

Evaluation of access to mammographies in Brazil and socioeconomic indicators: a space study

Avaliação do acesso em mamografias no Brasil e indicadores socioeconômicos: um estudo espacial

Evaluación del acceso en mamografías en Brasil e indicadores socioeconómicos: un estudio espacial

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ABSTRACT

Objective: To evaluate the correlation between mammography screening coverage in women from 50 to 69 years old and the socioeconomic indicators Human Development Index (HDI) and Gini Index.

Methods: Epidemiological, retrospective and ecological study carried out in Brazil with secondary data. The sample is made up of 5565 municipalities in Brazil. As a dependent variable: the ratio of screening mammography examinations performed in women aged 50 to 69 years, from 2008 to 2015, and as independent variables: The Human Development Index (HDI) and the Gini Index. Descriptive analysis, univariate and bivariate spatial analysis were performed.

Results: North, Northeast and Center-West are regions that are more propitious for breast cancer, due to the low access for mammograms. **Conclusion:** The HDI and the Gini index, determinants of inequalities, directly influence the mammography numbers in Brazil, highlighting the importance of evaluating public policies.

Keywords: Mammography. Women's health. Spatial analysis. Public health.

RESUMO

Objetivo: Avaliar a correlação entre a cobertura do exame mamografia em mulheres de 50 a 69 anos e os indicadores socioeconômicos Índice de Desenvolvimento Humano (IDH) e Índice de Gini.

Métodos: Estudo epidemiológico, retrospectivo e ecológico realizado no Brasil com dados secundários. A amostra é composta por 5565 municípios do Brasil. Como variável dependente: a Razão de exames de mamografia de rastreamento realizados em mulheres de 50 a 69 anos, de 2008 a 2015, e como variáveis independentes: o Índice de desenvolvimento humano (IDH) e Índice de Gini. Foi realizada a análise descritiva, análise espacial univariada e bivariada.

Resultados: Norte, Nordeste e Centro-Oeste são regiões que se mostram mais propícias para o câncer de mama, devido ao baixo acesso para mamografias.

Conclusão: O IDH e o índice de Gini, determinantes de desigualdades, influenciam diretamente na cobertura de exames de mamografia no Brasil, destacando a importância de avaliação das políticas públicas.

Palavras-chave: Mamografia. Saúde da mulher. Análise espacial. Saúde pública.

RESUMEN

Objetivo: Evaluar la correlación entre la cobertura del examen mamografía en mujeres de 50 a 69 años y los indicadores socioeconómicos Índice de Desarrollo Humano (IDH) e Índice de Gini.

Métodos: Estudio epidemiológico, retrospectivo y ecológico realizado en Brasil con datos secundarios. Muestra compuesta por 5565 municipios de Brasil. Como variable dependiente: Razón de exámenes de mamografía de rastreo realizados en mujeres de 50 a 69 años, de 2008 a 2015, y como variables independientes: el Índice de desarrollo humano (IDH) y el Índice de Gini. Se realizó análisis descriptivo y análisis espacial univariado y bivariado.

Resultados: Norte, Nordeste y Centro-Oeste son regiones que se muestran más propicias para el cáncer de mama, debido al bajo acceso para mamografías.

Conclusión: El IDH y el índice de Gini, determinantes de desigualdades, influyen directamente en cobertura de exámenes de mamografía en Brasil, destacando la importancia de evaluación de políticas públicas.

Palabras clave: Mamografía. Salud de la mujer. Análisis espacial. Salud pública.

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■ INTRODUCTION

Breast cancer is a public health problem that affects the entire world. According to worldwide cancer statistics, in 2017 breast neoplasia was the most common type of cancer among women, with rates of incidence and mortality that increase every year⁽¹⁾.

Except for non melanoma skin cancer, breast cancer among women is the most common type of cancer in Brazil. As much as 57,960 new cases of mammary neoplasia were estimated for 2016, with an estimated risk of 56.20 cases every 100,000 women. It is a heterogeneous and multifactorial disease, involving biological and endocrine factors, reproductive lives, behaviors and lifestyles⁽²⁾.

The need to monitor and screen for breast cancer is high, since its mortality rate in Brazil is so elevated. Breast cancer screening is necessary, an essential instrument for the establishment of actions to prevent and control this type of cancer and its risk factors⁽²⁾.

Breast cancer screening in populations was introduced in certain developed countries after randomized clinical trials had shown that it was responsible for diminishing the number of deaths from this neoplasia in 20% to 30%. The mammography was considered a potential exam, a golden standard for the control of the disease, since it enables the early detection of cases in which the lesion is restricted to the breast parenchyma, allowing for the use of less invasive therapeutic resources and increasing the chance of a cure⁽³⁾.

Brazilian public policies have been gradually incorporating actions to control breast cancer. The Ministry of Health recommends women from 50 to 69 years of age to undergo a mammography every two years. Those under greater risk (high-risk) for breast cancer (women with first-degree relatives who had the disease) are recommended to receive individual clinical attention and monitoring. For that to happen, health care must be organized as to guarantee that it is continuously accessible to this population⁽²⁻⁴⁾.

The availability of screenings through mammography has been growing. However, an increased use does not lead necessarily to the results expected from screenings, since these depend on important factors, such as well-made exams, target populations and on the frequency in which the exams are conducted⁽⁵⁾.

In Brazil, there are certain indexes of breast cancer control, such as the ratio of screenings through mammographies conducted with women from 50 to 69 years of age and people in the same age group. This index is very important, as it allows for an evaluation of the access women in the target population (from 50 to 69 years of age) have to mammographies for breast cancer screening,

showing that certain regions present a ratio of 1.0, thus offering enough exams to care for these women, while those with results below this number must improve the access to the screenings⁽⁶⁾. However, there are many differences between the different regions of the country, since several aspects are connected to the socioeconomic conditions of each one.

Considering the high prevalence of breast cancer in Brazil and the difficulties to make screening and early diagnostic accessible to all, a spatial analysis on the access to mammography for breast cancer screening in the country is extremely relevant. The analysis carried out by this study will add to the epidemiological knowledge needed to strengthen and redirect health policies for women, thus delineating better preventive and educational strategies regarding breast neoplasia. Therefore, this study aims to evaluate the correlations between the coverage of mammography for women from 50 to 69 years of age and two socioeconomic indexes, the Human Development Index (HDI) and the Gini Coefficient.

■ METHODOLOGY

This is an epidemiological, retrospective, observational and ecological study, conducted in Brazil. According to Bezerra Filho et al.⁽⁷⁾, ecological studies evaluate social and environmental contexts that affect the health of population groups. In this type of study, individual measurements are unable to adequately reflect the impact in a collective level. The research was based on secondary data extracted from the public national database DATA-SUS, and the sample included the 5565 cities in Brazil. DATASUS is the informatics department of the Unified Health System (SUS), which stores and processes information from SUS activities to organize, plan and evaluate the health system⁽⁸⁾.

The dependent variable was the Ratio of mammographies for breast cancer screening conducted in women from 50 to 69 years of age. This data was extracted from the DATASUS Cancer Information System (SISCAN) in all years which had available information, from 2008 to 2015, in the 5565 cities in Brazil. The independent variables were two indexes which are determinant to evaluate inequality: the Human Development Index (HDI) and the Gini Coefficient. The first evaluates the educational level and *per capita* family income of adults (25 years old or older) in the city, while the second evaluates wealth concentration and, consequently, social inequality. Independent variables (HDI and Gini coefficient) were extracted from the United Nations Development Programme (UNDP).

Data was inserted and processed in the software Statistical Package for the Social Sciences (SPSS), version 22.0. After data was inserted, a descriptive analysis of means, medians, standard deviations and Student's t test were performed regarding the 5565 cities in Brazil. Later, a mean for all variables from all Brazilian cities was calculated, to diminish the divergence between bigger and smaller cities. Data was distributed to the 161 Brazilian Urban Articulation Intermediary Regions.

The software Terra View, version 4.2.2 was used to conduct the spatial analysis, distributing the mean ratio of breast exams and creating Box and Moran maps, that show whether there are spatial associations⁽⁹⁾ and big and small agglomerates regarding the ration of mammographies and their independent variables. Later, data was crossed using the Geoda program, version 1.2, an open source geoprocessing software (as is Terra View).

Bivariate analyses were conducted in Geoda. It was also used to create the Lisa cluster Maps for ratios and independent variables. The Lisa cluster maps present spatial units that represent significant values ($p < 0.05$), classified in four possibilities, similarly to the Box Maps. The possibilities are: high-high and low-low, representing regions with high and low incidences surrounded by neighboring regions that also have high and low incidences, these categories represent agreeance. The other possibilities, respectively, are: high-low and low-high, and represent units with low and high incidences surrounded by regions with high and low incidences, respectively⁽¹⁰⁾.

Regarding the ethical aspects, this study did not require the approval of research ethics committees, since it was performed using public data.

■ RESULTS

Table 1 shows the mean, median, standard deviation and statistical significance according to Student's T test, regarding the index ratio of screening mammographies conducted with women from 50 to 69 years of age, from 2008 to 2015 in the 5,565 cities in Brazil.

The table showed that all values were statistically significant and, considering the years being analyzed, the worst mean for the ratio (access) of mammographies in Brazil was 2008, with a result of 0.10, while the best ones were 2014 and 2015. The numbers were very inferior to the 1.0 parameter, thus corresponding to an insufficient access to exams. Regarding the standard deviation, the highest was in 2015 (0.33). This was the year with the highest variation of mammography ratios regarding the mean, indicating that the results of many cities concerning access to this exam varied.

Table 1 -Descriptive analysis of the index ratio of mammography exams, conducted in women from 50 to 69 years of age, from 2008 to 2015, in the Brazilian cities

Year	N	Mean	Median	Standard deviation	P value
2008	5565	0.10	0.50	0.12837	0.00
2009	5565	0.13	0.70	0.16138	0.00
2010	5565	0.19	0.13	0.21162	0.00
2011	5565	0.13	0.17	0.24359	0.00
2012	5565	0.27	0.22	0.26855	0.00
2013	5565	0.33	0.27	0.30577	0.00
2014	5565	0.36	0.30	0.32215	0.00
2015	5565	0.36	0.30	0.33525	0.00

Source: SISCAN/DATASUS, 2018.

Figure 1 shows the spatial distribution of the index ratio of mammography screening exams conducted in women from 50 to 69 years of age, from 2008 to 2015, in the 161 intermediary urban articulation zones in Brazil. The darker sessions represent the regions with worst access, such as the North and Midwest, and parts of the Northwest. The cities in white, such as São José do Rio Preto in the state of São Paulo, Ponte Nova in Minas Gerais and Afogados da Ingazeira in Pernambuco, stood out with the highest ratio means (0.50 to 1.0).

The global Moran index was calculated for the mean mammography ratios, which gave a unique result to estimate whether there is a spatial evaluation. Its result was 0.66 with a p-value of 0.01, indicating that the intermediary articulation zones in Brazil have a positive spatial correlation regarding the ratio of mammographies.

Figure 2 shows the Box Map, which gave each intermediary urban articulation zone in Brazil a value, showing the formation of agglomerates with high and low values regarding the ratio of mammographies and the Moran Map, which showed significant values regarding the Box Map. It was noted that the Box Map classified the North municipalities, as well as some Midwestern and Northeastern ones, with the "Low-Low" classification. This indicates that these cities, as well as their neighboring towns, have a low mammography ratio (access). In addition, other cities stand out in the Box Map as "High-High", indicating that the access to mammography in them and in neighboring cities is high, which can be observed in the Southeast and in some cities in the South.

From the Moran Map, it was found that the "High-Low" classification was not present, since it had no spatial significance, in addition to other cities that were not significant to the Moran Map when associated to the Box Map.

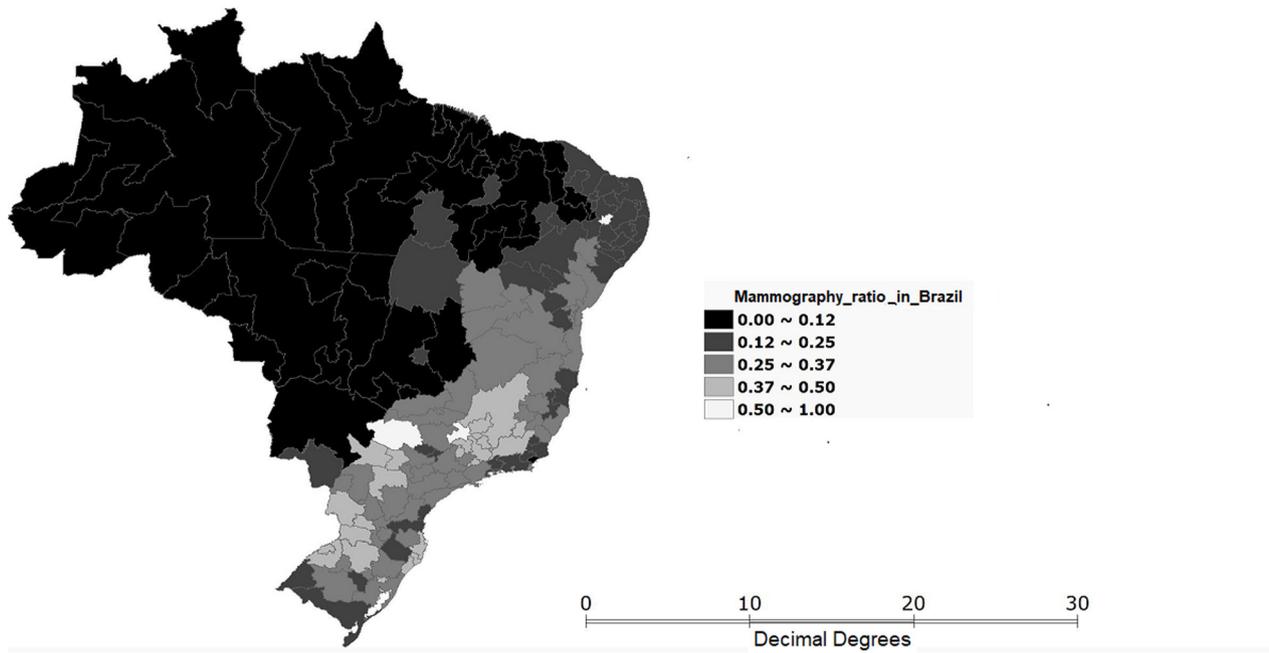
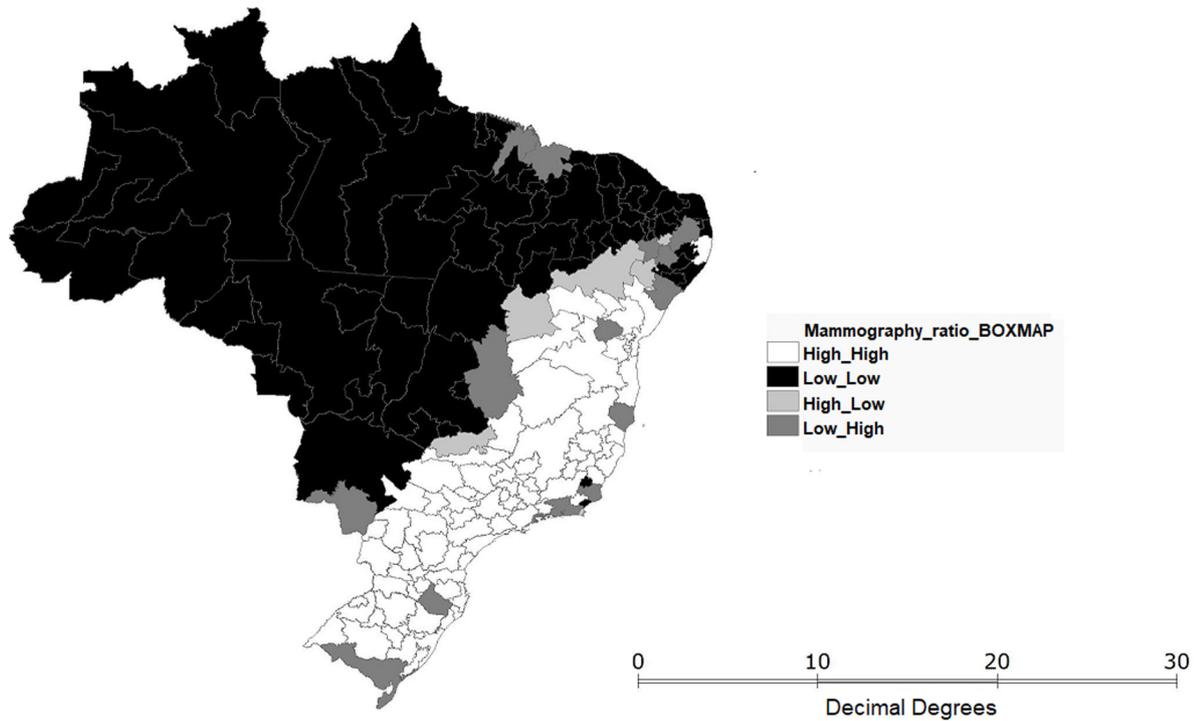


Figure 1 - Spatial analysis of the mean ratio of mammography screening exams conducted in women from 50 to 69 years of age, from 2008 to 2015, in the Intermediary Urban Articulation Zones in Brazil.

Source: SISCAN/DATASUS, 2018.



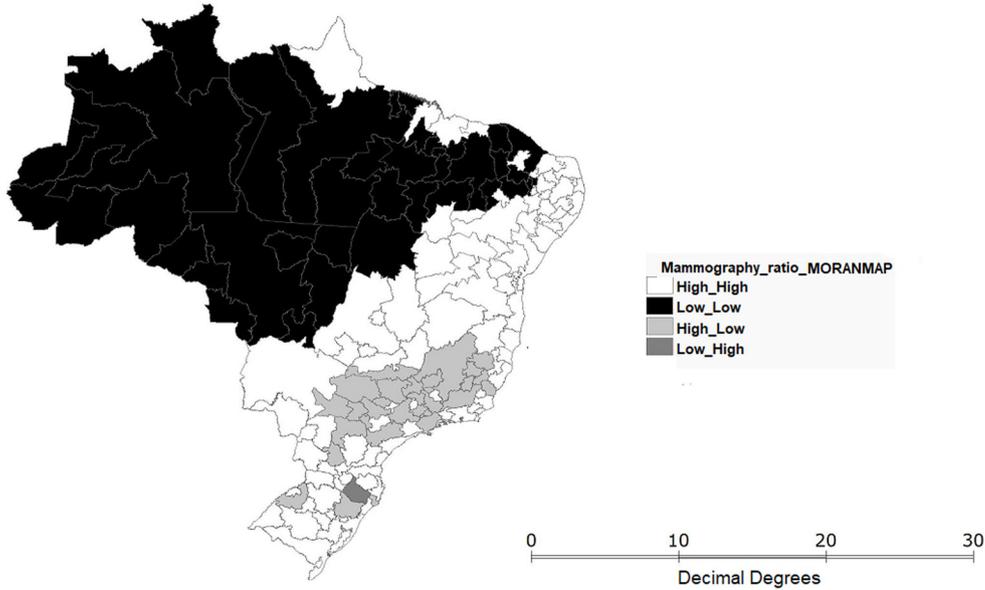


Figure 2 - Spatial analysis of the Box Map and the Moran Map (respectively), equivalent to the mean ratio of mammography screening exams conducted in women from 50 to 69 years of age, from 2008 to 2015, in the Intermediary Urban Articulation Zones in Brazil.

Source: SISCAN/DATASUS, 2018.

Figure 3 shows a cross-section between the HDI and the mammography ratio index through the Lisa Cluster Map. This map shows that some cities in the North and Northeast, in the states of Acre, Pará, Maranhão, Ceará and Piauí are classified as “Low-Low”, indicating that these locations have a low human development index (HDI) and low access to mammographies. Some cities in the North (Boa

Vista and Manaus), Fortaleza in the Northeast, and many Midwestern cities stood out, being classified as “High-Low”, indicating high HDI with low mammography ratios. In addition, the cities of Governador Valadares, Manhuaçu and Ponte Nova (all of which are in the state of Minas Gerais in the Southeast of the country) have low HDI, but high access to mammographies.

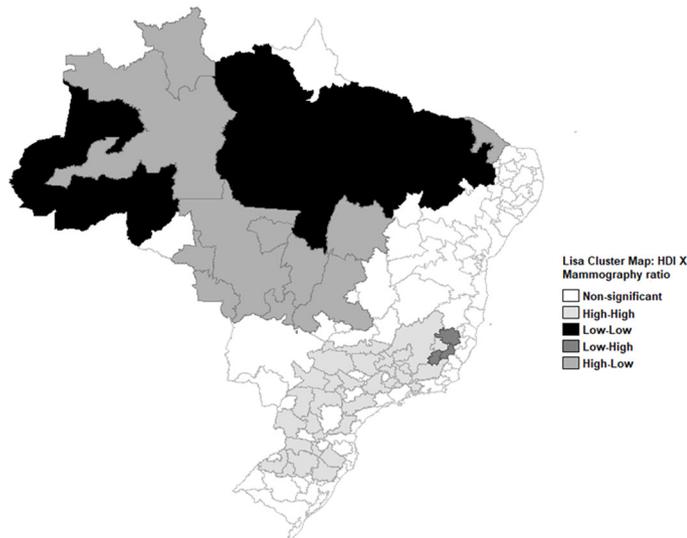


Figure 3 - Spatial bivariate analysis of the Lisa Cluster Map between the variables HDI and mean ratio of mammography screening exams conducted with women from 50 to 69 years of age, from 2008 to 2015, in the Intermediary Urban Articulation Zones in Brazil.

Source: SINAN/DATASUS; PNUD, 2018

Figure 4 shows a cross-section between the Gini Index and the mammography ratio index through the Lisa Cluster Map. In the map, the classification “High-Low” stood out in most of the North, Northeast and in part of the Midwest. These cities were inferred to have high

social inequalities, as shown by the Gini Index, and low access to mammography exams. Additionally, part of the Southeast region and some cities in the South were revealed to have low inequality (low Gini) and high access to mammographies.

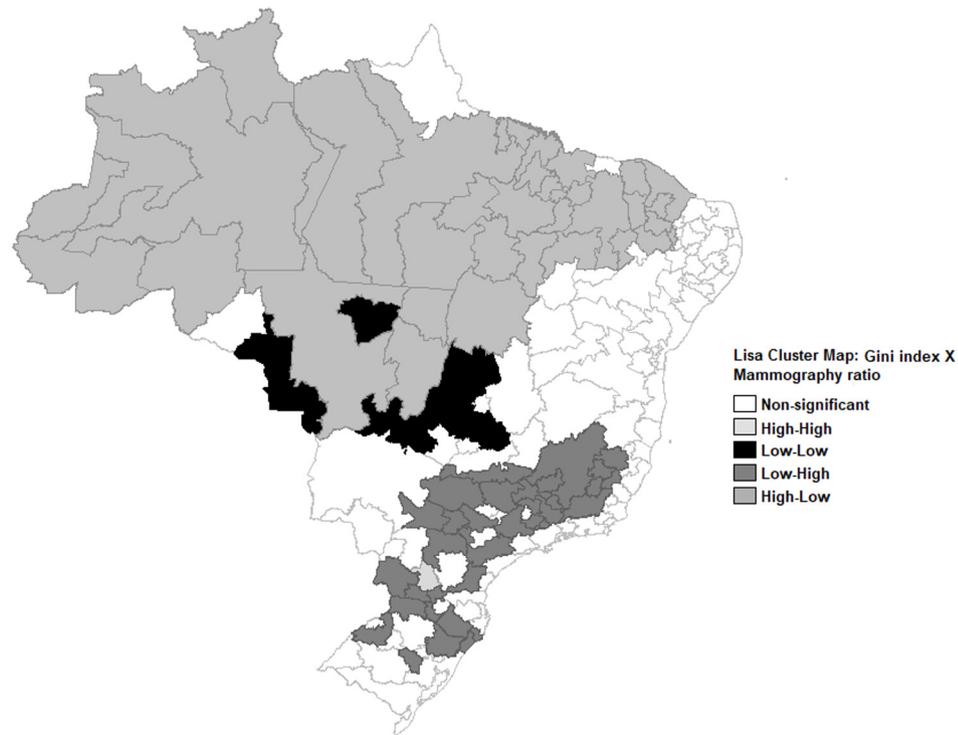


Figure 4 - Spatial bivariate analysis of the Lisa Cluster Map between the variables Gini Index and mean ratio of mammography screening exams conducted with women from 50 to 69 years of age, from 2008 to 2015, in the Intermediary Urban Articulation Zones in Brazil.

Source: SINAN/DATASUS; PNUD, 2018

DISCUSSION

The main element of breast cancer management is detecting it by raising the awareness of women and health professionals during mammographies, especially when it comes to the target population, women from 50 to 69 years of age⁽¹¹⁾. In Brazil, since 2004, there is a policy of mammography screening tests every two years or more for women from 50 to 69 years of age. However, there is no program for an effective screening process⁽¹²⁾.

From table 1, it can be inferred that, in 2008, the mean ratio of mammographies was very low in Brazilian cities, and despite the growth of this number over the years, it is still far from the result expected by the Ministry of Health (which is 1.0).

Despite the incidence and mortality of breast cancer, the screening of this neoplasia in Brazil is not satisfactory,

since, in some regions, attention needs to be better organized, with human resources and materials made available so that the mammographies can be performed⁽⁴⁾. However, this is not specifically a Brazilian problem. A recent study has shown that women in countries such as Chile, Hungary, Japan, Mexico, Slovakia, Turkey, and others, also have low access to mammographies⁽¹³⁾. To perform an effective screening, in addition to the offering of mammographies, the exams need to be conducted by qualified professionals, which is also important for the interpretation of the results and the referral of women after they are obtained.

Considering the low access to mammography in many Brazilian cities, early diagnostics are often not found, leading to an increase in the incidence and mortality of breast cancer in Brazil. According to a study conducted in the country, much of the breast cancer morbidity and morta-

lity is due to barriers to the access to early detection and diagnostic. These conditions have been generating serious public health problems⁽¹⁴⁾.

In figure 1, a low number was found for the index “ratio of mammographies conducted” in the North and in a large part of the Northeast and Midwest. This can be explained by the fact that these regions have few professionals trained to conduct the exam and little access to the equipment needed⁽⁴⁾. Additionally, women in more developed regions are more likely to undergo mammographies, also counting on a greater diagnostic capability and better quality information, which is the case of the regions Southeast and South⁽¹¹⁻¹⁵⁾.

Considering specialized attention’s lack of structure for the conduction of mammographies in less developed regions, it is relevant to take into account the importance of primary health care in the offering of integral attention to women, and to conduct an active screening for women in the risk age group whose signs and symptoms correspond to breast neoplasia.

Similarly to figure 1, figure 2 shows the statistical significance of groups of cities from the North, Northeast and Midwest classified as “Low-Low”. Girianelli, Gamarra and Silva show, in a study conducted in Brazil, a standard of regional growth of breast cancer in the Northeast and Midwest of the country in recent years. Additionally, when cities in the countryside are compared to capitals, the research showed that the mortality is higher in the smaller towns⁽¹⁶⁾, since they have less specialized services and face socioeconomic challenges for the performance of the screenings.

This data about the North, Northeast and Midwest show the need to strengthen the policies and actions targeted at improving women’s health, so that they can effectively increase the number of mammographies for the women in the region, especially considering older women, since the coverage of mammography diminishes as age advances⁽¹⁷⁾. Therefore, despite the low mammography access in these regions, educational actions are also necessary so that these women can understand how important it is to perform the examination.

Figure 3 shows that in addition to lower means of the ratio index, the North and Northeast have cities with low HDI, which impacts in their access to mammographies. However, the Southeast and South have, mostly, high HDI cities and a high ratio of mammographies (classified as “HIGH-HIGH”).

A study conducted in the South of Brazil showed that the growth in the number of mammographies in the region is largely due to its being a developed region, with a high number of white women with high income and edu-

cational level (many with higher education)⁽¹⁸⁾. However, many women in the South and Southeast undergo mammographies in the private health network, and their data is not included in the SUS database, which means that the number of mammographies in the region is much higher than what is shown in this study.

A study conducted in Brazil showed that the HDI is strongly correlated to the number of mammographies conducted in the country⁽¹⁹⁾, showing from these data that a good HDI can influence in a better access to mammographies and a consequent improvement in the mammography ratio index, in the different regions in Brazil.

In addition, the exams availability is lower in the North and Northeast due to the number of non-white people, the low educational level, low income and lack of health insurance. There are also barriers to the access to the services in these regions, such as the low number of professionals and mammography equipment⁽²⁰⁾.

It is very important to highlight that, despite being a high-relevance index, the HDI has limitations, since it cannot explicitly translate social realities, as it is a statistical mean formed by simple indicators (*per capita* family income and years of study in 25-year-old or older adults). Therefore, the individual reality of the population is not represented regarding their income and education or other characteristics not included in the index. Consequently, it does not show whether the population is developed. However, the limitations of the HDI index do not diminish the relevance of this study.

Regarding social inequality and mammography ratio, figure 4 shows the high social inequality and low mammography access (classification “HIGH-LOW”) in the majority of the North and in some cities in the Northeast. On the other hand, in the Southeast and South inequality is lower and the access to mammography is higher (“LOW-HIGH”).

Due to the regional and social inequalities in Brazil, regions such as the North and the Northeast are lacking in comparison to the coverage of mammographies throughout the country, increasing the mortality by breast cancer in capitals and in cities in the countryside, thus highlighting the inequalities in the access to mammography screening services⁽¹⁵⁾.

Screening and early detection of breast cancer are beneficial to women as they allow for smaller surgeries, higher chances of cure and a diminution in the final costs of the treatment. It also helps maintaining a significant part of the female population economically active. It is essential for policies targeted at increasing the access to mammographies to be implemented in Brazil⁽³⁾.

CONCLUSION

From this study, it can be observed that the access to breast cancer screening is lower in the North, Northeast and Midwest of Brazil, and higher in the South and Southeast. Also, the ratio of mammographies is influenced by the Gini Index and by the HDI, variables that are also related to social and economic factors, since by crossing the data from these two indexes, it can be found that the access to breast cancer screening is inversely proportional to the inequality of a region. Therefore, the higher the HDI, the higher the number of mammographies.

The South and Southeast of Brazil are examples of a planned and well-structured primary health care, have better Gini Indexes and HDI, and as a result, a higher ratio of mammographies. The social inequality and the lower HDI make the individuals more likely to get diseased due to lack of knowledge. These factors compromise breast cancer screening, since lower educational levels and less access to the services are obstacles for women to seek specialized services and undergo mammographies.

The limitation of this study was the use of secondary data from information systems that often deal with under-reporting by the cities. However, this does not mean that the study had no statistical significance or relevance.

Knowing the economic and social fragilities that affect the access to breast cancer screening is paramount to find a solution for these problems and improve the indexes, such as the ratio of screening mammographies conducted for women from 50 to 69 years of age, whose increase would consequently improve and strengthen public policies targeted at women's health. According to studies, this would lead to an improvement in the directions of health care and, as a result, diminish the breast cancer morbidity and mortality in Brazil.

It should also be highlighted that the nurses have a very important role, necessary for the quality of breast cancer screenings. Not only they have a primordial role in the exams themselves, as they do in the requirement for mammographies, health education, and in the active search for women who do not go to the health care services but are part of a group whose risk for mammary neoplasias is high.

Additionally, the study will contribute for teaching and research, since the knowledge acquired will be useful to support other investigations and advance the discussion on the theme.

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