnosed with screen-detected breast cancer.

In our study, there was a significant association between breast densities among the different lesion groups (*P*=.011). Of the women screened, 41.2% were of category ACR C and ACR D breast density which require a complementary ultrasound even if the mammogram was normal. In our study, we did not do ultrasound for all ACR C and D cases due to the large number of cases. Our future plan is to use an automated breast ultrasound unit for this category of patients in order to resolve this issue.

It is important to detect early-stage tumors because treatment is more successful. An earlier stage of diagnosis was noted compared to the Kuwait cancer registry data before the KNMSP was introduced.[16-18] Participation rates also differ dramatically (20%-50%) from country to country.[19,20] In Kuwait, the participation rate was 7.8% of the target population for a new initiative with only five facilities. Screening opportunities may have been provided to additional women, but this information is unavailable. The 20th anniversary report 1990-2010 of the Ontario Breast Screening Program found that the participation rate rose from 1.5% in 1990-1991 to 42% in 2008-2009.[21] In 2007, an initial program screen was given to 77.3% of women.

One of the drawbacks of our research is the low participation rate. The majority of our patients were referred to us by their health care workers, which emphasizes the significance of health care worker cooperation with the program. We are currently embarking on studies to determine reasons for why Kuwaiti women fail to get screening mammograms and the economics of organized breast cancer screening programs in Kuwait. These studies will assess areas of improvement in the current breast cancer screening program to accelerate the participation rate, which aims to screen 70% of the population.

Despite radiographers performing the procedures and interpretation by a trained/registered radiologist team, false-positive and false-negative results may have occurred. Errant results may be attributed to poor positioning, perception error, incorrect interpretation of a suspicious finding, subtle characteristics, and slow lesion development.[1,2,22] Although FFDM has many benefits, there are also few drawbacks. The most notable of these drawbacks is that some of the malignancies may be missed or misinterpreted; there is a restricted opportunity to image microcalcification and there is a concern with the radiation dose.[23-26] In addition, in Kuwait, digital breast tomosynthesis (DBT) is not used as a screening tool. Despite DBT having a few drawbacks, several authors are investigating the possibilities of using it effectively in screening.[27] In addition, clinical trials have shown that contrast-enhanced FFDM or DBT provides results consistent with MRI, thus increasing the diagnostic accuracy of FFDM.[28] The impact o the KNMSP on mortality from breast cancer can be assessed by long-term follow-up. In addition, to detect breast cancer as early as possible, we suggest more studies with a larger population of Kuwaiti women living in different provinces of Kuwait.

In conclusion, FFDM screening increases the clinical performance of mammography in breast cancer detection, which may have a positive effect on the mortality rate. In the upcoming years, we plan to screen more women, aiming at 70% of the population. This form of study can be used as a scientific basis for the delivery of health care decisions.

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Ethical consideration

The study is approved by the local institutional research committee (Approval No. 660/2017). The women who participated in this research received informed consent.

Disclaimer

All authors have given final approval of this manuscript to be published. In addition they have agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Centers for Disease Control and Prevention. Cancer among Women. Available at:http://www.cdc.gov/cancer/dcpc/data/women.htm. Accessed June 8 2021.
2. World Health Organization. Breast cancer. prevention and control [Online]. Available from: https:// www.who.int/cancer/detection/breastcancer/en/. Accessed 26 March 2021.
3. World Health Organization: Cancer Country Profiles - Kuwait. Available from: https://gco.iarc.fr/today/ data/factsheets/populations/414-kuwait-fact-sheets.pdf. Accessed on December 2020.
4. Al Ramadhan MA. Eradicating Breast Cancer. Longevity Impact on Kuwaiti Women. Asian Pac J Cancer Prev. 2017; 18: 803-09.
5. IARC Working Group on the Evaluation of Cancer-Preventive Strategies. Breast cancer screening, Volume 15. Lyon: IARC Press, 2016." ISBN-13 (Print Book) 978-92-832-3015-1
6. Mango VL, Al-Khawari H, Dershaw D, Ashkanani MH, Pennisi B, Turner P et al. Initiating a National Mammographic Screening Program: The Kuwait Experience Training with a US Cancer Center. J Am Coll Radiol. 2019; 16 (2): 202–207.
7. Burnside ES, Sickles EA, Bassett LW, Rubin DL, Lee CH, Ikeda DM, et al. The ACR BI-RADS experience: learning from history. J Am Coll Radiol. 2009; 6(12):851-60.
8. American College of Radiology: ACR BI-RADS-atlas. 5th ed. Reston, Virginia: American College of Radiology; 2013.
9. Roganovic D, Djilas D, Vujnovic S, Stojanov D, Dragan Stojanov. Breast MRI, digital mammography and breast tomosynthesis: Comparison of three methods for early detection of breast cancer. Bosn J Basic Med Sci 2015;15:64-68.
10. Asbeutah AM, Karmani N, Asbeutah A, Echreshzadeh YA, AlMajran AA, Al-Khalifah KH. Comparison between Digital Breast Tomosynthesis and Digital Mammography for Detection of Breast Cancer in Women in Kuwait. Med. Prin. Pract. 2019; 28:10-15.
11. von Karsa L, Dean PB, Arrossi S, Sankaranarayanan R. Screening – principles. In: Stewart BW, Wild CP, editors. World cancer report 2014. Lyon, France: International Agency for Research on Cancer; 2014a; pp. 322–9.
12. National Cancer Institute. https://www.cancer.gov/types/breast/mammograms-fact-sheet. Accessed on December 7, 2016
13. Elbasmi A, Al-Asfour A, Al-Nesf Y, Al-Awadi A. Cancer in Kuwait: magnitude of the problem. Gulf J Oncolog. 2010;8:7-14.
14. Cady B, Michaelson JS, Chung MA. The "tipping point" for breast cancer mortality decline has resulted from size reductions due to mammographic screening. Ann Surg Oncol 2011; 18:903-6.
15. van Schoor G, Moss SM, Otten JDM, Donders R, Paap E, den Heeten GJ, et al. Increasingly strong reduction in breast cancer mortality due to screening. Br J Cancer. 2011; 104:910-914.
16. El-Basmy AA, Al-Awadhi AA. Kuwait cancer registry annual report 2012. State of Kuwait, Ministry of Health, Kuwait Cancer Control Center.
17. Rosenberg RD, Yankaskas BC, Abraham LA, Sickles EA, Lehman CD, Geller BM, et al. Performance benchmarks for screening mammography. Radiology. 2006; 241:55-66.
18. Monticciolo DL, Rebner M, Appleton CM, Newell MS, Farria DM, Sickles EA, et al. The ACR/Society of Breast Imaging resident and fellowship training curriculum for breast imaging, updated. J Am Coll Radiol. 2013; 10: 207-210.
19. International Agency for Cancer on Research (IARC), World Health Organization. IARC Handbooks of Cancer Prevention. Volume 7: Breast Cancer Screening. IARC Press; 2002. Available from: http://www.iarc.fr/en/publications/pdfs-online/prev/handbook7/Handbook7_Breast-4.pdf. Accessed 15 Mar 2018.
20. International Cancer Screening Network: Breast cancer screening programs in 26 ICSN countries : organization, policies, and program reach. https://web.archive.org/web/20170721083337/https://healthcaredelivery.cancer.gov/icsn/breast/screening.html. Accessed 15 Oct 2017.
21. Rabeneck L. Ontario Breast Screening Program: 20th Anniversary Report 1990-2010; 2011.
22. Park JM, Franken EA, Jr, Garg M, Fajardo LL, Loren T. Niklason LT et al. Breast tomosynthesis: present considerations and future applications. Radiographics. 2007;27:S231–S240.
23. Kopans DB. Digital breast tomosynthesis: a better mammogram. Radiology. 2013;267:968–969
24. Spangler ML, Zuley ML, Sumkin JH, Abrams G, Ganott MA, Hakim C et al. Detection and classification of calcifications on digital breast tomosynthesis and 2D digital mammography: a comparison. AJR. 2011;196:320–324.
25. Svahn TM, Houssami N, Sechopoulos I, Mattssonet S. Review of radiation dose estimates in digital breast tomosynthesis relative to those in two-view full field digital mammography. Breast. 2015;24:93–99.
26. Alkhalifah K, Brindhaban A. Investigation of Exposure Factors for Various Breast Composition and Thickness in Digital Screening Mammography Related to Breast Dose. Med Princ Pract. 2018; 27(3):211-216.
27. Per Skaane. Breast cancer screening with digital breast tomosynthesis. Breast Cancer 2017;24:32–41.
28. Lobbes MBI, Houben I. Contrast-enhanced tomosynthesis: The best of both worlds or more of the same? European Journal of Radiology. 2016;85:507-508.