Breast-cancer screening with trained volunteers in a rural area of Sudan: a pilot study

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Summary

Background Breast cancer has a low cure rate in low-income and middle-income countries because patients often present with late-stage disease that has metastasised to other organs. We assessed whether the implementation of a cancer awareness and breast examination programme that uses local, volunteer women could increase the early detection of breast cancer in a rural area of sub-Saharan Africa.

Methods We did this pilot study in two counties in Gezira State, Sudan. We chose Keremet (56 villages) as the experimental county and Abugota (79 villages) as the control county. Female volunteers from villages in Keremet were trained in the detection of breast abnormalities. When trained, volunteers visited households in their village and screened women aged 18 years or older for breast abnormalities, referring women with suspected breast cancer for medical diagnosis and, if necessary, treatment at the district hospital. We also ran a cancer awareness programme for both men and women in study villages. Villages in the control population received no intervention. This study is ongoing.

Findings Between Jan 1, 2010, and Oct 10, 2012, 10 309 (70%) of 14 788 women in Keremet were screened. 138 women were identified as having breast abnormalities and were referred to the district hospital for diagnosis and treatment. 20 of these women did not report to the hospital. Of the 118 women who did report, 101 were diagnosed with benign lesions, eight with carcinoma in situ, and nine had malignant disease. After treatment, 12 of the 17 women with either carcinoma in situ or malignant disease (four had early breast cancer and eight had ductal carcinoma in situ) were disease-free and had a good prognosis. In the control villages, only four women reported to the centre: one was found to have a benign lesion while three were diagnosed with advanced disease.

Interpretation Our findings show that a screening programme using local volunteers can increase the detection of breast cancer in asymptomatic women in low-income rural communities. These findings can inform policy-makers' decisions in the design of cancer control programmes in Sudan and other similar areas in sub-Saharan Africa.

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Introduction

Breast cancer is the most commonly diagnosed cancer in women and the second leading cause of death in women in Africa, with much geographical variation in incidence and mortality within the continent.[1] The age-adjusted incidence of breast cancer is 38·1 per 100 000 per year in southern Africa, 32·7 per 100 000 per year in northern Africa, 19·3 per 100 000 per year in eastern Africa, and 38·1 per 100 000 per year in western Africa,[1] with much variation between urban and rural populations.[2,3] In Sudan, breast cancer accounts for around a third of all cancers.[3] In a descriptive study done in Sudan in 2010, the prevalence of advanced, stage III or worse metastatic disease was higher in women living in rural areas than it was in women living in urban areas (p=0·002).[4] In general, women living in sub-Saharan African countries present with advanced-stage disease that is difficult to treat and results in death.[5] By contrast, breast cancer deaths in high-income countries are in decline. This decrease is largely driven by the implementation of cancer-screening programmes and the availability of effective treatments.[6] However, the implementation of similar screening programmes in Africa is challenging. Sub-Saharan African countries do not have the infrastructure, resources, or trained personnel to undertake such programmes effectively,[7] especially in areas outside major cities.

As well as the restricted capabilities of health-care systems, health education is poor in sub-Saharan African countries and few people are aware of cancer. In high-income countries, detection of a mass or a visible sore usually prompts medical investigation but, for most African women, the appearance of such a mass is usually thought to be non-life threatening and is ignored. Some women might seek treatment from a traditional healer.[8] For others, to leave familiar surroundings and seek medical care often seems too difficult (eg, they might have to travel long distances), too expensive, or a cause of too much anxiety. These women do, however, seek medical treatment during the later stages of their disease, when they have pain and disability, at which point their chance of successful treatment is substantially reduced.

The absence of readily available sources of information, poor transportation systems, and the scarcity of trained, local professionals perpetuates this problem.[9]

Village health administrations in most African countries, including Sudan, consist of the village chief, midwives, and a village dispensary where nurses with varying degrees of training dispense health-care services, including some pharmaceuticals.[10,11] In Sudan, these nurses usually refer patients with advanced breast masses to the district hospital. At the district hospital, a biopsy might be done, but the tissues are ordinarily sent to a central facility in Khartoum, the capital of Sudan, for pathological assessment. Although Sudan has more than one cancer centre (one in Khartoum and one in Wadmadani, which is about 112 miles south of Khartoum), referral to these institutions is too late for successful treatment for most patients with cancer—patients and their families are often briefed in palliative care and return home to await death from advancing cancer.

In this study, we assessed whether cancer can be detected earlier with the provision of simple educational messages, and whether provision of such health messaging could increase the chances of women receiving timely treatment. If successful, such programmes could decrease morbidity and increase women's survival and number of productive years of life in low-resource and middle-resource African countries.

Methods

Study population and design

We did this study in two counties in rural areas of Gezira State, Sudan. Although, Gezira has 31 counties, the administrations from only 15 agreed to participate in this study. From these 15 counties, we selected Keremet (El Managil District; 56 villages) and Abugota (Elhassahisa District; 79 villages) because they were among the closest to the National Cancer Institute, Gezira University (NCI-UG) cancer centre and had the most stable populations. The two counties, which are 100 km apart, share similarities in their remoteness from modern health-care facilities, demographics, high proportion of the population working in the agriculture sector, and little awareness of breast cancer in the general population. Furthermore, the population of both counties have restricted resources, poor education, and most women work at home. In both counties, houses are very basic. Small dispensaries in both counties provide primary medical services. Patients are referred by village health workers to the University of Gezira Teaching Hospital and National Cancer Institute, the only facilities that provide tertiary medical care or cancer treatment in Gezira. Keremet was chosen as the experimental county and Abugota as the control county by coin toss.

	Keremet (experimental population)	Abugota (control population)
Number of villages	56	79
Villages screened	33	0
Number of women ≥18 years	14 788*	24 550
Number of women screened	10 309 (70%)	0 (0%)

*from the 35 participating villages.

Table 1: **The proportion of villages and women screened in Keremet and Abugota**

The study was approved by the Sudanese National Cancer Institute review board committee.

In November, 2008, before the study began, the medical team and study investigators, including oncologists, pathologists, nurses, and statisticians from NCI-UG met with the Gezira state governor to discuss the objectives of the project and expected outcomes.

We had intended to screen all visible and palpable cancers, but chose to screen only breast cancer in this pilot study. With the governor's approval, we met with village leaders from 35 of the 56 villages in Keremet (we did not include the other 21 villages because they consisted of small nomadic communities). We educated the leaders about cancer and its socioeconomic effect on their village. We explained that a simple screening programme that had no financial cost to the village, but used volunteers from the village, could have a positive effect by reducing pain and suffering from cancer. We also explained that the project would educate and train the villages' own women (aged 20–40 years) in cancer awareness and early signs and symptoms of the disease. Subsequently, the trained women would go door-to-door and do breast examinations for women aged 18 years or older.

Village chiefs chose women on the basis of their level of education and perceived competency to do the task. These women attended a 5 day, intensive training course, which took place on March 1–5, 2009. We gave no compensation to these volunteers. The young women were taught and trained by both male and female medical oncologists and nurses. Female doctors and nurses taught the practical sessions. The course covered the biology of cancer, cancer risk factors, the importance of early detection, and how to examine breasts for abnormalities. The women were trained in breast self-examination and trained in clinical breast examination and the use of mammograms for early breast cancer detection. To aid learning, the women were given presentations, handouts, brochures, and hands-on practical sessions covering breast examinations. We assessed all womens' competences on the basis of their ability to do breast examinations on prosthetic breast models, on themselves, and on their fellow volunteers. We also assessed women on their ability to undertake interviews and complete the referral forms. On completion of the course, the women were given certificates.

After receiving consent from participating village chiefs, the screening programme was launched in

tandem with a cancer awareness campaign in each participating village. Classroom and public presentations in local school cafeterias, schoolyards, and mosques were offered in a simple and interactive session to educate the local population (both sexes) about breast cancer and the importance of early detection. The trained volunteers' task of home visits and breast examinations were carefully explained and breast-cancer examination techniques were shown. At the presentations, we distributed education materials such as brochures illustrating breast-cancer examinations and information about cancer.

Procedures

Trained volunteers went door-to-door offering and doing breast examinations for breast masses and other signs of possible breast cancer. This was done for every household, targeting women aged 18 years or older. Volunteers collected sociodemographic data (eg, age, marital status, number of children, level of education, etc) and information about last menstrual cycle and history of breast health problems. The volunteers recorded information for every woman on a form. The volunteers also had a document with an illustration of the breasts so that the location of abnormal findings could be noted.

	Population (n)	Women and girls in village (n)	Women (aged ≥ 18 years) in village (n)	Women (aged ≥ 18 years) screened (n)	Women screened per village (%)	Patients referred (n)	Patients who reached the NCI-UG (n)	Patients who were referred but did not present at the NCI-UG (n)	Number of volunteers	Comments
Kitrah (two villages together)	1669	855	486	486	100%	4	4	0	2	
Abohajab (two villages together)	1746	894	426	403	95%	17	15	2	2	
Umdeganah	2111	1101	491	440	90%	3	3	0	1	
Shasha	394	202	145	145	100%	4	4	0	1	
Elfakhakher	2969	1520	724	193	27%	3	3	0	1	Volunteer was shy (had weak social skills)
Elkremet (five villages together)	14 252	7297	3476	2911	84%	32	25	7	5	
Abatah	3112	1499	707	555	79%	8	5	3	2	
Wadrazoog and Taybah	4193	2147	1023	582	57%	4	4	0	2	
Elzareeba	3507	1796	886	886	100%	21	18	3	1	
Abraq	2473	1266	403	311	77%	1	1	0	1	
Massoud	991	455	201	201	100%	11	10	1	1	
Elshitatah	2227	1140	549	549	100%	5	5	0	1	
Elserair	1715	878	418	78	19%	0	0	0	1	Volunteer expected some compensation
Amara Abdelrahim-1	3266	1672	796	612	77%	10	7	3	1	
Kamelnoomak	3302	1591	606	452	75%	0	0	0	1	
DaouAhamda	1162	595	284	220	77%	0	0	0	1	
DaouAgleen	1628	839	399	180	45%	0	0	0	0	Screened by volunteer from Daouahamda
Fakiabiad	1100	513	173	124	72%	4	4	0	1	
Bashair	813	406	198	12	6%	5	5	0	0	Screened by volunteer from Fakiabiad
Village 65	990	486	219	171	78%	1	1	0	0	Screened by volunteer from Kamelnoomak
Umbeabush and Karamala	2324	1190	567	327	58%	3	2	1	1	One volunteer screened both villages
Amara Abedlrahim-2	1776	909	433	158	36%	0	0	0	1	
Wadelameen	1002	486	280	267	95%	2	2	0	1	
SerarAldar	799	360	157	0	0%	0	0	0	0	Village not screened, no trained volunteer
FakiBasheer	786	389	198	0	0%	0	0	0	0	Village not screened, no trained volunteer
Altaqie and Hamral	2227	1140	543	46	8%	0	0	0	1	Volunteer was shy (had weak social skills)
Total	62 544	31 626	14 788	10 309	70%	138	118	20	29	

NCI-UG=National Cancer Institute, Gezira University. Some villages are grouped together due to the difficulty in demarcation between villages.

Table 2: **The number of women screened and the number of those referred or diagnosed with cancer in each village in Keremet**

Women with suspected breast abnormalities were referred to the NCI-UG in Wadmadani for medical diagnosis and disease management. No assistance was given to travel to the NCI-UG. Complete diagnostic procedures were done for every referred woman. Diagnosis was made on the basis of a mammogram, ultrasound, biopsy, and pathological examination. In Sudan, medical treatment in Sudan is given free of charge, but women have to pay for diagnosis. Women, in the experimental arm only, did not have to pay for diagnosis. Any woman diagnosed with breast cancer was treated, and managed according to the standard protocol for their case. Patients with early breast cancer (stage I and stage II [T1T2N1]) underwent conservative surgery, chemotherapy according to the Nottingham prognostic index, radiation therapy, and then hormonal therapy, depending on their oestrogen and progesterone receptor status. Patients with advanced disease (stage III and stage IV [T3T4N2N3]) received neoadjuvant chemotherapy followed by surgery with axillary clearance. Surgery was followed by radiotherapy and hormonal treatment. Patients with metastatic breast cancer were treated with chemotherapy and radiation therapy for palliation.

For first-line chemotherapy, patients received cyclophosphamide, doxorubicin, and fluorouracil for younger women (premenopausal) and a combination of cyclophosphamide, methotrexate, and fluorouracil for older patients (postmenopausal). Second-line chemotherapy consisted of a taxane-based regimen (paclitaxel or docetaxel plus cyclophosphamide) and doxorubicin or gemcitabine and cisplatin. Third-line treatment was given at clinicians' discretion and consisted of irinotecan and capecitabine when available. Hormonal treatment was tamoxifen for premenopausal women. Postmenopausal women received tamoxifen for 2–3 years followed by letrozole. Radiation therapy was equivalent to 50 Gy per dose, given in 18–20 fractions.

Role of the funding source

The sponsor of this study was not involved in the study design, data interpretation, or decision to submit this publication. The corresponding author had full access to all of the data and the final responsibility to submit this publication.

	Keremet (experimental group)	Abugota (control group)
Benign lesions*	101	1
Ductal carcinoma in situ	8	0
Malignant disease	9	3
Women referred but who did not report to NCI-UG	20	NA
Total	138	4

NCI-UG=National Cancer Institute, Gezira University. *Included fibroadenoma or fibroadenosis, mastitis, ductectasia, galactocele, and typical breast deformities. NA=not applicable.

Table 3: **Diagnosis of patients in experimental and control villages**

Results

The findings presented here are from the beginning of screening on Jan 1, 2010, to the date of last follow-up on Oct 10, 2012.

Only 29 of the 35 villages that agreed to participate in screening sent a volunteer to the training course. Nevertheless, women in 33 villages were screened because volunteers from neighbouring villages did screening in four villages that did not send an agent for training (tables 1 and 2). The women in the other two villages refused to be seen by volunteers from another village.

10 309 women were screened (table 2). Women had either never attended school or had received 4–8 years of schooling. Due to the inconsistencies in the reporting of other baseline data we were unable to study these characteristics further.

Villages with a high number of screened women such as Elkeremet villages, Elzareeba, and Amara Abdelrahim-1 had a high number of suspected cases (table 2). On average, villages screened by volunteers from other villages had a smaller proportion of women screened than those screened by local volunteers (table 2). As anticipated, villages with less active volunteers had fewer women screened, and fewer cases were detected in these villages.

Of the screened women, 138 were referred to the NCI-UG centre; 20 of these women did not attend the centre and received no further follow-up, diagnosis, or treatment. Of the 118 that did report, 101 were diagnosed with fine-needle biopsy with benign lesions and were treated and discharged (table 2). On further clinical examination of the remaining 17 patients, eight were diagnosed with non-palpable ductal carcinoma in situ, detected on mammographic examination (table 3). These eight patients were treated and, as of Oct 10, 2012, were under clinical and mammographic follow-up with no sign of progression.

The remaining nine women were diagnosed with breast cancer: four had localised tumours without lymph node involvement, three had tumours that had spread to the first axillary lymph node, and two had metastatic disease (table 4). Four patients diagnosed with localised breast cancer with or without lymph node involvement received treatment and were, as of last follow-up, disease-free with good prognosis (table 4). Two patients with localised disease and lymphatic spread refused treatment (although one of these patients has subsequently presented to the centre in October, 2011, with bone and lung metastasis and was receiving treatment as of last follow-up; table 4). The two patients with metastatic disease died shortly after diagnosis, and thus did not receive treatment (table 4). One of the women diagnosed with localised cancer was already aware of her cancer before the screening programme and was receiving treatment from the Radiation and Isotope Centre in Khartoum.

	Description	Date of diagnosis	Comments (as of last follow-up on Oct 10, 2012)
Keremet (experimental group)			
Patient number one	IV (T4N2M1)	May, 2009	Died 2 months after diagnosis. ER/PR status not tested.
Patient number two	I (T1N0M0)	July, 2009	Completed WLE and radiotherapy. Alive, receiving tamoxifen, good prognosis. ER/PR positive.
Patient number three	IV (T3N1Mx)	August, 2009	Refused treatment at initial diagnosis. After 1 year returned to the centre and diagnosed with invasive cancer that metastasised to the bone and lung. On treatment, chemotherapy (TAC), and doing well ER/PR negative.
Patient number four	IIA (T2NxM0)	August, 2009	Refused surgery, received chemotherapy (TAC) and radiotherapy. ER/PR positive. On tamoxifen and fluorouracil; alive with good prognosis.
Patient number five	IIA (T2N1M0)	March, 2010	Treated with surgery (mastectomy) and was then given chemotherapy (CAF). On regular fluorouracil, with a good prognosis. ER/PR negative.
Patient number six*	IIB (T3N0M0)	December, 2009	Treated at another cancer centre in Khartoum. No further information.
Patient number seven	IV (T3N2M1)	May, 2012	Died after diagnosis and before treatment. ER/PR negative.
Patient number eight	IIB (T3N0M0)	August, 2011	Treated with WLE and received chemotherapy (CAF), radiation on and tamoxifen tamoxifen. Patient has a good prognosis. ER/PR positive.
Patient number nine	Stage unknown (T2N0Mx)	December, 2011	Refused treatment after diagnosis (cytology). Expected to come back with metastasis. ER/PR status not tested.
Abugota (control group)			
Patient number one	IV (T3N2M1)	December, 2009	On chemotherapy (CAF). Disease progressing, ER/PR negative, with a poor prognosis.
Patient number two	IIA (T2N1M0)	March, 2012	Underwent surgery (mastectomy) then chemotherapy (CAF) and radiotherapy (ER/PR positive). On tamoxifen and regular fluorouracil.
Patient number three	IV (T4CN3M1)	March, 2011	On chemotherapy (second-line; CAF then TAC) with diseases progression, ER/PR positive, with poor prognosis.

CAF=cyclophosphamide, doxorubicin, and fluorouracil. ER=oestrogen receptor. PR=progesterone receptor. TAC=docetaxel, doxorubicin, and cyclophosphamide. WLE=wide lesion excision.

Table 4: **Patients diagnosed with cancer during the study period in Keremet and Abugota**

By contrast, only four women in Abugota visited the NCI-UG with breast abnormalities, all of whom had referred themselves. One woman had a benign lesion. The remaining three women had advanced disease (table 4), two of whom received treatment but had poor prognosis; their disease has subsequently progressed. The third patient had completed treatment and was in remission as of October, 2012.

Discussion

Our findings show that a screening programme using local volunteers is feasible in low-income rural communities and can increase the detection of breast cancer in asymptomatic women in low-income rural communities. We know of no other study to test such a programme in rural areas of sub-Saharan Africa (panel).

Despite the pilot nature of the study and the small size of the screened population, this programme succeeded in identifying women with early stage cancer or with carcinomas in situ. Nine women were diagnosed with cancer; of whom four had early stage disease with no lymph node involvement (stage I and II [T1–T2N0Mx]) and eight women were diagnosed with ductal carcinoma in situ. Only one woman in the experimental county had been aware of her cancer and was undergoing treatment at the time of screening. Therefore, 12 women were diagnosed with breast abnormalities that otherwise would later have been diagnosed as advanced cancer. As of the date of last follow-up, these women were receiving treatment, were disease-free, and had a good prognosis. By contrast, only four women in the control county presented to the NCI-UG, of whom three were diagnosed with advanced invasive cancer.

Although we do not have sufficient follow-up to determine whether the screening programme has an effect on survival, diagnosis of breast cancer at an early stage is generally associated with improved cancer survival.[12] Breast cancer is common in high-income countries, but the cure rate in these countries is high—eg, 90% in the USA—because of early detection and prompt treatment.[13,14] The USA and other high-income countries have implemented organised breast-screening programmes for early detection of breast cancer using mammography. However, African countries such as Sudan do not have the equipment, trained personnel, or supplies to organise a national or even a regional mammography-based screening programme.[15] Because of these limitations, implementation of a programme similar to the one tested in this study might help increase breast cancer survival and improve women's quality of life.

Results from randomised trials and other studies show that screening programmes that use mammography can help reduce the number of deaths from breast cancer in women aged 40–70 years, especially so in those older than 50 years.[16] However, findings from studies have not shown a benefit from regular screening in women younger than 40 years, which is the age at which most

African women are diagnosed with breast cancer.[17,18] In a retrospective study done at the NCI-UG, we reported that breast cancer in women from central Sudan started at age 20 years and gradually increased in prevalence in older women, peaking in women aged 34–45 years.[4] In this study, we screened women aged 18 years or older. There are no guidelines that state the age at which cancer screening should begin in Sudan or any other low-income and middle-income African countries, which means that screening programmes such as the one described in this study could be beneficial in low-income and middle-income African countries. Additionally, although mammography is clearly a life-saving technology, its role in the decrease in deaths due to breast cancer has been overestimated and its benefit have been widely debated.[19,20] Non-mammographic early detection through awareness campaigns have been shown to have substantial positive effects and to contribute to almost half of the decrease in breast cancer mortality in high-income countries.[21]

Early detection of breast cancer allows early treatment—an association that should benefit the women who were treated for carcinoma in situ and early breast cancer in our study. However, although being followed-up for any change in their status or recurrences of disease—we plan to follow up these women for at least 5 years—whether these women will develop invasive cancer in the future is difficult to predict. This fact (ie, whether women identified with early disease will develop invasive cancer in the future) is also true for mammography screening. Lesions detected by mammography vary widely in histological appearance and biological aggressiveness.[22] Therefore, some women diagnosed with either method (mammography or self-examination) will develop invasive cancer. At present, there are no tests to stratify women according to their risk of progressing to invasive breast cancer.

We were not surprised that the two women who died within 2 months of diagnosis had not sought cancer treatment despite the late stage of their disease. If not for the work of the volunteers in this pilot study, these women would probably have died in their homes, without the health authority's knowledge of their disease. Such deaths are not recorded in hospital-based cancer registries and can lead to inaccurate estimates of the prevalence of cancer in a region. Furthermore, this observation is consistent with the fact that women do not seek medical help even though their cancers have spread. Reasons for such delay probably include poor cancer awareness, attitudes about the disease (eg, that breast cancer equals death),[23] and fear of surgery and mastectomy, especially in a society dominated by men and in which men can have more than one wife. Further, since breast cancer in Sudanese women and in African women in general often occurs at a younger age than in high-income countries,[4] women often fear stigmatisation, the loss of a breast, and the loss of her husband and perhaps support for her children. Furthermore, some African communities are Muslim. Women's belief that Allah determines their fate, in addition to their Islamic beliefs, which require women to be completely covered, can hinder women's decisions to seek medical help. For a woman to expose her breasts to a male doctor or nurse as part of a screening programme would not be acceptable to either them or their husbands. Similar factors probably played a part in the decisions of the 20 women who were referred for follow-up but did not report to the NCI-UG. Generally, women seek alternative, traditional treatment and seek professional medical help only at a late stage of their cancer. Therefore, the intervention proposed in this study could break down some of the barriers that prevent women from seeking professional help and could raise awareness about the importance of early detection in these low-income communities.

Our findings also showed the benefit of using volunteers chosen from the community for cancer screening and cancer awareness programmes. Women villagers in the study area had little education and little knowledge about how to recognise cancer or to seek appropriate treatment, and might not have the resources to cover transportation to or accommodation at health centres. These young female volunteers provided women in the villages with an intervention within the village from a familiar and trusted person, obviating the need for—and removing the social and educational barriers to—access to care outside the village.[24] Other studies that

Panel: Research in context

Systemic review

We searched PubMed using terms including "breast screening and mammography and Africa" and "breast cancer screening and Africa and laywomen". We restricted our search to studies written in English and published between 2002 and 2012. The first term "breast screening, and mammography and Africa" yielded 55 publications advocating for raising cancer awareness in Africa and few examined the level of knowledge of breast cancer and breast self-examination in groups such as nurses and university students. One study from Egypt reported on breast cancer screening using clinical breast examination by surgeons in satellite clinics. None of the studies did an organised screening programme of female villagers with locally recruited volunteers.

Interpretation

Our findings suggest that screening programmes that use locally recruited volunteers can increase the early detection of breast cancer in low-income and middle-income countries. Such programmes require collaboration of the community, village leaders, and the health-care providers. Simple educational means and public awareness programmes could improve the rate of successful treatment of breast cancer in low-income and middle income countries.

have used local volunteers for cancer education have shown that they are usually more effective than professionals in disseminating information because women identify more easily with their peers (panel). They share the same environment and have a similar social fabric and belief system. In Turkey, peer education was shown to be more effective in such low-income and religiously conservative communities than were professionals and successful in increasing the knowledge, belief, and practice of women related to breast cancer.[25]

The success of our programme depended on the commitment of the volunteers, as shown by the between-village variation in the percentage of women screened (table 2). Some of these women volunteers were very active, others were not, and some expected incentives or rewards for their services. Use of volunteers to screen the neighbouring villages was not completely successful (the proportion of women screened in these villages was low), which could be because of cultural differences or pride. To be successful and sustainable, such programmes will need the continued involvement and commitment of volunteers. Incentives for volunteering and training of new volunteers through training-the-trainer protocols might provide stability to such programmes. Nevertheless, even without payment, we think that such a programme is sustainable because the women who volunteer and act as health workers will, in doing so, improve their position in their society.[26] Added benefits of such programmes are the creation of community advocates for cancer prevention who can then be used for other programmes and an improved awareness of cultures in rural communities.

Community leaders' participation was a key factor in the success of this work; villages whose representatives attended the leaders meeting and sent a volunteer health worker to training had the best screening coverage. Up until the date of last follow-up, about 70% of women in Keremet were screened in all participating villages and the programme will continue until the maximum possible number of women in Keremet are screened, which will probably take a further year. We will then hold a meeting with the state governor with a view to extending the programme to Abugota and possibly to other counties in Al-Gezira.

We know of no crossover of women between the study and control groups, and feel that such crossover would be unlikely because the villages are far apart, every village is independent, and the study was not advertised in newspapers or radio. A limitation to our study was that the volunteers were not compensated for their work, which resulted in between-village variation in the proportion of women screened. Also, the competency of volunteers varied between villages, which could also have contributed to between-village variations in coverage and outcomes. Furthermore, crowded public transportation and its cost and time might have prevented women from seeking treatment. Interestingly, in these communities, if a family member is admitted to hospital, their whole village (most of whom are related to the patient) will neglect work and stay with the patient in or outside the hospital—women therefore avoid visiting hospital if possible in an attempt not to disrupt the village. Our study was also restricted by the fact that not all the counties agreed to participate. Further, women who were referred to the medical centre for diagnosis did not have to pay for diagnostic tests; those in the control group had to pay, which could have acted as a barrier to presentation. Other limitations were the poor availability of pathology services and trained personnel in pathology grading, in addition to the scarcity of resources such as wire-guided biopsy to confirm diagnoses of ductal carcinoma in situ.

In conclusion, the implementation of a breast-cancer screening programme using local volunteers is feasible in low-income rural communities and should decrease morbidity, increase women's survival, and increase their number of productive years of life. It could also inform public policy and influence public and governmental attitudes toward cancer awareness and interventions.

Contributors

All authors contributed to public awareness programmes and lectures to the female volunteers. AE, HM, and MA did all surgeries (operation and biopsies). EE did pathological diagnoses. AOA did radiological diagnoses. DOA contributed to the study design, training, education, treatment, writing of the paper, and study supervision. SIM had the idea for and designed the study and wrote and revised the paper.

Conflicts of interest

We declare that we have no conflicts of interest.

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