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Performance of physical activity as a predictor of women's mammography screening attendance in a population of Northeast Brazil

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ABSTRACT

Introduction: Despite the increasing incidence of breast cancer among women in Northeast Brazil, there have been no studies on the association between physical activity and attendance to mammography screening. **Objective:** This study of Brazilian women addressed socio-economic variables, physical activity, and knowledge about breast cancer and their impact on attendance to mammography screening. **Methods:** A cross-sectional quantitative study was conducted as an epidemiological evaluation. Data were obtained by interviewing 307 women in a public health center. Logistic regression analysis was applied to determine the odds ratio (ORs) and confidence intervals (CI) of variables. **Results:** Mean age of women was 49.79 (SD=8.63) years and 172 (56.0%) were between 40 and 49 years old. Women aged from 40 to 49 and ≥50 years who performed physical activity, had a 2.4-fold (95% CI: 1.13-5.04) and 10.6-fold (95% CI: 2.66-41.95) increased chance to attend MS every year (p=0.040; p<0.001). Women aged between 40 and 49 years with a low and middle income, had a 10.3-fold (OR=0.097; 95% CI: 0.02-0.53) and 13.2-fold (OR=0.076; 95% CI: 0.11-0.53) decreased chance to attend MS every second year (p=0.007). The MS attendance of women aged ≥50 years with basic education level was 13.3 (OR=0.075; 95% CI: 0.09-0.66) times decreased (p=0.010). **Conclusion:** Physical activity represented an important predictor of MS attendance of all women. The impact of income and education level, in contrast, depended strongly on the age group.

Keywords: breast neoplasms; disease prevention; control; mammography; Behavior; Exercise; Health Sciences.

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INTRODUCTION

The World Health Organization (WHO) estimated 2,088,849 new cases of breast cancer in the year 2018 which contributed to 11.6% of all cancer death in the world[1]. Between 1990 and 2015, Latin America and the Caribbean had the highest-increasing mortality trend of all regions in the world, with a slope of 1.48 per 100,000 women[2]. In Brazil, there are estimated 66.280 new breast cancer cases from 2020 to 2022 every year[2]. In the Southern regions, including also the two largest urban centers of the country, namely,

São Paulo and Rio de Janeiro, the incidence has stabilized over the last 15 years[3,4]. This is in sharp contrast to the Northeast region, where the incidence of breast cancer has increased between 2005 and 2020 from 27.23 to 44.29 new cases per 100,000 women[3,4].

A Brazilian public campaign for breast cancer "Rose October" established in 2003 combined awareness about the disease with the opportunity for mammography screening (MS). This public campaign is opportunistic, and women are neither personally invited for MS, nor are the data of participating women registered in a database. The campaign is propagated in television, radio, and other media every year. Prospective studies about the effectiveness of this program in reducing the mortality of breast cancer are so far missing. Regarding the age threshold and interval for MS the Ministry of Health recommends biannual mammography for women aged 50 to 69 years, whereas the Brazilian Society of Mastology recommends annual MS starting at 40 years[4,5]. Therefore, for individual women, the recommendations regarding starting age and interval of MS are conflicting. In Northeast Brazil, women often present at advanced stages of disease (Stage III and IV) and high breast cancer mortality rates were attributed to non-adherence to the MS program[6-8]. Recent studies indicated that attendance to MS is lower in the Northeast compared to the Southern regions of the country[9,10].

Studies conducted in South Africa, Lithuania, and the US indicated that regular physical activity increased women's chance to attend MS programs[11-13]. Similarly, it was shown for women of the Southern region of Brazil, that regular physical activity increased women's chance of regular MS attendance[10]. Based on data of more than 30.000 women from all regions of Brazil the study of Theme Filha et al.[9] revealed that regular physical activity, as a component of a healthier lifestyle, increased the chance of MS attendance. The performance of leisurely physical activity varied among distinct regions of the country: Leisurely physical activity was performed by 18.0% to 19.1% of women in southern regions, compared to a lower rate of 17.6% in the Northeast region[9].

There exist no studies of populations in Northeast Brazil about the possible direct association between regular physical activity and MS attendance. The present study aimed at the possible association between socio-economic variables, respectively regular physical activity and MS attendance in a population of Northeast Brazil.

METHODS

Study population

The data sampling protocol was reviewed and approved by the Brazilian National Ethics Research Committee (CAAE 63089416.0.0000.5187). Written informed consent was obtained from each participant of the study. Female participants were recruited in the public health service center "*Dr. Francisco Pinto de Oliveira*" in Campina Grande, state of Paraíba, Brazil. Power sample calculation for the catchment area of the health care center indicated a sample of a minimum of 96 persons. Campina Grande is situated inland, about 120 km away from João Pessoa, the state capital on the Atlantic coast. With about 400,000 inhabitants it is the second largest urban center of Paraíba. The project was explained to individual women or small groups of two to five women who were personally asked to participate. Selection of eligible women and interviews were conducted in the morning in the waiting room of the health service center. Women were eligible if aged 40 years or older and did not have any type of breast cancer or any other chronic disease. It was always tried to include all eligible women in the waiting room on one morning with only one restriction: Data collection from more than two women who were related, such as mother-daughter pairs or two sisters was avoided by the inclusion of only one individual from each family. Most of the interviewed women accompanied children, mainly because of vaccination. Other ones had viral infections causing cough and sneezing, or gastro-intestinal problems.

Sampling was performed between May and December of 2019. This study period also included the "Rose October", the month in which women were invited to participate in the public breast cancer screening program. As this month is accompanied by public advertisements in favor of the public screening program, communication with women and subsequent sampling were facilitated.

Sampling and questionnaires

Data about socio-demographic characteristics, attendance to MS, and the sources of information about the prevention of breast cancer, were obtained by face-to-face interviews of 307 women. All interviews were performed by one of the authors applying a questionnaire. Data about knowledge of risk factors and symptoms of breast cancer were obtained by self-completion of a second questionnaire. The questionnaires used were based on very similar ones that have been developed and applied in previous studies[14,15].

Of all 307 women, 91 never attended MS, whereas eight attended only sometimes. The 99 (32.2%) women together, were defined as the group of "Never or irregular" MS participation.

The basic education level was defined as ≤ 8 years of basic school education. The middle and high education level was defined as 8-12 years, respectively >12 years of school education. Minimum wage and multiple values were used to characterize income. This is a popular and well-known method used to define the economic level among low- and middle-class subjects. A minimum wage or less was defined as "low" income, whereas incomes equivalent to two or more times the minimum wage were defined as "high" income. The minimum wage in 2019 was R$998.00/month (US$237.60/month; 23rd January 2020). Women were asked if a first-degree relative had breast cancer or any other type of cancer. Information about religion was obtained

by the question of whether the participant was Catholic, or any other confession, respectively religion.

Performance of regular physical activity was defined as engaged in mild to moderate and/or vigorous physical activity at the recommended levels of ≥150 min and ≥75 min per week[16]. All women who performed regular physical activity did it several times every week. If asked about the type of physical activity most women mentioned daily walking. Furthermore, hydro gymnastics and gymnastics in an academy also were often cited.

Knowledge about risk factors and symptoms of breast cancer

To assess knowledge about risk factors, preventive behaviors, and symptoms of breast cancer, women were encouraged to tick a box next to each of the 33 potential risk factors, seven prevention behaviors, and 22 symptoms, that they recognized. Risk factors were related to lifestyle, reproduction, and family history. To enhance the assessment of participants' knowledge about risk factors and to lower the chance of ticking boxes without reflection, 16 additional non-risk factors were included in the questionnaire among 17 true risk factors. Similarly, among nine true symptoms were additionally included 13 non-symptoms. This method was successfully applied in a previous study[17].

Regarding questions related to knowledge, each factor correctly identified was assigned a score of 1 (known), while a factor incorrectly identified was assigned a score of 0 (unknown). The total score was determined for each participant as the sum of factors and correctly identified knowledge. The maximum possible score was 62 points. The mean and median scores reached were 37.69 (SD=4.58) and 38.00 points. The minimum and maximum score reached were 21, respectively 53 points. The quartiles were used to categorize knowledge: ≤ 34 points (25% quartile) was defined as "low"; >34 and ≤ 38 (50% quartile) was defined as "basic"; >38 and ≤ 41 points (75% quartile) was defined as "middle"; >41 points (100% quartile) were defined as "high".

Statistical analysis

All statistical analyses were performed using the SPSS Statistics™ software (SPPS; IBM company; version 24). The t-test was applied to compare continuous variables. ANOVA was used to compare more than two groups of continuous variables. Fisher's exact test and Pearson's chi-square ($\chi 2$) test were used to analyze categorical variables. To quantify associations among single risk factors for BC, nominal logistic regression analysis was applied. Data from women who did not attend MS regularly were used as reference groups. Results were presented as adjusted odd ratios (OR), 95% confidence interval (CI), and p-value of likelihood ratio tests. Significant univariate regression analysis variables were used for regression modeling with multiple adjusted variables: Variables with significance levels less than 0.2 in the univariate analysis were included in the model. Then, variables with a significance level of less than 0.05 were kept in the model. Backward selection was used when significant variables were selected. The final model was tested for fitness using the likelihood ratio test.

RESULTS

The 307 women were on average 49.79 (SD= 8.63) years old, and 172 (56.0%) were aged between 40 and 49 years (Table 1). Of all women, 138 (45.0%) and 70 (22.8%) attended MS every year and every second year, respectively. 99 (32.2%) never

Table 1: Socio-demographic characteristics, MS behavior and knowledge about risk factors respectively, symptoms of disease of all (N= 307) women.

Characteristics	
Age mean±SD (years)	49.79±8.63
40- 49	172 (56.0%)
50- 59	91 (29.7%)
60- 69	35 (11.4%)
≥70	9 (2.9%)
Mammography screening	
Never or irregular	99 (32.2%)
Each year	138 (45.0%)
Each second year	70 (22.8%)
Education level	
Basic	145 (47.2%)
Middle	120 (39.1%)
High	42 (13.7%)
Income	
Low	226 (73.6%)
High	81 (26.4%)
Occupation status	
Not occupied	188 (61.2%)
Occupied	119 (38.8%)
Civil state	
No stable union	137 (44.6%)
Stable union	170 (55.4%)
Religion	
Catholic	188 (61.2%)
Not catholic	119 (38.8%)
Family history of cancer	
Yes	181 (59.0%)
No	126 (41.0%)
Physical activity	
Yes	126 (41.0%)
No	181 (59.0%)
Smoking	
Yes	21 (6.8%)
No	286 (93.2%)
Alcohol consumption	
Yes	47 (13.3%)
No	260 (84.7%)
Knowledge	
Very poor	77 (25.1%)
Poor	92 (30.0%)
Middle	81 (26.4%)
Good	57 (18.5%)

attended or were not regular (Table 1). Basic education level and low income were characteristics of 145 (47.2%), and 226 (73.6%) of the women respectively. Together 57 (18.5%) out of 307 women had good knowledge about risk factors and symptoms of disease. Of all women aged between 40 and 49, and ≥ 50 years, respectively 29 (16.9%) and 28 (20.7%) had good knowledge (p=0.658). Within both age groups knowledge was not significantly different among women with distinct education levels (p=0.085; p=0.406). Altogether 126 (41.0%) women performed regular physical activity (Table 1). Of all 126 and 181 women performing and not performing regular physical activity, four (3.2%) and 17 (9.4%) were smoking and 14 (11.1%), respectively 33 (18.2%) were consuming alcohol (p=0.026; p=0.060).

If asked about prevention of breast cancer 300 (97.7%) and 296 (96.4%) of all women cited television and the preventive campaign in October as main sources of information (Table 2). Books and journals, in contrast, were the most statistically insignificant sources of information and were cited by 160 (52.1%) women.

A comparison of women aged between 40-49 years and those aged 50 years and older, indicated remarkable differences. Regression analysis of single variables was therefore performed separately for each age group (Table 3). Women aged between 40-49 years with a middle income, had a 12-fold (OR=0.083; 95%CI: 1.10-4.51) decrease in chance to attend MS every second year, compared to women with a high income (p=0.045; Table 3). Women aged ≥ 50 years with basic education level and low income, had an 8.7 (OR=0.115; 95%CI: 0.01-0.93), respectively 11.4 (OR=0.088; 95%CI: 0.01-0.69) times decreased chance to attend MS every year (p=0.030; p<0.001; Table 3). Physical activity was associated with a 9.9-fold (95%CI: 2.66-36.93) increased chance of women aged ≥50 years of yearly MS attendance (p=0.001; Table 3). Among women aged ≥50 years, low, basic, and middle knowledge, tended to be associated with decreased attendance to MS, compared to women with high knowledge (Table 3). However, it was not possible to establish any significant relation between knowledge and MS (Table 3).

Regression modeling was performed to identify independent variables (Table 4). Women aged from 40 to 49 years with a low and middle income had a 10.3-fold (OR= 0.097; 95%CI: 0.02-0.53), respectively 13.2-fold (OR=0.076; 95%CI: 0.11-0.53) decreased chance to attend MS every second year, compared to women with high income (p=0.007; Table 4). Women who performed regular physical activity had a 2.4-fold (95%CI: 1.13-5.04) times increased chance of annual MS attendance (p=0.040; Table 4). Women aged ≥50 years with a basic education level attended MS every year 13.3 (OR=0.075; 95%CI: 0.09-0.66) times less often, compared to women with a high education level (p=0.010; Table 4). Those women who performed physical activity had a 10.6-fold (95%CI: 2.66-41.95) increased chance of attending MS every year (p=0.001; Table 4).

Results revealed that regular physical activity was an independent variable that predicted MS adherence and that this effect was most prominent among women aged ≥50 years.

Table 2: Women's (N= 307) sources of information about prevention of breast cancer.

Source of information	N (%)
Television	300 (97.7%)
Radio	222 (72.3%)
Books and Journals	160 (52.1%)
Internet	198 (64.5%)
Medical consultation	209 (68.1%)
Preventive campaign	296 (96.4%)
Family members	195 (63.5%)
Other persons	199 (64.8%)

DISCUSSION

Present results indicated that physical activity was an important variable in predicting women's attendance in the MS program. Regression modeling indicated that physical activity was an independent variable. The association of physical activity with MS attendance was stronger among women aged ≥50 years, but also significant among women aged from 40 to 49 years. To the best of our knowledge, the direct positive association between physical activity and MS attendance of women aged from 40 to 49 years has never been reported so far for a population in Northeast Brazil. In agreement with present results previous Brazilian studies revealed positive associations between physical activity and MS attendance of women in Southern Brazil respectively, women aged from 50 to 69 years: A recent database study of women in Southern Brazil indicated that any kind of regular exercise during the last three month was positively associated to MS attendance within the last two years[10]. Another database study analyzed MS attendance of Brazilian women from the whole country aged between 50 and 69 years: Women who practiced ≥150 mild/moderate, or ≥75 minutes of vigorous physical activity had an increased chance of MS attendance within the last two years[9].

Studies conducted in other countries corroborate present findings about the association between physical activity and MS attendance: a recent study based on data from more than 160 thousand women in the US revealed that the chance of ever MS attendance was higher among women who practiced more physical activity[13]. A Lithuanian study associated MS attendance of at minimum once within the last two years with an increased number of leisure-time physical activity[12]. Similarly, a recent study from South Africa revealed a positive association between moderate and/or vigorous physical activity and regular MS attendance[11].

It is possible that among more active women of the present study group, regular physical exercise was associated with a stronger consciousness about health and that this also triggered

Table 3: Attendance of MS of women aged 40-49 and ≥50 years by annual frequency.

	Women aged 40- 49 years (N= 172)				Women aged ≥ 50 years (N= 135)			
	N (%)	Every year (N= 58)	Every second year (N= 34)	P	N (%)	Every year (N= 80)	Every second year (N= 36)	P
		OR (95%CI)				OR (95%CI)		
Education level								
Basic	70 (40.7%)	0.634 (0.22- 1.87)	0.465 (0.16- 1.33)	0.127	75 (55.6%)	0.115* (0.01- 0.93)	0.412 (0.04- 4.33)	0.030
Middle	83 (48.3%)	4.966 (0.57- 43.08)	2.791 (0.32- 24.21)		37 (27.4%)	1.263 (0.07- 21.54)	4.000 (0.19- 84.20)	
High	19 (11.0%)	Ref.			23 (17%)	Ref.		
Income								
Low	127 (73.8%)	0.911 (0.19- 4.29)	1.167 (0.22- 6.14)	0.045	99 (73.3%)	0.088* (0.01-0.69)	0.444 (0.05- 4.29)	<0.001
Middle	31 (18.6%)	0.289 (0.08- 1.11)	0.083* (0.01-0.58)		36 (26.7%)	Ref.		
High	13 (7.6%)	Ref.						
Occupation status								
Not occupied	98 (57.0%)	0.988 (0.50- 1.95)	2.07 (0.88- 4.87)	0.191	90 (66.7%)	0.313 (0.08- 1.16)	0.375 (0.09- 1.54)	0.165
Occupied	74 (43.0%)	Ref.			45 (33.3%)	Ref.		
Civil status								
No stable union	70 (40.7%)	1.263 (0.64- 2.49)	0.416 (0.167- 1.03)	0.052	67 (49.6%)	0.538 (0.20- 1.48)	1.143 (0.37- 3.54)	0.131
Stable union	102 (59.3%)	Ref.			68 (50.4%)	Ref.		
Religion								
Catholic	98 (57%)	0.864 (0.44- 1.71)	0.889 (0.40- 2.00)	0.906	90 (66.7%)	0.885 (0.29- 2.74)	0.399 (0.12- 1.34)	0.124
Not catholic	74 (43%)	Ref.			45 (33.3%)	Ref.		
Family history of cancer								
Yes	98 (57.0%)	2.222* (1.10- 4.51)	1.125 (0.50- 2.51)	0.070	83 (61.5%)	2.292 (0.83- 6.34)	3.125 (0.99- 9.91)	0.140
No	74 (43.0%)	Ref.			52 (38.5%)	Ref.		
Physical activity								
Yes	60 (34.9%)	2.283* (1.11- 4.68)	1.74 (0.74- 4.08)	0.069	66 (48.9%)	9.905* (2.66- 36.93)	2.347 (0.57- 9.73)	<0.001
No	112 (65.1%)	Ref.			69 (51.1%)	Ref.		
Smoking								
Yes	11 (6.4%)	1.111 (0.29- 4.33)	0.94 (0.17- 5.09)	0.979	10 (7.4%)	0.356 (0.08- 1.64)	0.314 (0.05- 2.07)	0.394
No	161 (93.6%)	Ref.			125 (92.6%)	Ref.		
Alcohol consumption								
Yes	32 (18.6%)	0.718 (0.30- 1.70)	0.459 (0.14- 1.48)	0.366	15 (11.1%)	2.870 (0.35- 23.71)	1.636 (0.16- 16.90)	0.442
No	140 (81.4%)	Ref.			120 (88.9%)	Ref.		
Knowledge about risk factors and symptoms								
Low	41 (23.8%)	0.948 (0.32- 2.85)	0.333 (0.08- 1.34)		36 (26.7%)	0.667 (0.11- 4.05)	0.500 (0.70- 3.55)	
Basic	53 (30.8%)	1.352 (0.46- 3.96)	1.273 (0.41- 3.93)	0.329	39 (28.9%)	0.365 (0.07- 1.98)	0.321 (0.05- 2.02)	0.577
Middle	49 (28.5%)	1.750 (0.60- 5.09)	0.900 (0.27- 2.99)		32 (23.7%)	0.278 (0.05- 1.58)	0.458 (0.07- 2.89)	
High	29 (16.9%)	Ref.		28 (20.7%)	Ref.			

*p<0.050

OR: odds ratios, 95%CI: confidence intervals

regular attendance to MS. Physical exercise is one attribute of healthy lifestyle behavior and may also be associated with other aspects like avoidance of smoking and alcohol abuse, respectively, healthy dietary habits. On one hand in the present study smoking and alcohol consumption were not directly associated with women's MS behavior. On the other hand, those women who practiced physical activity also smoked, respectively consumed alcohol less often. Comparable to present findings previous studies revealed a negative association between smoking and MS attendance[9,13]. The consumption of strong alcoholic drinks at least

Table 4: Two models of MS attendance of women aged 40-49 and ≥50 years by annual frequency.

	N (%)	Every year	Every second year	P
		OR (95%CI)		
Women aged 40- 49 years (N= 172)				
Income				
Low	127 (73.8%)	0.949 (0.17- 5.34)	0.097* (0.02- 0.53)	0.007
Middle	32 (18.6%)	1.228 (0.214- 7.04)	0.034* (0.04- 0.30)	
High	13 (7.6%)	Ref.		
Physical activity				
Yes	60 (34.9%)	2.385* (1.13- 5.04)	2.343 (0.92- 5.95)	0.040
No	112 (65.1%)	Ref.		
Women aged ≥ 50 years (N= 135)				
Education level				
Basic	75 (55.6%)	0.075* (0.09- 0.66)	0.375 (0.04- 4.00)	0.010
Middle	37 (27.4%)	0.943 (0.05- 17.37)	3.663 (0.17- 78.46)	
High	23 (17%)	Ref.		
Physical activity				
Yes	66 (48.9%)	10.569*(2.66-41.95)	2.204 (0.51- 9.50)	<0.001
No	69 (51.1%)	Ref.		

OR: odds ratios, 95%CI: confidence intervals

once per week diminished the chance of MS attendance in the Lithuanian study[12]. A recent meta-analysis including 65 studies identified health beliefs like greater perceived benefits, motivation towards screening, and higher perceived seriousness as important factors for MS attendance[18]. Physical activity could also be positively associated with health beliefs that influence women's decisions about MS attendance.

The number of studies that identified physical activity as a predictor of MS attendance is relatively limited. This contrasts with the well-established variables of income and education level as shown in a recent systematic review of 24 Latin American studies[19]. In univariate analysis of present data high income was positively associated with MS attendance among women of both age groups. In a regression model income remained an independent variable for women aged between 40 and 49 years. In agreement with present results recent studies conducted in the US and Latin American countries also showed that women with higher income attended regular or sporadic MS more often, compared to low-income women[13,19]. Furthermore, several Brazilian studies identified high income as the most important predictor of adherence to the MS program[6,17,20].

Results of the present study indicated that women aged ≥50 years with a basic education level, attended annual MS less often compared to those women with a high education level. Comparable to the results of the present Brazilian study group, recent studies from Lithuania, South Africa, and the USA also showed that women with higher education levels attended MS more often[11-13]. Similarly, several Brazilian studies indicated a positive association between MS attendance and better education levels[6,9,10,20].

Modeling of present data indicated that income and education level had a distinct impact on MS attendance for women of both age groups. Data indicated that among women aged from 40 to 49 years income was a more important variable than education level, whereas among women aged ≥50 years, the latter variable was more prominent. Previous Brazilian studies revealed that women with private health insurance attended MS more often than women without it[9,10]. This indicated that MS is more often recommended and performed in the private health sector. Private health insurance highly depends on income. Furthermore, as in the Brazilian public health system MS is recommended at the age of 50 years onwards, women aged between 40 and 49 may receive the recommendation to attend MS mainly by physicians of private health services[4,5]. This may explain why high income is stronger coupled with MS attendance of women who are under 50 years old compared to women aged ≥50 years.

Women in the present study with good knowledge about symptoms and risk factors of disease tended to attend regular MS more often. However, the heterogenic distribution of this variable and its association with MS was neither significant nor was it possible to establish any difference in knowledge between women of both age groups. Furthermore, better knowledge was also not associated with a higher education level. Therefore, a higher education level must be associated with other skills than knowledge alone to trigger women's prevention behavior. In this context, physical activity and higher education level could not only be associated with healthy behaviors but also with health beliefs that support MS attendance.

An important limitation of the present study was that it did not include information about women's health beliefs. Furthermore, information about health insurance status was missing. Another limitation of the present study may have been recalling bias among the interviewed women and a selection bias also cannot be excluded.

The present study established an overall positive association between physical activity and regular attendance to MS among women in a population of Northeast Brazil. This positive association was stronger among women aged ≥50 years, but also present

among women aged from 40 to 49 years. Women aged between 40 and 49 years with a high income attended regular MS more often compared to women with low income. In contrast to women aged between 40 and 49 years, in the group of women aged ≥50 years high education level was associated with an increased chance of regular MS attendance. Future studies should elucidate if physical activity is further positively associated with other behaviors like a healthy diet, positive attitudes towards cancer prevention, and health beliefs that support women's MS attendance. In contrast to low-income women those with a high income, probably have more often private health insurance and a better possibility to attend MS. Therefore, future studies should also include data about the health insurance status of women and recommendations of MS by the medical staff.

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REFERENCES

1. World Health Organization (WHO). WHO report on cancer: setting priorities, investing wisely and providing care for all. Geneva: World Health Organization, 2020.

2. Fitzmaurice C, Allen C, Barber RM, Barregard L, Bhutta ZA, Brenner H, et al. Global, Regional, and National Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life-years for 32 Cancer Groups, 1990 to 2015: a systematic analysis for the Global Burden of Disease Study. JAMA Oncol. 2017;3(4):524-48. https://doi.org/10.1001/jamaoncol.2016.5688

3. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Secretaria de Atenção à Saúde. Instituto Nacional de Câncer (INCA). Estimativa 2005: Incidência de câncer no Brasil. Rio de Janeiro: INCA, 2004.

4. Brasil. Ministério da Saúde. Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA). Estimativa 2020: incidência de câncer no Brasil. Rio de Janeiro: INCA, 2019.

5. Urban LABD, Schaefer MB, Duarte DL, Santos RP, Maranhão NMA, Kefalas AL, et al. Recomendações do Colégio Brasileiro de Radiologia e Diagnóstico por Imagem, da Sociedade Brasileira de Mastologia e da Federação Brasileira das Associações de Ginecologia e Obstetrícia para rastreamento do câncer de mama por métodos de imagem. Radiol Bras. 2012;45(6):334-9. https://doi.org/10.1590/S0100-39842012000600009

6. Silva TB, Mauad EC, Carvalho AL, Jacobs LA, Shulman LN. Difficulties in implementing an organized screening program for breast cancer in Brazil with emphasis on diagnostic methods. Rural Remote Health. 2013;13(2):2321.

7. Schneider IJC, Corseuil MW, Boing AF, D'Orsi E. Knowledge about mammography and associated factors: population surveys with female adults and elderly. Rev Bras Epidemiol. 2013;16(4):930-42. https://doi.org/10.1590/S1415-790X2013000400013

8. Andrade ACM, Ferreira Júnior CA, Guimarães BD, Barros AWP, Almeida GS, Weller M. Molecular breast cancer subtypes and therapies in a public hospital of Northeastern Brazil. BMC Women's Health. 2014;14:110. https://doi.org/10.1186/1472-6874-14-110

9. Theme Filha MM, Leal MC, Oliveira EFV, Esteves-Pereira AP, Gama SGN. Regional and social inequalities in the performance of Pap test and screening mammography and their correlation with lifestyle: Brazilian national health survey, 2013. Int J Equity Health. 2016;15:136. https://doi.org/10.1186/s12939-016-0430-9

10. Barbosa YC, Oliveira AGC, Rabêlo PPC, Silva FS, Santos AM. Factors associated with lack of mammography: National Health Survey, 2013. Rev Bras Epidemiol. 2019;22:e190069. https://doi.org/10.1590/1980-549720190069

11. Phaswana- Mafuya N, Peltzer K. Breast and Cervical Cancer Screening Prevalence and Associated Factors among Women in the South African General Population. Asian Pac J Cancer Prev. 2018;19(6):1465-70. https://doi.org/10.22034/APJCP.2018.19.6.1465

12. Kriaucioniene V, Petkeviciene J. Predictors and Trend in Attendance for Breast Cancer Screening in Lithuania, 2006-2014. Int J Environ Res Public Health. 2019;16(22):4535. https://doi.org/10.3390/ijerph16224535

13. Progovac AM, Pettinger M, Donohue JM, Chang CCHJ, Matthews KA, Habermann EB, et al. Optimism may moderate screening mammogram frequency in Medicare. Medicine (Baltimore). 2019;98(24):e15869. https://doi.org/10.1097/MD.0000000000015869

14. Alves SAV, Batiston AP, Weller M. Impact of Education and Health Treatment Options on Performance of Clinical Breast Examination. Acta Sci Women's Health. 2019;1(6):2-9.

15. Freitas ÂGQ, Weller M. Women's knowledge about risk factors of breast cancer in a Brazilian community. Women Health. 2019;59(5):558-68. https://doi.org/10.1080/03630242.2018.1516266

16. Runowicz CD, Leach CR, Henry NL, Henry KS, Mackey HT, Cowens-Alvarado, et al. American Cancer Society/American Society of Clinical Oncology Breast Cancer Survivorship Care Guideline. CA Cancer J Clin. 2016;66(1):43-73. https://doi.org/10.3322/caac.21319

17. Freitas ÂGQ, Weller M. Knowledge about Risk Factors of Breast Cancer and Its Effect on Women's Screening Behaviour in a Community of Rio Grande do Norte, North-eastern Brazil. Breast J. 2017;23(3):365-6. https://doi.org/10.1111/tbj.12746

18. Grimley CE, Kato PM, Grunfeld EA. Health and health belief factors associated with screening and help-seeking behaviours for breast cancer: A systematic review and meta-analysis of the European evidence. Br J Health Psychol. 2020;25(1):107-28. https://doi.org/10.1111/bjhp.12397

19. Nuche- Berenguer B, Sakellariou D. Socioeconomic determinants of cancer screening utilisation in Latin America: A systematic review. PLoS One. 2019;14(11):e0225667. https://doi.org/10.1371/journal.pone.0225667

20. Vieira RAC, Lourenço TS, Mauad EC, Filho VGM, Peres SV, Silva TB et al. Barriers related to non-adherence in a mammography breast-screening program during the implementation period in the interior of São Paulo State, Brazil. J Epidemiol Glob Health. 2015;5(3):211-9. https://doi.org/10.1016/j.jegh.2014.09.007