Barriers related to non-adherence in a mammography breast-screening program during the implementation period in the interior of São Paulo State, Brazil

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Abstract Mammography is the best exam for early diagnosis of breast cancer. Developing countries frequently have a low income of mammography and absence of organized screening. The knowledge of vulnerable population and strategies to increase adherence are important to improve the implementation of an organized breast-screening program. A mammography regional-screening program was implemented in a place around 54.238 women, aged 40–69 years old. It was proposed to perform biannual mammography free of cost for the women. We analyze the first 2 years of the implementation of the project. Mammography was realized in 17.964 women. 42.1% of the women hadn't done de mammography in their lives and these women were principally from low socio-economic status (OR = 2.99), low education (OR = 3.00). The best strategies to include these women were mobile unit (OR = 1.43) and Family Health Program (OR = 1.79). The incidence of early breast tumors before the project was 14.5%, a fact that changed to 43.2% in this phase. Multivariate analysis showed that the association of illiterate and the mobile

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unit achieve more women who had not performed mammography in their lives. The strategies to increase adherence to mammography must be multiple and a large organization is necessary to overpass the barriers related to system health and education.

1. Introduction

Globally, breast cancer is the most commonly occurring cancer in women, comprising 23% of new cases and 14% of cancer-related deaths; furthermore, half of the cases and 60% of the related deaths occur in developing countries [1]. In countries with limited resources, diagnoses are delayed, and a high percentage of advanced cases occur consequent to the limited ability to promote appropriate early detection and diagnosis throughout the population [2].

Breast cancer prognosis is considered good, with a survival rate of approximately 73% in developed countries and 57% in developing countries [3]. In the United States, the increased incidence of breast cancer has been associated with reduced mortality, which has been attributed to improved treatment and early diagnosis [4]. However, both an increased incidence and mortality have been observed in Brazil [5], because a large number of women are diagnosed at advanced stages [6] resulting in more expensive treatments and reducing the likelihood of achieving a cure.

To reduce the breast cancer mortality rates in developing countries such as Brazil, it is necessary to improve strategies related to the control and early detection of the disease. This is because despite the higher overall mortality rates in Brazil, compared with those in the United States, the results of the 2 countries were similar when mortality was compared according to the clinical stage [7].

The literature regarding the implementation of mammography screening programs in developing countries is limited because the transition from diagnostic mammography to population-based opportunistic screening is gradual and has no specific parameters. In the previous decades in Brazil, there were improvements in the public health system, with a gradual increase in the number of mammograms performed. However, there is no organized screening program, and only isolated studies were conducted [8]. A regional pilot screening program was initiated in the countryside of São Paulo State, in which mammography screening was implemented at the population level [8,9].

In this sense, identification of the vulnerable population and knowledge regarding adherence strategies will facilitate the implementation and multiplication of screening centers in Brazil and other developing countries.

Thus, the objective of this study is to evaluate the barriers [10] related to mammogram non-adherence in a region of Brazil prior to the implementation of a mammography screening program and strategies to achieve this objective.

2. Materials and methods

A mammography screening program was implemented in 2003 by the 5th Regional Health Administration of the State Department of Health/State of São Paulo, which is located in the countryside of São Paulo State. A total of 19 municipalities were involved, and the program was headquartered in the city of Barretos, including both rural and urban populations. This project anticipated the performance of a biennial mammography screening for an estimated population of 54,238 women aged between 40 and 69 years [11].

A comprehensive discussion with the State and Municipal departments occurred before beginning of the project, and it was decided that a Tertiary Oncology Hospital, the Barretos Cancer Hospital (BCH), would be responsible for conducting the mammography screenings, complementary tests, medical care, diagnosis, treatment, and follow-up.

The municipalities' health care team was previously trained through lectures, discussions, and visits to their respective cities in an attempt to increase the team's awareness and training. Through their representatives (nurses and physicians), each municipality was responsible for disseminating the project via radio, loudspeaker-equipped cars, brochures, posters, home visits, and appointments at the Public Health Centers with regard to the Family Health Program [12].

Mammograms could be performed at either the BCH or at the Mobile Health Unit (MHU), and a total of 40 exams were offered per day by each place. The MHU was built to provide mammograms to women in remote cities and comprised a modified

bus that contained the mammography device (SenographTM 700 T; GE Healthcare, Waukesha, WI, USA). The MHU visited the cities of the region in a sequential manner and remained in each for 3—5 days. The exams were free to the population, and the costs were subsidized by the State (Unified Health System). The appointments were scheduled at the Basic Health Unit of the visited municipality, with periodic (every 4 months) evaluations of the adherence strategies.

Before the mammograms, women were interviewed by a nurse or community health agent of the municipality who used a structured questionnaire to assess the participants' information, including age, socioeconomic status, educational level, previous mammogram history, and the main reason that led them to undergo the mammogram. All women received an explanatory brochure about the project that described its objective, the mammogram limitations, the possibility that new exams would be required, the confidentiality of the results, and the need for regular mammograms.

This was a normative and educational document; the women then signed their consent term to perform the mammogram and committed to return for a consultation if the exam revealed abnormal findings.

Socioeconomic statuses were assessed according to the classification of the Brazilian Association of Market Research, which scores socioeconomic status based on the possession of household items and the educational level of the household head; women of higher socioeconomic status belong to class A, whereas those of lower socioeconomic status belong to class E [13].

The standardized forms were entered into EXCEL for Windows® (Microsoft Corporation, Redmond, WA, USA), and the statistical analysis was performed with software SPSS 15.0 for Windows® (SPSS Inc., Chicago, IL, USA).

A descriptive data analysis was performed using the absolute and relative frequencies (Table 1). Subsequently, a chi-square test of association was used for the independent variables (demographic and social), with ''no previous mammogram'' as the dependent variable. Univariate and multiple logistic regression analyses were performed to identify the factors associated with the high-risk women that had no previous mammogram and the best methodology that could identify and lead to the increase of the adherence of these women (Table 2). Multivariate logistic regression was performed to evaluate the factors that significantly could identify and increase the adherence of these high-risk women selected by univariate analysis (Table 3). A p-value <0.05 was adopted for statistical significance.

This study was conducted retrospectively using the screening program database of the Department of Cancer Prevention and was approved by the Research Ethics Committee of the Pio XII Foundation, under Protocol 072/2007.

3. Results

A total of 17,964 women were subjected to mammography during the first 2 years of the project implementation (the period from April 2003 to March 2005). The mean age was 51.1 years (range, 40—69 years; SD = 7.8). The majority of the women in the age group 40—49 years (48.2%) belonged to the socioeconomic class C/D (85.4%) and had an educational level of <8 years of education (86.3%). The Family Health Program was the main means through which women were recruited for mammograms (Table 1). A total of 76 cases of cancer were identified among the evaluated patients,

Table 1 Number and percentage of women attended by the screening program, according to demographic, social and clinical characteristics.

Variable	Category	n°	%
Age (years)	40—49	8666	48.2
	50—9	6173	34.4
	60—69	3125	17.4
Socioeconomic class [14]	B	522	2.9
	C	4585	25.6
	D	10,687	59.8
	E	2091	11.7
Education	Illiterate	1518	8.5
	1—8 years	13,823	77.8
	9—11 years	1786	10.1
	High education	643	3.6
Factor related to MMR adherence	Family Health Program	8405	46.8
	Doctor	4862	27.1
	Media	2218	12.3
	Neighbors	1026	5.7
	Other	1453	8.1
Previous MMG	Never performed	7560	42.1
	Performed	10,404	57.9
Clinical stage (TNM)	0	8	10.5
	I	25	32.9
	II	31	40.8
	III	11	4.5
	IV	1	1.3
Total		17,964	100

Table 2 Results of univariate and multivariate analysis of women seen at the screening program. Logistic regression, according to the non-realization of prior mammogram. Barretos Cancer Hospital-SP, 2008.

Variable	Category	Never performed MMG n (%)	Performed MMG n (%)	p (χ^2)	OR Gross	CI$_{95\%}$	OR Adjusted	CI$_{95\%}$
General variable								
Age (years-old)	40—49	4164 (48.0)	4502 (52.0)	<0.001	1.0		1.0	
	50—59	2169 (35.1)	4004 (64.9)		0.45	0.42—0.48	0.39	0.37—0.42
	60—69	1227 (39.3)	1898 (60.7)		0.63	0.58—0.68	0.48	0.44—0.53
Socioeconomic Class [14]	B	144 (27.6)	378 (72.4)	<0.001	1.0		1.0	
	C	1672 (36.5)	2913 (63.5)		1.51	1.23—1.84	1.35	1.08—1.69
	D	4649 (43.5)	6038 (56.5)		2.02	1.66—2.46	1.84	1.46—2.31
	E	1058 (50.6)	1033 (49.4)		2.99	2.18—3.32	2.20	1.71—2.83
Education	High education	230 (35.8)	413 (64.2)	<0.001	1.0		1.0	
	9—11 years	706 (39.5)	1,080 (60,5)		1.55	1.27—1.89	1.30	1.05—1.62
	1—8 years	5801 (42.0)	8022 (58.0)		1.88	1.57—2.34	1.61	1.31—1.98
	Illiterate	738 (48.6)	780 (51.4)		3.00	2.45—3.66	2.78	2.10—3.42
Variable related to the adherence of MMG								
Local of MMG	Hospital	2113 (36.3)	3706 (63.7)	<0.001	1.0		1.0	
	Mobile Health Unit	5447 (44.8)	6698 (55.2)		1.43	1.34—1.52	1.18	1.09—1.29
Methodology to MMG adherence	Doctor	1646 (33.9)	3216 (66.1)	<0.001	1.0		1.0	
	Other factor	555 (38.2)	898 (61.8)		1.21	1.07—1.36	1.18	1.04—1.35
	Media	875 (39.4)	1343 (60.6)		1.27	1.15—1.41	1.20	1.06—1.36
	Neighbors	459 (44.7)	567 (55.3)		1.58	1.38—1.81	1.54	1.32—1.79
	FHP	4025 (47.9)	4380 (52.1)		1.79	1.67—1.93	1.69	1.54—1.85

MMG = mammography; *n* = number; OR = odds ratio; CI = confidence interval; FHP = Family Health Program.

Table 3 Final model of multivariate logistic regression analysis of women served by the breast screening program, according to the non-realization of prior mammogram. Barretos Cancer Hospital-SP, 2008.

Category[*]	$OR_{adjusted}$	$CI_{95\%}$
Hospital/ ⩾9 years of education	1.0	—
Hospital/1—8 years of education	1.26	1.05—1.52
Hospital/Illiterate	2.02	1.53—2.66
MHU/ ⩾ 9 years of education	1.15	0.94—1.40
MHU/1—8 years of education	1.50	1.25—1.80
MHU/Illiterate	2.53	2.00—3.20

[*] Values adjusted by age, socio-economic class and reason; MUH = Mobile Health Unit; OR = odds ratio; CI = confidence interval.

of which 43.2% were at clinical stage 0 + I breast cancer.

Among the women who underwent mammography screening, 7560 (42.1%) had never been examined previously. All analyzed factors were associated (χ^2) with the variable ''no previous mammogram'' (II). A higher proportion of the women who had never undergone a mammogram were found in the youngest age group (40—49 years), compared with the oldest age groups (50—59 years and 60—69 years; 48.0% vs. 35.1% and 39.3%; $p < 0.001$). The proportion of women who had not previously undergone a mammogram was also higher among women of the socioeconomic classes D and E, compared with those of classes B and C ($p < 0.001$). Women with a low educational level (illiterate or <8 years of education) were less likely to have undergone a mammogram ($p < 0.001$). The MHU performed more mammograms and had a larger number of women who had never undergone a mammogram than did the BCH (44.8% vs. 36.3%; $p < 0.001$). The same was true for the FHP in comparison with other adherence modalities ($p < 0.001$).

In the univariate logistic regression analysis (Table 2), age was shown to be a protective factor. Women in older age groups exhibited a lower risk of never having undergone a mammogram ($OR_{crude} = 0.45$ and 0.63 for the age groups 50—59 years and 60—69 years, respectively). The variables of socioeconomic status and educational level revealed that women with a lower educational level and lower socioeconomic status had an increased risk for non-adherence to mammography screening. Women who had never undergone a mammogram were more frequent among women of socioeconomic class E ($OR_{crude} = 2.99$), compared

with women of class B. Women who had never undergone a mammogram were also more frequent among illiterate women, compared with those with a higher educational level ($OR_{crude} = 3.00$). Dose—response effects of these variables were observed in the univariate logistic regression analysis, which showed a gradual increase in the risk of non-adherence to mammogram that correlated with a worse socioeconomic status or lower educational level. Regarding the location where the exam was performed, in this study, women were more likely to access the MHU than the hospital ($OR_{crude} = 1.4$). Similarly, using an active search, the FHP obtained a greater adherence of women who had never undergone a mammogram ($OR_{crude} = 1.8$).

In the multiple logistic regression analysis (Table 3), in which the interactions were adjusted according to the variables of age, socioeconomic status, and the reason for performing the exam, the associations between the locale where mammograms were performed and the educational level was evaluated. Illiterate women were more likely to avoid mammograms; this finding was observed not only at the hospital ($OR_{adjusted} = 2.02$), but also in the MHU ($OR_{adjusted} = 2.53$), although the MHU permits to identify and adhere higher-risk women.

4. Discussion

The first evidence for the benefits of mammography screening was demonstrated in a proposed long-term clinical trial of the Health Insurance Plan of Greater New York (HIP), beginning in 1963. This study of clinical examination and mammography was performed on women aged 40—64 years, and a 30% reduction in mortality was observed [14]. A meta-analysis showed an approximate 15% reduction in mortality [15]. Currently, based on observations in developed countries, it is thought that reductions in mortality occur because of the association between mammography screening and progress in breast cancer treatment [16].

In the United States, an evaluation of the rates of mammograms performed on women aged ⩾40 years in the previous year demonstrated that the rate was higher in white women (51.5%), those with health insurance coverage (55.0%), and those with a high educational level (57.0%), in contrast with those without health insurance coverage (16.9%) and with a lower educational level (37.7%) [17]. A 2003 Brazilian population survey analyzed 27,692 Brazilian women, aged 50—69 years, and found that 42.5% and 8.2% of them had not undergone a mammogram in the past

2 and 3 years, respectively, and 49.3% of them had never undergone a mammogram [18]. Regarding the population analyzed in the current study, 42.1% of women aged 40—69 years had never undergone a mammogram. This finding highlights the limitations of the health care system with regard to offering mammography screening to the general population, which was observed before the beginning of the project, as well as a scenario of diagnostic mammograms in the absence of population screening, given the limitations associated with performing mammography screening at a population level.

The Breast Health Global Initiative (BHGI) sought to categorize the organizational levels of countries with regard to breast cancer; the basic level represents breast self-examination, the limited level includes diagnostic ultrasound and mammography, the enhanced level includes diagnostic mammography with opportunistic breast screening, and the maximal level includes organized population-based breast cancer screening [2]. According to this categorization, Brazil is at the limited level. Developing countries have limited budgets for public health, which are mainly allocated to disease treatment, and reduced budgets that are directed to the primary and secondary prevention of chronic degenerative diseases and cancer. Therefore, it is important to promote women's health by expanding the infrastructure for cancer diagnosis and treatment, the implementation of early detection programs, and the system organization for the large-scale performance of mammograms — the situation experienced at the beginning of this project.

The development level of a nation, state or city can be indirectly assessed by using the ''Human Development Index (HDI)''; this index comprises the relationship between income, health and education. An HDI >0.80 is associated with high development, and an HDI between 0.50 and 0.80 is associated with medium development. In 2012, the HDIs of the United States, Holland and Brazil were 0.937, 0.921 and 0.730, respectively. In a 2000 population census, the HDIs of Brazil, São Paulo State, Barretos region, and the city of Barretos were 0.769, 0.814, 0.649, and 0.710, respectively, demonstrating a regional limitation [19] — a scenario that was related to the implementation of the screening program [19]. Therefore, this region experienced a transition from the diagnostic mammography stage, in which mammograms were often performed in symptomatic patients while the demand for diagnostic exams was suppressed, to a large-scale mammography screening. In the years

before this project, the incidence of early tumors (clinical staging 0 + I) in this region was 14.5%; this rate increased to 43.2% among the women who adhered to the project, reflecting a prior deficiency in access to mammography screening [9].

In the literature, the barriers related to non-adherence to mammography screening have been briefly classified as barriers related to the health care system, education, and adherence to mammography [10]. The large-scale availability of free exams during the implementation phase of screening programs mainly affects the barriers related to the health care system, a condition that is much more evident in developing countries where large percentages of the population have low incomes and depend on the public health systems [20]. Discussions with the State and city administrators, reorganization of the patient care flowchart, and improvements to the referral system, in association with the viability of local patient care and an effective capacity for resolution, established an effective patient care flowchart, thus reducing the barriers related to the health system. Similarly, there was a cultural inertia related to an unawareness of the importance of mammography screening [21] because of the limited number of available mammograms. In addition, educational strategies were not performed in this context, thus creating a vicious cycle with regard to information, education, and socioeconomic status, as observed in the elevated numbers of women with low educational levels and low socioeconomic statuses who had not previously undergone mammography screening. Therefore, the dissemination of the exam and the implementation of educational strategies are required.

The barriers related to adherence in developing countries can only be evaluated after implementing large-scale mammography screening in association with educational strategies. The absence of symptoms, fear of pain caused by the mammogram, and fear of cancer were the barriers described in this milieu [22].

The city of Barretos, where the fixed health care facility was located, has a larger population size and better health care infrastructure, and patients from smaller cities are referred to this facility for treatment at the regional level. The regional cities have a large population variation (median, 9010 residents; mean, 19,896; range, 2478—104,913) such that only three cities have populations exceeding 40,000 residents [11]. Accordingly, patients who are referred to the city of Barretos usually commute 21—125 km (median, 64.4 km), a fact that justifies the preference for the MHU.

The MHU aims to facilitate access to the exams, particularly for the poor populations that live in remote areas and therefore have increased difficulty with regard to access [9], because it permitted that the MMG was performed near the women's houses, decreasing the necessity of displacement to the bigger city with more infrastructure conditions, e.g., the hospital. In this study, 67.6% of the mammograms were performed at the MHU, and this was an important factor related to the adherence of women who had not previously undergone a mammogram ($p < 0.001$). The possibility of undergoing mammography screening free of cost eliminates the financial, distance and education barriers, as demonstrated by the more effective adherence in the MHUs, compared to the hospital.

In the United States, the American Cancer Society recommends that mammography screening be performed after the age of 40 years [17]; however, in Europe [23], the recommended age is between 50 and 69 years. The Ministry of Health of Brazil recommends that the age used to begin breast cancer screening is 50 years [24], the Brazilian Society of Mastology recommends the age of 40 years [25], but when this study was performed, the doctors could offer MMG based on their beliefs, but they had a limited number of MMG to offer because of limited infrastructure. A limited coverage, mainly in the public system of women's, health was associated with a high risk related to non-adherence to MMG [18].

In this project, mammography screening was offered to women aged 40—69 years because of the lack of Brazilian indicators for the age group 40—49 years before the beginning of the project. After the inclusion of more women, the incidence of breast cancer in the age group 45—49 years was observed to be equivalent to that of the age group 60—69 years, suggesting that in this population, screening should begin at age 45 [8]. In this study, there was an age-related decrease in adherence that was possibly influenced by the age pyramid of the population, which exhibits a gradual decrease with increasing age [11]. Older patients exhibited a higher rate of positive responses with regard to previous mammograms when considering the question asked about any mammograms during their lifetime. However, 39.3% of the women aged 60—69 years had never undergone a mammogram, indicating limited access to mammography screening. Moreover, age is the most important risk factor for breast cancer, and therefore older women are more vulnerable members. Poor adherence to mammography screening is regularly observed in elderly populations [26], given their limited financial resources [27], the presence of associated diseases, and the unawareness of the risk factors, all of which focus health care concerns in other directions [28].

In this study, the previous performance of a mammogram was related to a higher educational level and higher socioeconomic status (B), given the lower limitations in the health care system that are associated with higher education and socioeconomic status. This finding has also been observed in the United States where, in the absence of a public health system, women with health insurance and a higher educational level exhibited a greater adherence to mammography screening [17]. Ward et al. (2004), when evaluating the performance of mammography screening two years before their survey, observed lower adherence in women without health insurance (39.5%), immigrants (65.0%), and women with an education level ≤11 years (56.8%) [29]. Those numbers are higher than the values observed in the present study, in which 48.6% of illiterate women and 50.6% of women of low socioeconomic status had undergone a mammogram at some point in their lifetime.

In Europe, the organized public system promotes mammography screening. In the United States, the American Cancer Society [17] recommends mammography screening in women >40 years of age, and the exam is promoted during medical appointments. In this study, multiple strategies for adherence to mammography screening were used, and the community health agents and medical appointments were responsible for 73.9% of the adherence to mammography screening. Prior to the beginning of the project, mammography screening was frequently performed for diagnosis, given the regional limitations related to the numbers of mammograms and women to be evaluated. After the beginning of the project, the local paradigm changed because of the increased numbers of exams and the reorganization of the health care system. This change was supported by the FHP, a program based on monitoring families that reside in geographic areas close to primary health care units (PCU) [30]. The community health agents are part of a multidisciplinary team associated with the PCU [12], which, when associated with a MHU, greatly facilitated the identification, training and access to mammography screening in areas near the women's residences. Similarly, physicians from FHP were allowed to request mammograms of all women within the appropriate age group.

Table 2 confirms all of the above-described factors according to risk in the univariate model, in

which non-adherence to mammography screening prior to the beginning of the program correlated with the younger age group (40—49 years), lower educational level (illiterate), and lower socioeconomic status (E). The MHU and FHP, administered through the community health agents, were the main strategies to reach this population. By analyzing the multiple logistic regression (Table 3) results with the interactions, it can be observed that the MHU, decreasing the distance related to a MMG, best facilitated the adherence to the mammography screening, especially in women who were illiterate or had only a primary education, as it mainly addressed the barriers related to the health care system and education, a finding that indicates the value of this community intervention model.

5. Conclusions

In places with limited mammography screening, in which mammograms are frequently performed as diagnostic exams, the variables of age, socioeconomic status and educational level are important factors related to non-adherence to breast screening. During the transition to a mammography screening program, the presence of the MHU and the FHP were important factors related to the increased adherence to mammography screening observed in this vulnerable population; this finding suggests that adherence can be changed with the gradual structuring of a mammography screening program.

Conflict of interest

The authors have no conflict of interest to declare.

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