Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

Research Article

Cancer Epidemiology, Biomarkers & Prevention

Adherence to a Breast Cancer Screening Program and Its Predictors in Underserved Women in Southern Brazil

Maira Caleffi[1], Rodrigo A. Ribeiro[1,2], Ademar J. Bedin, Jr.[1], Júlia M.P. Viegas-Butzke[1], Fernanda D.G. Baldisserotto[1], Giovana P. Skonieski[1], Juliana Giacomazzi[3,7,8], Suzi A. Camey[2,5], and Patrícia Ashton-Prolla[3,4,6,7,8]

Abstract

Background: Adherence to breast cancer screening is a key element to ensure effectiveness of programs aiming at downstaging of breast cancer. In this study, we evaluated adherence to a screening program and its predictors in underserved women in southern Brazil.

Methods: Attendance to the program, which is based on yearly mammogram and clinical examination, was evaluated prospectively. Mean time frames between visits were calculated. Possible predictors of adherence (defined as mean intervals ≤18 mo), such as socioeconomic indicators and health/lifestyle behaviors, were investigated.

Results: A total of 3,749 women (age 51 ± 8 y, illiteracy rate of 6.8%, 57.4% with parity ≥3) were analyzed. Median time between screening rounds was 16.5 months (interquartile range, 13.1-25.7), and median number of rounds attended was 3 (interquartile range, 2-4); 57.6% had mean intervals ≤18, and 71% ≤24 months. The most important independent predictors of adherence were high genetic risk [relative risk (RR), 1.25; 95% confidence interval (95% CI), 1.11-1.40], illiteracy (RR, 0.77; 95% CI, 0.67-0.90), parity ≥5 (RR, 0.89; 95% CI, 0.83-0.96), and smoking (RR, 0.82; 95% CI, 0.77-0.88).

Conclusions: Although the proposed screening interval was 1 year, compliance to biannual screening (accepted in several international programs) was high, especially when considering the low socioeconomic level of the sample.

Impact: This project aims to test a breast cancer screening model for underserved populations in limited-resource countries where adherence is an issue. The identification of worst adherence predictors can point to interventions to improve outcomes of similar public health screening strategies. *Cancer Epidemiol Biomarkers Prev; 19(10); 2673–9. ©2010 AACR.*

Introduction

Breast cancer is the most common non-skin cancer in women in the majority of western countries (1). Although mortality has been progressively declining in developed countries, the same is not true in the developing ones, such as Brazil (2). Because there are no measures with proven effectiveness applicable to all women to reduce the incidence of the disease, early diagnosis through proper screening is the only means toward reduction of breast cancer–associated mortality.

An effective screening program relies largely on the adherence of the target population to it, which includes two components: the proportion of the target women that undergo screening and the frequency with which they attend the program. The latter is one of the cornerstones of a successful screening program because regular intervals between exams, which should be shorter than the mean lead time, are required to guarantee early breast cancer detection (3).

Some studies, conducted mostly in the United Kingdom and the United States, have assessed women's adherence to mammographic screening and associated factors. The main factors related to worse compliance to screening were lower educational level, positive family history, current tobacco use, hormone replacement therapy, previous negative mammographic experiences, insurance status, and lower socioeconomic level, assessed either individually or with the use of data on women's neighborhood (4-10). Obesity was associated with lower adherence in White, but not in Black, women (11). Effect of age was inconsistent among studies, with younger women presenting either worse (5, 6) or better adherence (9).

Authors' Affiliations: [1]Núcleo Mama Porto Alegre, Associação Hospitalar Moinhos de Vento, Brazil; [2]Programas de Pós-Graduação em Epidemiologia, [3]Programa de Pós-Graduação em Medicina: Ciências Médicas, [4]Programa de Pós-Graduação em Genética e Biologia Molecular, [5]Departamento de Estatística, Instituto de Matemática, and [6]Departamento de Genética, Universidade Federal do Rio Grande do Sul, Brazil; [7]Laboratório de Medicina Genômica, Centro de Pesquisa Experimental and [8]Serviço de Genética Médica, Hospital de Clínicas de Porto Alegre, Brazil

M. Caleffi and R.A. Ribeiro contributed equally to this work.

Corresponding Author: Maira Caleffi, Rua Ramiro Barcelos, 910, 11° andar. Porto Alegre, Rio Grande do Sul, Brazil, CEP 90035-001. Phone: 55-51-3314-3696; Fax: 55-51-3314-3697. E-mail: maira@hmv.org.br

doi: 10.1158/1055-9965.EPI-10-0338

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

Conversely, studies in specific populations showed conflicting results: whereas Schumacher et al. have found similar factors for worst adherence in American Indian and Alaska native people (6), Graves et al. did not observe any association between the aforementioned factors and screening adherence in a sample of 328 Latinas living in the United States (12).

Although these studies have provided valuable information, many used a cross-sectional design, which is not fully capable of capturing actual adherence to screening, whereas others, although using a longitudinal design, collected data retrospectively, which limits the precision of results. Besides, many of these studies were based on administrative data and not on primary data collected with research purposes. Moreover, none of them evaluated a sample from a developing country, in which different factors might play a role in screening compliance. Finally, few studies focused on underserved women, among which barriers to screening are possibly different from the ones observed in the general population. In 2004, we started a screening project to test the effectiveness of an early diagnosis and treatment program for underserved women in Southern Brazil (13). The objective of this study was to evaluate screening adherence and related factors in women who have undergone at least their first mammogram after an invitation to a screening program.

Materials and Methods

Study design, setting, and sample

We conducted a prospective cohort study with the participants of a screening and early treatment program, the Porto Alegre Breast Health Intervention Cohort (Núcleo Mama Porto Alegre). The full description of this project has been published elsewhere (13). Briefly, the project aims to test the effectiveness and cost-effectiveness of an early detection and treatment program for underserved women between the ages of 40 and 69 years through yearly breast clinical exam and mammography. The initiative derives from a partnership between a private institution (Associação Hospitalar Moinhos de Vento) and the public sector (Porto Alegre City Health Department), in which the major contribution of the latter is to assist in the active search for participants, which is carried out by lay community health workers from the associated basic healthcare units. The project is also supported by the third sector (Breast Institute of Rio Grande do Sul, a nonprofit institution that focuses on improving breast health care) and a federal university (Universidade Federal do Rio Grande do Sul). The project was approved by the Institutional Review Board of both Associação Hospitalar Moinhos de Vento and the Porto Alegre City Health Department.

Every month, women who had their last visit 12 months before are reminded of their annual appointment by thoroughly trained community workers through home visits. Although participants may spontaneously come to the basic healthcare units to schedule their appointment, the program is based on active search, which starts on the 12th month after the participants' last mammogram (i.e., not only after they are overdue). A breast clinical exam (done by a trained nurse or breast surgeon) and mammography are carried out on all attending participants. Women with abnormal mammograms are referred for further evaluation (e.g., diagnostic mammogram with compression and/or magnification, ultrasound, fine-needle or core biopsy) in the same facility where screening takes place. All women are assessed for family or personal history of breast, colorectal, and/or ovarian cancer with the use of a simple seven-question instrument, FHS-7, which has been validated in this population (14). If the family history is suggestive of a hereditary breast cancer syndrome, the patient is referred to a clinical geneticist for further evaluation (15). The program also includes nutritional support for overweight women and psychological follow-up for all breast cancer patients. All these clinical visits (genetic assessment, nutrition, and psychology) take place at the same location where breast cancer screening occurs, the Núcleo Mama Porto Alegre center.

All women included in the project come from underserved communities from Porto Alegre (capital of Rio Grande do Sul, the southernmost state in Brazil). The recruitment occurred between April 2004 and March 2006, when women between 15 and 69 years old were enrolled. Women between 40 and 69 years were invited to the screening cohort, and participants in the age range of 15 to 39 years were sensitized to the importance of breast cancer early detection and advised to attend their basic healthcare units once yearly for clinical follow-up. When these women reach the age of 40 years, they are visited by the community workers, who invite them to join the screening cohort.

The recruitment was based on two main mechanisms. The first one relied on the aid of the community workers, who announced the project in the community and to women attending the basic healthcare units for any reason. These women were examined by family physicians (previously trained in breast examination and instructed about the importance of early diagnosis) and referred to the Núcleo Mama Porto Alegre center subsequently. The second mechanism was based on community efforts conducted by our team, from which a breast surgeon, a nurse, and a nurse technician visited some of the communities on predetermined days (a large advertising effort was made to increase the community's participation), examined the attending women, and referred them to Núcleo Mama Porto Alegre center whenever indicated. Globally, these procedures achieved a 25% recruitment rate from the target age group (40-69 y) in the selected area.

Currently, >4,200 women have been enrolled in the screening cohort. In the present analysis, we included all participants who had joined the cohort at least 18 months before the dataset was prepared for this report.

Data collection and measurements

All participants responded to a standardized questionnaire applied by the attending nurse or physician during

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

enrollment, which included socioeconomic and clinical data. All appointments are registered in a computerized system, which keeps track of all clinical and imaging exam data.

The variables included in the analysis of potential predictors of screening compliance were the following: educational level, income, number of children, high genetic risk, history of oral contraceptive use and hormone replacement therapy, previous breast biopsy, smoking habits, regular breast self-exam, age, body mass index, and enrollment during community efforts. Age was analyzed both as a continuous and a dichotomous variable, in which the cut point was 50 years old. This cut point was set seeing that the Brazilian Ministry of Health screening recommendation is for women 50 years or older. Because we did not have individual income data available for a significant amount of the sample, we used the neighborhood income level as a proxy for individual income. Genetic risk was determined by review of the personal and family history of cancer, and estimation of the lifetime risk of developing breast cancer measured by three different mathematic models (the Gail and Tyrer-Cuzick models, and the Claus tables; refs. 16-18). Women with an estimated lifetime risk (adjusted to age) of developing breast cancer <0.2 were considered in the average risk group (similar to population risk). Those with an estimated lifetime risk of developing breast cancer ≥0.2 with the use of either the Gail and Tyrer-Cuzick models or the Claus tables, and those presenting phenotypic criteria for a hereditary breast cancer predisposition syndrome by pedigree analysis were considered at high lifetime risk for developing breast cancer (referred to as high genetic risk hereafter).

Adherence to the program was considered as a mean interval between exams of ≤18 months. Although the recommended screening interval in the project is 12 months, we defined an 18-month interval as acceptable because some previous clinical trials have also used an 18-month screening interval (19, 20). Furthermore, other studies also evaluating adherence to mammography have used even larger intervals (2 y; refs. 21-24). Moreover, considering the mean sojourn time of the disease in the population in this age range, the 18-month interval has a performance marginally inferior to 12 months. We used the average interval time between exams in the analysis, which was calculated as the mean time between all screening mammographies that participants have undergone to date. If a participant has undergone her last mammogram ≥18 months before the closure of the dataset, we used the time between the last exam and the dataset closure date as an interval and applied it in the mean time calculation. Because several screening programs worldwide advocate a 2-year interval between screening rounds, we also evaluated the proportion of participants with a mean interval below this cut point.

Statistical analysis

Continuous variables are expressed as mean and SD for variables with normal distribution, and as median and interquartile range for asymmetrical distributions; categorical variables are expressed as proportions. The relationship between possible predictors of adherence and the latter, defined as a mean interval between mammograms of ≤18 months, was determined through univariate and multivariate robust Poisson regression. The robust Poisson model was chosen in accordance with the study design (25). Only variables with a P-value < 0.20 in the univariate analysis were included in the multivariate regression. In the final model, P-values < 0.05 were considered significant.

Results

Sample characteristics

The final sample was composed of 3,749 women who joined the screening program between April 2004 and July 2007, which corresponds to 91% of the women who have joined the cohort until the dataset closure (January 2009). Mean age was 51 years (SD, 8), illiteracy rate was 6.8%, and 5.3% had a family history of breast or ovarian cancer in a first-degree relative. Reported performance of breast self-examination was 55%, and 36% were current or former smokers. A complete baseline profile is displayed in Table 1. Mean follow-up was 3.3 (SD, 0.9) years, with a total follow-up in the cohort of 12,360 person-years. Median time between screening rounds was 16.5 months (interquartile range, 13.1-25.7), and the median number of rounds attended by each participant was 3 (interquartile range, 2-4).

Adherence and its predictors

The percentage of participants who had a mean interval between screening rounds of ≤18 months was 57.6%. When the cut point evaluated was increased to 24 months, this proportion was 71.0%.

The effect of predictors on adherence, considered as a mean interval of ≤18 months between mammograms, is displayed in Table 2. The most important independent predictors were high genetic risk [relative risk (RR), 1.25; 95% confidence interval (95% CI), 1.11-1.40), illiteracy (RR, 0.77; 95% CI, 0.67-0.90), history of oral contraceptive use (RR, 1.11; 95% CI, 1.04-1.19), and number of children, in which a parity of ≥5 yielded an 11% smaller probability of adherence (95% CI, 4%-17%) when compared with a parity of ≤2. The history of smoking habits generated diverse results: whereas current smoking was associated with a substantially smaller probability of adherence (RR, 0.82; 95% CI, 0.77-0.88), participants who were former smokers had a higher adherence (RR, 1.10; 95% CI, 1.01-1.19). Age, body mass index, and the habit of doing regular breast self-examination had no effect on adherence.

Discussion

Breast cancer screening, through either mammography alone or in combination with clinical breast examination,

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

Table 1. Characteristics of the study sample

Variable	*N* (%)
Age at baseline, y	
40-49	1,952 (52.1%)
50-59	1,238 (33.0%)
60-69	559 (14.9%)
No. of pregnancies	
Age at first delivery (y)*	21 (5)
0-2	1,597 (42.6%)
3-4	1,271 (33.9%)
≥5	881 (23.5%)
Education level	
Illiterate	245 (6.7%)
Between 1 and 7 y of education	2,067 (56.6%)
≥8 y of education	1,340 (46.7%)
Menopause after 55 y old†	42 (4.7%)
Menarche before 12 y old	773 (19.6%)
History of HRT use	445 (11.9%)
History of OC use	2,789 (74.4%)
Regular breast self-examination	2,087 (55.7%)
Smoking status	
Current smoker	1,040 (28.3%)
Former smoker	358 (9.7%)
No history	2,275 (61.9%)
First-degree relative with history of cancer (any site)	1,214 (32.4%)
First-degree relative with history of breast or ovary cancer	199 (5.3%)
High genetic risk	125 (3.3%)
Previous breast biopsy	162 (4.3%)
BMI	
<25	986 (26.3%)
≥25 and <30	1,409 (37.5%)
≥30	1,354 (36.1%)
No. of screening rounds	
1	632 (16.9%)
2	887 (23.7%)
3	1,134 (30.2%)
4	862 (23.0%)
5	234 (6.2%)

Abbreviations: HRT, hormone replacement therapy; OC, oral contraceptives; BMI, body mass index.
*Expressed as mean and SD.
†Percentage over 1,860 women who have already entered menopause.

is of major importance in the reduction of breast cancer–associated death. However, a screening program relies mainly on adherence of the target population to the program, especially on the frequency of attendance. Although our adherence to the predefined interval of 18 months between mammograms was suboptimal, our results for the 24-month cut point were good. The North American goal for the year of 2010, for example, is 70% coverage of biannual screening (26).

The adherence seen in this project should be evaluated in light of the cultural, social, and economic reality of these women. The regions where these women come from have a mean monthly family income of R$531.00(US$301.00). These data, taken into account together with the low educational level of the women that were included in this sample, support that an adherence of 57% on an 18-month interval is a significant achievement.

Moreover, some cultural issues that might play a role here should be mentioned. First, there might be a cultural difference in understanding the effect of preventive and early detection interventions (22, 27, 28), especially in a country such as Brazil where there is no structured breast cancer screening program; thus, women are historically not used to undergoing regular mammography or other early detection measures. Second, certain cultures are more fatalistic about cancer and perceive fewer benefits from screening (29), which is, in the authors' perception, an important issue in Brazil, especially in lower socioeconomic classes. Finally, in many of these women, concerns about their own healthcare are frequently neglected because of more urgent needs, such as childcare and providing food.

The variables associated with adherence in this sample fall into three categories. The first is socioeconomic level, measured by education level and income, and also represented by the proxies oral contraceptive use and number of children, depicting family planning, which is in turn directly influenced by the socioeconomic level of an individual. Although it was already known that a lower socioeconomic level was a predictor of worse adherence in the general population (9, 10, 30), our results show that, even in a population composed majorly of underserved women, economic contrasts are still observed and also influence screening compliance.

The second category, healthy lifestyle behaviors, had conflicting results: whereas regular breast self-examination had no relation to adherence, smoking had an interesting effect. Previous studies have already shown that nonsmokers were more likely to adhere to screening than current smokers (6, 31). In our study, we split the category of nonsmokers into never and ex-smokers, and observed a higher adherence in the latter. Although it might look paradoxical that current and previous smoking were associated with lower and higher adherence, respectively, we believe that a person who used to smoke and quits might be more concerned about his/her own health than a person who never started smoking. We could not find an explanation for the lack of association between breast self-examination and adherence.

Finally, risk of breast cancer played a role in adherence, represented by high genetic risk. Whereas other studies have shown association between perceived risk of breast cancer and adherence (23, 32), our study shows a different variable, which represents informed risk (as assessed by a

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

trained clinical geneticist), because all patients with high genetic risk were adequately informed and counseled about this issue. The strong association between this variable and adherence highlights the importance of an adequate communication between healthcare practitioners and the patient: a high genetic risk increases the need for an adequate screening attendance, which can more easily be achieved in patients properly made aware of their condition.

Our results are comparable with previous similar studies conducted in developed countries (4–7), where lower educational and socioeconomic levels, positive family history (represented in our study by high genetic risk), and current tobacco use were associated with lower adherence. In contrast to these studies, age had no influence in our analysis. This probably reflects the educational efforts from our group, which reinforces to all women, regardless of their age, the importance of screening through mammography between the ages of 40 and 69 years.

The main strengths of our study are the sample used and the way that data was collected. Whereas the majority of other studies analyzed the general population, our focus on underserved women expands the body of knowledge about breast cancer screening attendance to a group of women in which breast cancer is usually more devastating, considering the more difficult access to the best treatments available and consequent worse disease course. Second, the primary collection of data, in opposition to many of the other studies in the area, which used either administrative data for predictor assessment or interview response to determine adherence, ensures greater data accuracy. Moreover, our longitudinal and prospective data collection is more powerful in adherence evaluation than the cross-sectional data used in the majority of studies in the field. Our large sample, with a good representation from the geographic area that originated this study population, is also a methodologic strength of our study.

Some limitations should be mentioned. Our sample is not population-based (i.e., considering the enrollment process, some women were probably not aware of the project), which configures a self-selection bias. This might overestimate the adherence to screening in similar populations, but we do not believe that the effect on the evaluation of predictors is large. Moreover, the objective of this research was to evaluate the adherence to screening in women who came at least once for mammography, an approach that will always incur self-selection bias to some extent. Also, some important information was not collected, such as a better and more direct assessment of socioeconomic conditions. The evaluation of wages with

Table 2. Crude and adjusted analysis of factors associated with adherence

Factors	Univariate Poisson regression RR (95% CI)	Multivariate Poisson regression RR (95% CI)
Mean income (neighborhood)*	1.05 (1.03-1.06)	1.04 (1.02-1.05)
Educational level		
≤8 y of schooling vs >8 y of schooling	0.89 (0.84-0.94)	0.93 (0.88-0.99)
Illiterate vs > 8 y of schooling	0.74 (0.64-0.85)	0.77 (0.67-0.90)
Age at baseline, y		
50-59 vs 40-49	1.02 (0.94-1.10)	— (—)
60-69 vs 40-49	1.01 (0.95-1.07)	— (—)
Regular breast self-examination	1.00 (0.95-1.06)	— (—)
Smoking habits		
Former smoker vs never smoker	1.10 (1.01-1.19)	1.10 (1.01-1.19)
Current smoker vs never smoker	0.83 (0.77-0.89)	0.82 (0.77-0.88)
BMI		
Between 25 and 29.9 vs <25	1.03 (0.96-1.10)	— (—)
≥30 vs <25	0.99 (0.92-1.06)	— (—)
History of OC use	1.09 (1.02-1.16)	1.11 (1.04-1.19)
History of HRT use	1.07 (0.98-1.16)	1.06 (0.98-1.15)
High genetic risk	1.29 (1.16-1.44)	1.25 (1.11-1.40)
No. of children		
3-4 vs 0-2	0.91 (0.86-0.97)	0.91 (0.85-0.97)
≥5 vs 0-2	0.84 (0.78-0.90)	0.89 (0.83-0.96)
Previous breast biopsy	1.04 (0.92-1.19)	— (—)
Enrollment during community activities/efforts	0.92 (0.84-0.99)	0.94 (0.86-1.02)

NOTE: Only variables with a *P*-value <0.20 were included in the multivariate Poisson regression.
*RR expressed by the increase for each R$100 (~US$45).

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

the use of neighborhood income level is a possible problem, especially when the neighborhood is financially heterogeneous. Unfortunately, the only available statistics for neighborhood income is the mean, which does not allow us to appraise how heterogeneous the population is.

The results from our research point to two possible pathways to increase overall breast cancer screening in underserved populations similar to the one we studied. The first one would be closer monitoring of women with risk factors for worse adherence, with elaboration of focused strategies to increase compliance. However, the good average adherence seen in this screening program (71% if we consider the 2-y interval as acceptable) suggests that the greater efforts that ought to be made are in encouraging women to initiate screening. The low recruitment rate achieved in the project (25%) reinforces this idea: although it is possible that some of the remaining women in this area are being screened for breast cancer in other centers (e.g., through private insurance), it is most likely that the majority of women in this population are not undergoing mammography on a regular basis.

Public health policies toward breast cancer early diagnosis in Brazil have not been implemented according to the increased number of new cases a year (almost 50,000 women). Mortality rates have been steadily increasing in the last 20 years. Thus, pilot studies, such as the one presented here, should be encouraged in an attempt to design a national program for early detection. The identification of population-specific predictors of adherence to breast cancer screening programs is essential to concentrate efforts to reduce those situations associated with decreased adherence and thus maximize the effectiveness of breast cancer downstaging programs.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Acknowledgments

We thank the City Health Department of Porto Alegre for its contributions, especially the lay community health workers, who are directly responsible for our adherence results; and the staff from Instituto da Mama do Rio Grande do Sul.

Grant Support

Social responsibility budget from the Associação Hospitalar Moinhos de Vento.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked *advertisement* in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

Received 04/05/2010; revised 06/16/2010; accepted 07/10/2010; published online 10/07/2010.

References

1. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. CA Cancer J Clin 2005;55:74–108.
2. Instituto Nacional de Câncer; Ministério da Saúde. Controle do câncer de mama: documento de consenso. Rev Bras Cancerol 2004;50:77–90.
3. Smith RA, Cokkinides V, von Eschenbach AC, et al. American Cancer Society guidelines for the early detection of cancer. CA Cancer J Clin 2002;52:8–22.
4. Schootman M, Jeffe DB, Baker EA, Walker MS. Effect of area poverty rate on cancer screening across US communities. J Epidemiol Community Health 2006;60:202–7.
5. Meissner HI, Breen N, Taubman ML, Vernon SW, Graubard BI. Which women aren't getting mammograms and why? (United States). Cancer Causes Control 2007;18:61–70.
6. Schumacher MC, Slattery ML, Lanier AP, et al. Prevalence and predictors of cancer screening among American Indian and Alaska native people: the EARTH study. Cancer Causes Control 2008;19:725–37.
7. Maheswaran R, Pearson T, Jordan H, Black D. Socioeconomic deprivation, travel distance, location of service, and uptake of breast cancer screening in North Derbyshire, UK. J Epidemiol Community Health 2006;60:208–12.
8. Carney PA, Harwood BG, Weiss JE, Eliassen MS, Goodrich ME. Factors associated with interval adherence to mammography screening in a population-based sample of New Hampshire women. Cancer 2002;95:219–27.
9. Phillips KA, Kerlikowske K, Baker LC, Chang SW, Brown ML. Factors associated with women's adherence to mammography screening guidelines. Health Serv Res 1998;33:29–53.
10. Rahman SM, Dignan MB, Shelton BJ. Factors influencing adherence to guidelines for screening mammography among women aged 40 years and older. Ethn Dis 2003;13:477–84.
11. Cohen SS, Signorello LB, Gammon MD, Blot WJ. Obesity and recent mammography use among black and white women in the Southern Community Cohort Study (United States). Cancer Causes Control 2007;18:765–73.
12. Graves KD, Huerta E, Cullen J, et al. Perceived risk of breast cancer among Latinas attending community clinics: risk comprehension and relationship with mammography adherence. Cancer Causes Control 2008;19:1373–82.
13. Caleffi M, Ribeiro RA, Duarte Filho DL, et al. A model to optimize public health care and downstage breast cancer in limited-resource populations in southern Brazil. (Porto Alegre Breast Health Intervention Cohort). BMC Public Health 2009;9:83.
14. Ashton-Prolla P, Giacomazzi J, Schmidt AV, et al. Development and validation of a simple questionnaire for the identification of hereditary breast cancer in primary care. BMC Cancer 2009;9:283.
15. Palmero EI, Caleffi M, Schuler-Faccini L, et al. Population prevalence of hereditary breast cancer phenotypes and implementation of a genetic cancer risk assessment program in Southern Brazil. Genet Mol Biol 2009;32:447–455.
16. Claus EB, Risch N, Thompson WD. Autosomal dominant inheritance of early-onset breast cancer. Implications for risk prediction. Cancer 1994;73:643–51.
17. Gail MH, Brinton LA, Byar DP, et al. Projecting individualized probabilities of developing breast cancer for white females who are being examined annually. J Natl Cancer Inst 1989;81:1879–86.
18. Tyrer J, Duffy SW, Cuzick J. A breast cancer prediction model incorporating familial and personal risk factors. Stat Med 2004;23:1111–30.
19. Andersson I, Aspegren K, Janzon L, et al. Mammographic screening and mortality from breast cancer: the Malmo mammographic screening trial. BMJ 1988;297:943–8.
20. Bjurstam N, Bjorneld L, Warwick J, et al. The Gothenburg Breast Screening Trial. Cancer 2003;97:2387–96.
21. Selvin E, Brett KM. Breast and cervical cancer screening: sociodemographic predictors among White, Black, and Hispanic women. Am J Public Health 2003;93:618–23.
22. Achat H, Close G, Taylor R. Who has regular mammograms? Effects of knowledge, beliefs, socioeconomic status, and health-related factors. Prev Med 2005;41:312–20.
23. Calvocoressi L, Kasl SV, Lee CH, Stolar M, Claus EB, Jones BA. A

Published OnlineFirst August 17, 2010; DOI: 10.1158/1055-9965.EPI-10-0338

prospective study of perceived susceptibility to breast cancer and nonadherence to mammography screening guidelines in African American and White women ages 40 to 79 years. Cancer Epidemiol Biomarkers Prev 2004;13:2096–105.

24. Hiatt RA, Pasick RJ, Stewart S, et al. Cancer screening for underserved women: the Breast and Cervical Cancer Intervention Study. Cancer Epidemiol Biomarkers Prev 2008;17:1945–9.
25. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. BMC Med Res Methodol 2003;3:21.
26. Centers for Disease Control and Prevention, NIH. Healthy People 2010: Cancer; (10/01/2009): Available from: http://www.healthypeople.gov/document/html/volume1/03cancer.htm.
27. Ricker C, Lagos V, Feldman N, et al. If we build it … will they come?-establishing a cancer genetics services clinic for an underserved predominantly Latina cohort. J Genet Couns 2006;15:505–14.
28. Farmer D, Reddick B, D'Agostino R, Jackson SA. Psychosocial correlates of mammography screening in older African American women. Oncol Nurs Forum 2007;34:117–23.
29. Russell KM, Perkins SM, Zollinger TW, Champion VL. Sociocultural context of mammography screening use. Oncol Nurs Forum 2006; 33:105–12.
30. Tatla RK, Paszat LF, Bondy SJ, Chen Z, Chiarelli AM, Mai V. Socioeconomic status and returning for a second screen in the Ontario breast screening program. Breast 2003;12:237–46.
31. Bancej CM, Maxwell CJ, Onysko J, Eliasziw M. Mammography utilization in Canadian women aged 50 to 69: identification of factors that predict initiation and adherence. Cancer J Public Health 2005; 96:364–8.
32. Katapodi MC, Lee KA, Facione NC, Dodd MJ. Predictors of perceived breast cancer risk and the relation between perceived risk and breast cancer screening: a meta-analytic review. Prev Med 2004;38:388–402.

Cancer Epidemiology, Biomarkers & Prevention

AACR American Association for Cancer Research

Adherence to a Breast Cancer Screening Program and Its Predictors in Underserved Women in Southern Brazil

Maira Caleffi, Rodrigo A. Ribeiro, Ademar J. Bedin, Jr., et al.

Cancer Epidemiol Biomarkers Prev 2010;19:2673-2679. Published OnlineFirst August 17, 2010.