Acta Scientiarum
http://periodicos.uem.br/ojs/acta
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v41i1.45388

Mortality rate for cervical cancer in Brazil and socioeconomic indicators: a spatial study

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ABSTRACT. The objective of the study was to analyze the correlation between the mortality rate from cervical cancer with schooling, Gini index and Human Development Index (HDI). This is an epidemiological, retrospective, observational and ecological study carried out in the 161 intermediate regions of urban articulation in Brazil. The study was based on secondary data from DATASUS and the United Nations Development Program. The spatial analysis of mortality versus schooling, Gini index and HDI was performed. Most municipalities in Brazil with high mortality rate are located in the North and Northeast. In addition, it was observed that schooling, Gini index and HDI directly influence the increase or reduction of mortality. Knowing these fragilities and their distribution in Brazil is necessary to solve the problems and improve the indicators such as the mortality rate.

Keywords: mortality; social indicators; spatial analysis.

Received on November 15, 2018.
Accepted on April 18, 2019.

Introduction

Cervical cancer has increased its numbers of incidence and mortality in some countries and has been seen as a global public health problem. Cervical cancer can be prevented through effective screening programs, and treated for good prognosis if early diagnosis and effective oncology care are available. For this, better strategies are needed from public policies.

Cervical cancer has a worldwide mortality of 275,100 cases per year, a prevalence of 440 million and an incidence of approximately 529,800 new cases each year, corresponding to the third most common cancer type in the world (Jemal et al., 2013).

In the American continent, each year an average of 42,000 new cases and 18,000 deaths occur in women between the ages of 40 and 64 years. The numbers show that although highly diagnosable, cervical cancer still has high incidence and mortality rates (World Health Organization [WHO], 2016).

As for the mortality rate, between 2010 and 2013, the global rate for cervical cancer was 4.7 per 100,000 women. In Brazil, this rate surpassed the world rate, with 5.05 for every 100,000 women (Girianelli, Gamarra & Silva, 2014; Instituto Nacional de Câncer [INCA], 2015).

The Pap smear test is the most used method for the screening and prevention of cervical cancer in sexually active women in Brazil, as well as being the best in relation to the lower cost and better benefit to the Unified Health System (Pinheiro et al., 2018).

However, to reduce the mortality rate, in addition to the Pap smear, actions such as increased supply and access to treatments for cervical cancer are also required. Countries with economically disadvantaged conditions show that most patients do not receive adequate treatment due to lack of resources. If they are diagnosed early and get immediate treatment, most women survive. However, those who do not receive immediate treatment or who have advanced cancer have little chance of survival (Kantelhardt et al., 2014).

In Brazil, the mortality rate increases according to the lowest social and economic level. Moreover, women living in large cities or capitals have a better prognosis, as this is directly related to timely access to health services for diagnosis and treatment, and therefore intervention measures (Mascarello, Zandonade & Amorim, 2013).

Therefore, it is necessary to develop research to know where the highest mortality rates from cervical cancer are in Brazil, and what factors are associated with them, so that the study serves as a support for the

improvement of public policies. From this, the goal of the study was to analyze the correlation between cervical cancer mortality rate and schooling, GINI index and Human Development Index (HDI), as well as to spatially know the association of these indicators in Brazil.

Material and methods

This is an epidemiological, retrospective, observational and ecological study carried out in the 161 intermediate regions of urban articulation in Brazil. The research was carried out from secondary data, from the public and national database titled DATASUS. This database is the information technology department of the Unified Health System (SUS), which stores and processes the information on the activities developed in SUS required for organization, planning and evaluation of this system (Departamento de Informática do SUS [DATASUS], 2018).

The object of this study was the mortality rate from cervical cancer (number of deaths of women from cervical cancer/resident population of women*100,000) as the dependent variable equivalent to the years 2008 to 2014, which are years available in the system. It was extracted from DATASUS in the Mortality Information System (SIM), the absolute number of women who died from cervical cancer, and from the 2010 Census of DATASUS, the number of women in Brazil from 25 to 64 years, to calculate the mortality rate.

The independent variables were schooling, human development index (HDI) and Gini index, all extracted from the United Nations Development Program (UNDP).

Data were entered and processed in the Statistical Package for the Social Sciences (SPSS), version 22.0 with serial number 10101141047. After data storage, the cervical cancer mortality rate was calculated, and afterwards a mean of all Brazilian municipalities (5,565) in relation to all variables, in order to reduce divergences between larger and smaller municipalities, distributing the data for the 161 Intermediate Regions of urban articulation in Brazil. In addition, the bivariate cross between the cervical cancer mortality rate and the independent variables, one by one, was performed in a Scatter Plot.

For spatial analysis purposes, SPSS data were inserted in the TerraView version 4.2.2 for spatialization of the distribution of the means of the variables in Brazil, and after that, data were crossed in the software Geoda, version 1.2. Geoda is a free and open source geoprocessing software as well as Terra View. However, it can create maps by crossing the variables, different from the first. The bivariate analyses were performed by crossing the dependent variable cervical cancer mortality rate with the variables HDI, Gini index and schooling.

In Geoda the maps were created equivalent to the Lisa cluster map of the mortality rate and independent variables. The Lisa cluster map presents the spatial units that presented statistically significant values ($p < 0.05$), classified into five possibilities: high-high and low-low, representing spatial regions with high and low incidences surrounded by neighboring regions also with high and low incidences, these categories represent agreement. The other possibilities, respectively; high-low and low-high, represent units with low and high incidence surrounded by regions with high and low incidence, respectively. And finally, the classification of 'non-significant' when the value is equal to $p > 0.05$. These last categories represent areas of transition (Vendramini et al., 2010).

Results

Figure 1 illustrates the dispersion between the mortality rate and schooling (illiteracy). There is a large dispersion of the points for illiteracy, from 24.35 to 63.34. However, the variable mortality rate does not present a significant dispersion like illiteracy. Even with a small number of illiterates, there are points that have a high cervical cancer mortality rate (117.00). However, there are also points that are located at a high rate of illiteracy and a high mortality rate. This reveals the fragility of coverage of some regions of urban articulation in Brazil, which, even with a low value of illiteracy, there is a high number of deaths from cervical cancer, demonstrating that women can often fail to do the Pap smear test, not for lack of knowledge, but for lack of supply, access and other flaws.

Figure 2 shows the association of mortality rate with the Gini Index. It is observed that in some points, as the Gini index increases, the mortality rate also increases. The distribution of the points follows proportional, in which when the Gini index reaches 0.49, the mortality rate reaches its peak with 1.71. After, the mortality rate declines, rising again, but the Gini index continues to increase. As the Gini index measures the level of social inequality, it can be inferred that in most intermediate regions of urban articulation in Brazil, social inequality can bring with it an increase in the mortality rate.

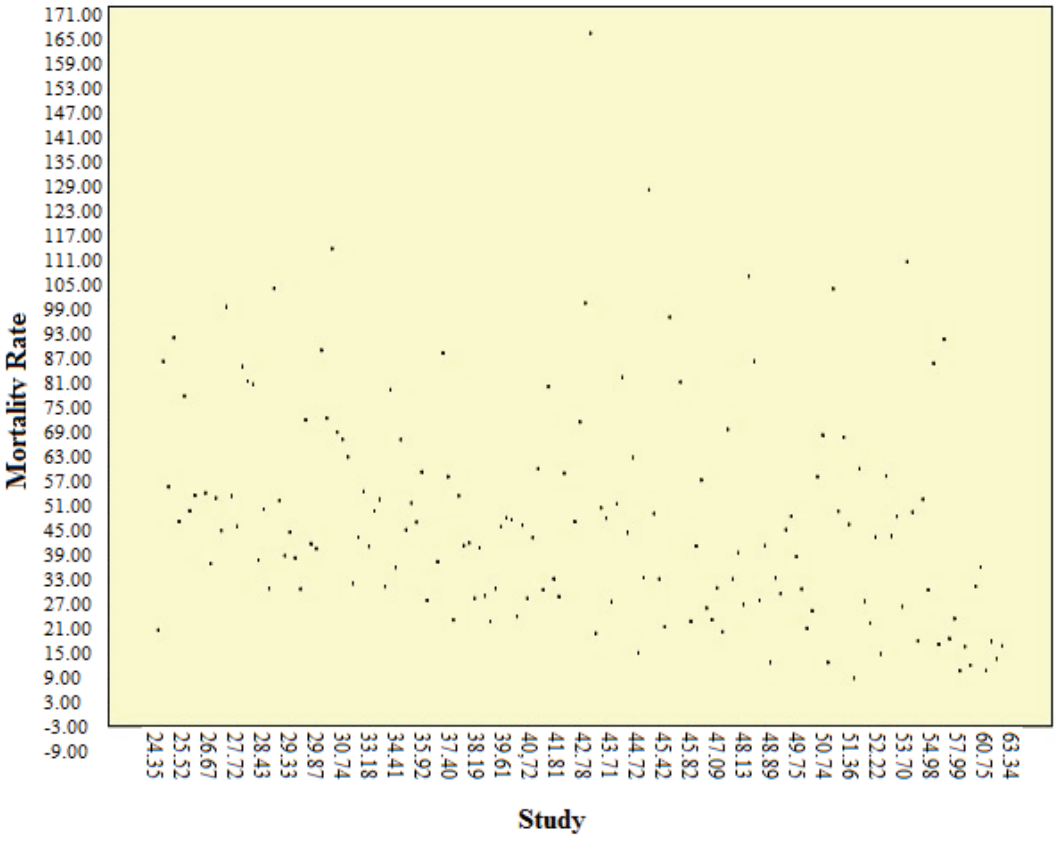

Figure 1. Distribution of the association of cervical cancer mortality rate with schooling in the years 2008 to 2014, in the Intermediate regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

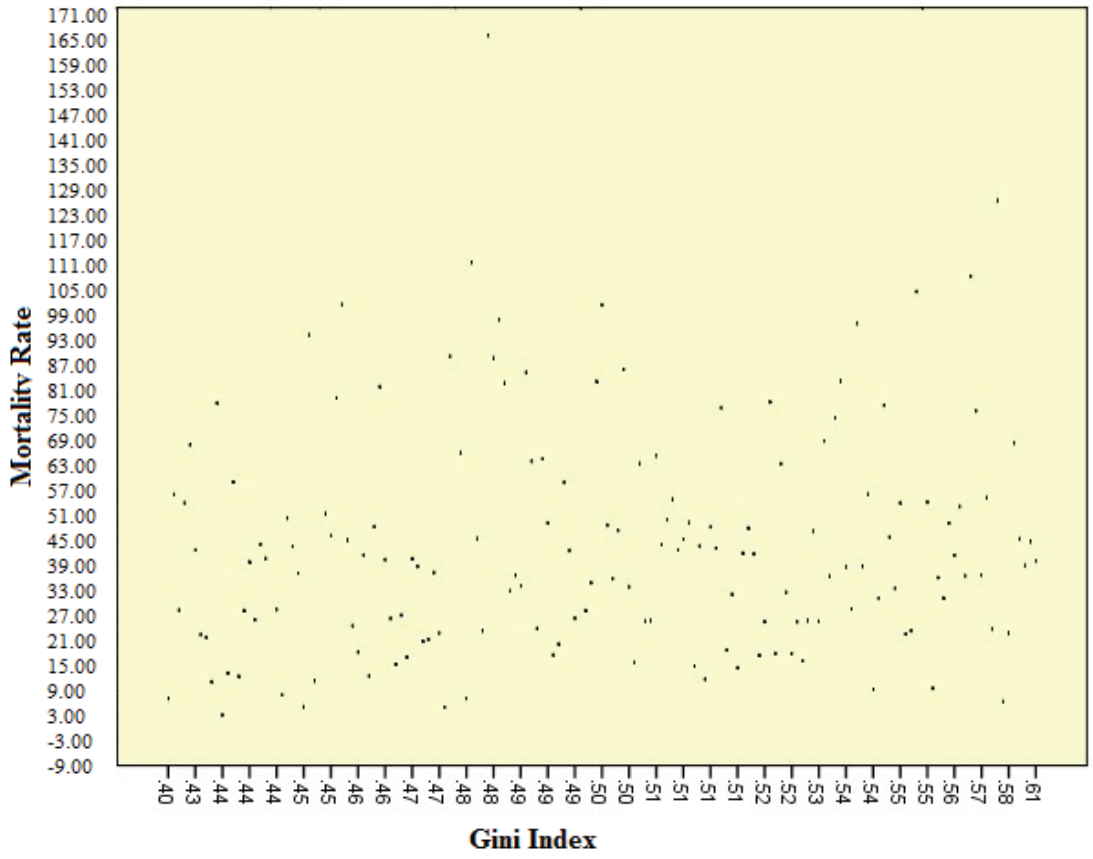

Figure 2. Distribution of the association of cervical cancer mortality rate with Gini index in the years 2008 to 2014, in the Intermediate regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

Figure 3 shows the association of mortality rate with HDI. It is observed a greater agglomeration of intermediate regions of articulation in relation to the HDI of 0.61 to 0.72, in which in this location the mortality only goes up to 57.0. Greater HDI growth is identified as the mortality rate is stable in most regions. With this, it is shown that few points have a Good HDI with high mortality. From this analysis, it can be stated that a good human development index (increased income, education and schooling) brings with it a stability in mortality and even a decline in mortality in some regions.

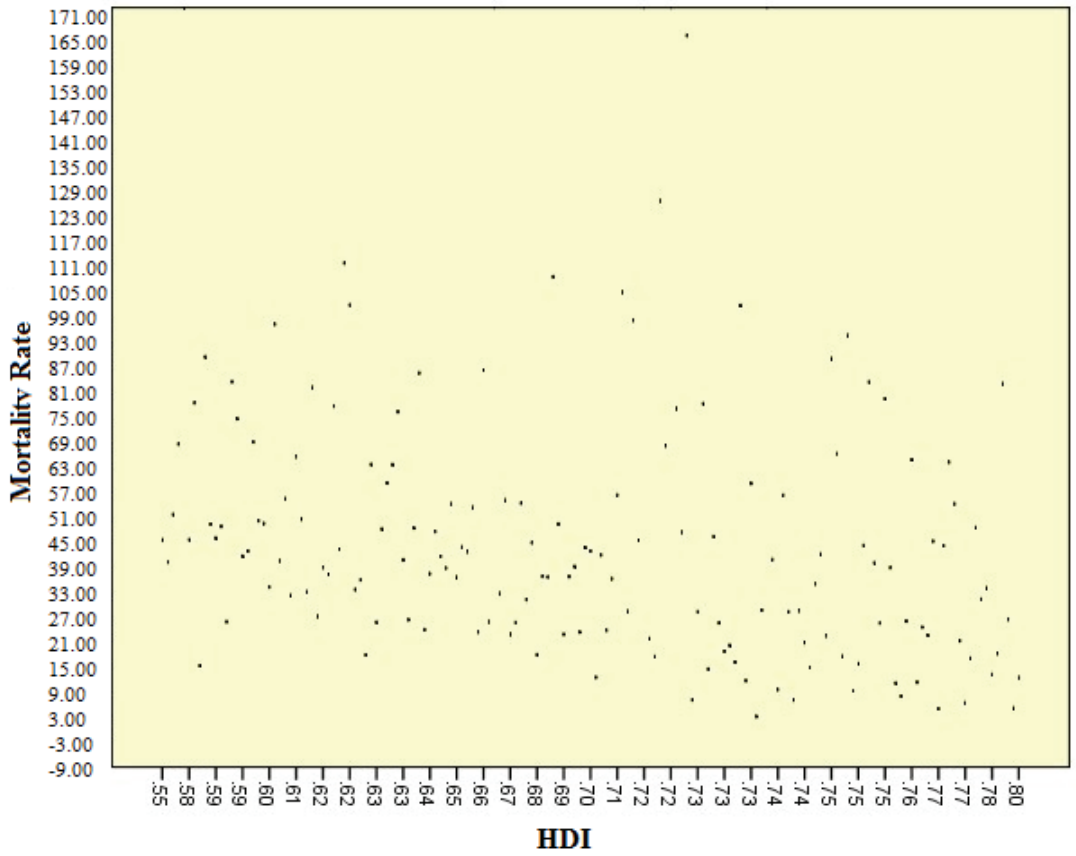

Figure 3. Distribution of the association of cervical cancer mortality rate with HDI in the years 2008 to 2014, in the Intermediate regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

Figure 4 shows the bivariate analysis in the Lisa Cluster Map for the mortality rate from cervical cancer and schooling (illiteracy) in women 25 years of age or older.

In the Lisa Cluster Map (Figure 4), there is only one High-High cluster (group of municipalities), which is in the Center-West region, more precisely the municipalities of Campo Grande in the State of Mato Grosso and the municipalities of São José do Rio Preto and Presidente Prudente both in the State of São Paulo, indicating high mortality from cervical cancer and a high number of illiterate women over 25 years. There are also High-High clusters in some cities in the Northeast and Southeast regions. Most of the clusters are in the Northeast region, classified as Low-Low. This shows that low illiteracy is associated with low mortality from cervical cancer in the Northeast. However, the southern region has Low-High clusters, revealing low mortality and high illiteracy. As the South is a more developed region, low mortality may be related to increased use of private services by women.

Figure 5 illustrates the bivariate analysis in the Lisa Cluster Map for the cervical cancer mortality rate and the Gini Index. There is a high-high cluster in the Northeast region, the municipalities of Pinheiro, Imperatriz, Bacabal, Pedreiras, Caxias Presidente Dutra, Balsas located in the State of Maranhão, besides the cities Floriano, Corrente and Bom Jesus and São Raimundo Nonato, in the State of Piauí. From these clusters, we can see that these municipalities have a high mortality rate from cervical cancer and high Gini index. Given this, it can be seen that social inequality can generate an increase in the mortality rate in some municipalities in the Northeast.

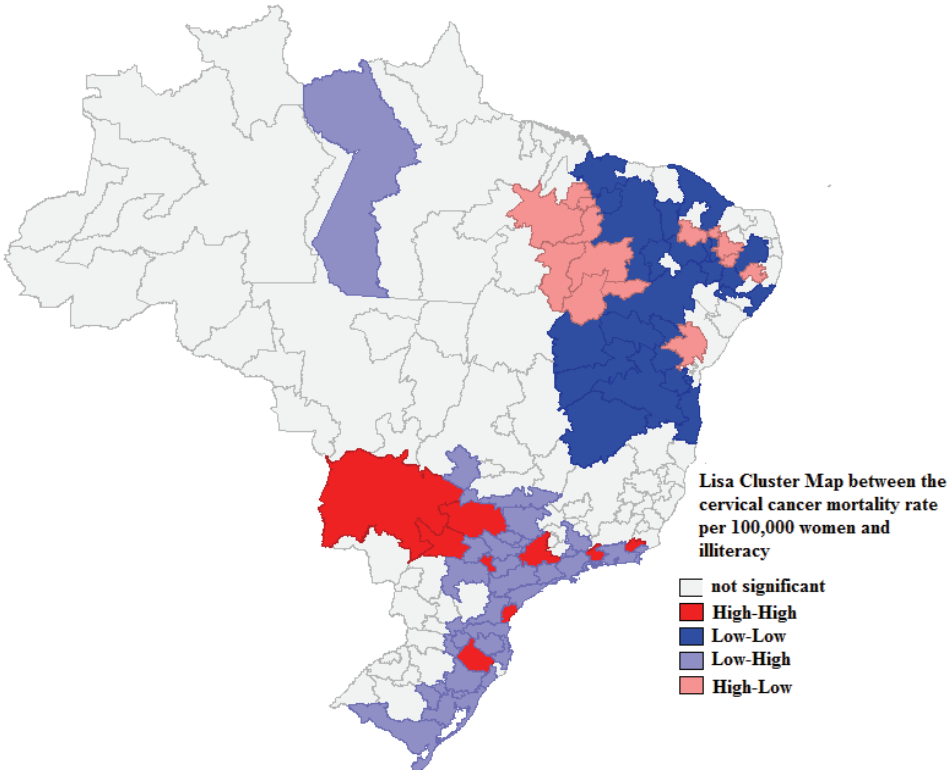

Figure 4. Bivariate spatial analysis in the Lisa Cluster Map between the cervical cancer mortality rate per 100,000 women and illiteracy in women aged 25 years and over from 2008 to 2014 in the Intermediate Regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

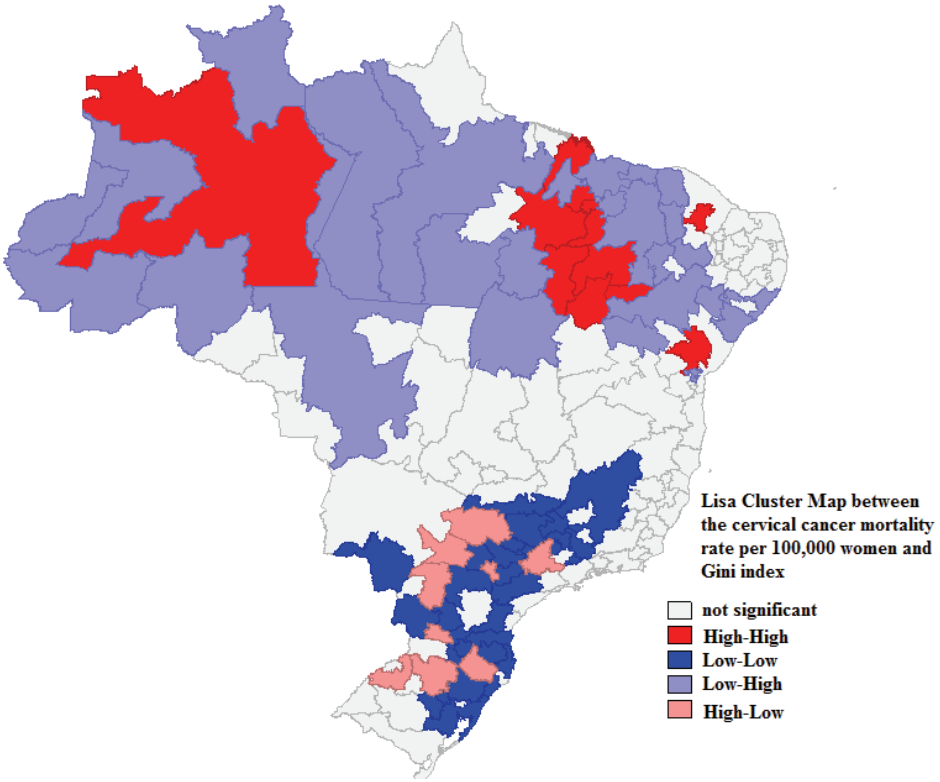

Figure 5. Bivariate spatial analysis in the Lisa Cluster Map between the cervical cancer mortality rate per 100,000 women and Gini index from 2008 to 2014 in the Intermediate Regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

In addition, there are low-low clusters in some municipalities in the Southeast and South regions. This reveals that the high mortality rate in some municipalities in the Northeast, together with the low coverage in some municipalities of the region, bring with them greater social inequality, as well as some municipalities in Southern Brazil that have low mortality from this type of neoplasm and low social

inequality. However, Low-High clusters are more prominent in the North and Northeast regions, indicating low mortality and high social inequality. This may reveal that despite the greater social inequality, not all municipalities have low mortality from cervical cancer.

Figure 6 shows the bivariate analysis in the Lisa Cluster Map for the cervical cancer mortality rate and the HDI. High-low clusters are observed in some municipalities in the Northeast, such as Bragança-capanema in the State of Pará, Imperatriz, Bacabal, Pedreiras, Presidente Dutra and Balsas in the State of Maranhão, Floriano, Corrente and Bom Jesus and São Raimundo Nonato in the State of Piaui. These municipalities deserve special mention because of their high mortality rate from cervical cancer and low human development index (HDI), as well as several clusters in the Center-West and South regions of Brazil show low-high clusters. It can be inferred from this analysis that most municipalities may have low mortality and high human development index, or the opposite. However, there are also clusters in the Northeast that indicate low mortality and low human development index. Low mortality from this type of cancer may be linked to an improvement in the treatment of cervical cancer in these regions.

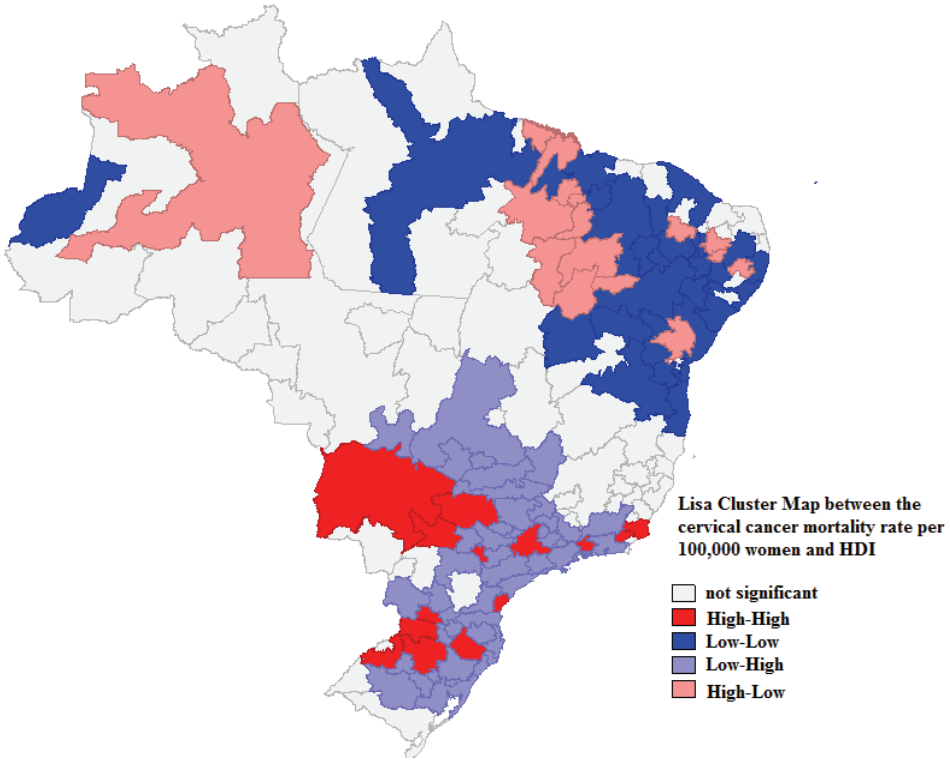

Figure 6. Bivariate spatial analysis in the Lisa Cluster Map between the cervical cancer mortality rate per 100,000 women and HDI from 2008 to 2014 in the Intermediate Regions of Urban Articulation in Brazil, 2018. Source: SIM/DATASUS (2018); PNUD (2010).

Discussion

The mortality rate may be related to factors such as schooling (illiteracy), Gini index and HDI. From Figure 1, this study shows that there are some intermediate regions of urban articulation in Brazil that have a high number of illiterates and a high mortality rate. However, there are also regions with low illiteracy and high mortality from cervical cancer, demonstrating that schooling will not always influence death from cervical cancer.

A survey conducted in the Northeast of Brazil showed that the mortality rate did not present a statistically significant positive correlation with illiteracy (Gamarra, Valente & Silva, 2010). Corroborating this study, other authors also found a weak correlation between the mortality rate from cervical cancer and schooling or illiteracy (Girianelli et al., 2014).

Nevertheless, a study in the city of Rio Branco, in the State of Acre, showed that the majority of women who present alterations in cytopathological examinations, such as low, high grade lesions and cancer, are more likely to have a few years of study or to be illiterate (Prado, Koifman, Santana & Silva, 2012). Moreover, many women are not treated because of the low supply of treatment or difficulties in accessing medium and high complexity levels.

Cervical cancer can be an avoidable death, but good coverage is needed in primary health care, and when this does not happen either because of lack of demand from the woman or difficulties in the service, to avoid mortality from cervical cancer, there must be a care structure prepared for early diagnosis and immediate treatment. When the region that the woman with cervical cancer resides does not have these factors, this woman will have a late diagnosis and treatment that can lead to death.

Social and economic inequality, as well as the HDI, may interfere with the mortality rate from cervical cancer, as shown in Figures 2 and 3 of the present study. One of the factors influencing the HDI is the per capita gross domestic product, in this way, smaller municipalities tend to have less capacity to invest in health, and consequently lack of structure and less supply and access for cytopathological examination, in addition to investments in the medium- and high-complexity for oncological treatments (Fischer et al., 2015).

The increase in cervical cancer mortality, for the most part, is related to less developed regions where cure is not guaranteed and adherence of the target population is limited, in which some women can only be treated when the disease is already in a very advanced state, with minimal possibilities of cure (Gamarra et al., 2010).

In Brazil, the different regions, states and municipalities present disparities equivalent to the mortality rate from cervical cancer. Figure 4 shows that most of the regions in Brazil were not statistically significant for the association of schooling with mortality rate, as well as some studies (Gamarra et al., 2010; Prado et al., 2012).

However, the regions with high mortality rate and high illiteracy rate are some municipalities in the Center-West. This information corroborates information from Brazil, which shows that the Center-West region is the second region with the highest incidence of cervical cancer in Brazil, second only to the Northeast region (Departamento de Informática do SUS [DATASUS], 2018). In this sense, this increase in incidence may lead to an increase in mortality.

Regarding the distribution of the association of mortality rate and Gini index in the intermediate regions of urban articulation in Brazil, it was observed in Figure 5 that most municipalities that have high mortality and high social inequality are located in the the Northeast region. However, in this same region there are clusters of municipalities that have low mortality and high Gini index.

As the Northeast is a peripheral region, it has a low economic and social development of the population, being characterized as a region of social inequality, influencing the increase in the mortality rate from cervical cancer (Gamarra et al., 2010). However, there are states in the Northeast in which access to cancer treatment is limited, increasing the mortality rate, but there are states that provide early diagnosis and adequate treatment in a timely manner (Gonzaga et al., 2013; Souza, Teixeira & Lana, 2014). Given this, one can understand the disparities in the mortality rate within the same region.

Corroborating these data, most of the municipalities in the North and Northeast regions that had high mortality rates and high Gini index also have a high mortality rate and low HDI, as shown in Figure 6. Authors found an association between cervical cancer mortality and socioeconomic level, because it is directly linked to the sexual behavior of women, who can have several sexual partners, and thus greater chances of contracting the virus that causes cancer of the cervix, HPV.

The mortality rate can be controlled by efficient specialized oncology care that provides easier access and greater supply, but for that, financial resources and good planning are needed in the region. However, there are many regional inequalities in Brazil in relation to social and economic resources, and many of these differences can be made explicit by differentiated Gini and HDI index numbers across the country.

A survey carried out in Brazil shows that most of the capitals of the North and Northeast regions of Brazil have lower HDI and Gini indices, and with this, less development. In Brazil, the structure of the health care network and socio-economic factors differ across its territory, forming regional characteristics with different strategies regarding cervical cancer indicators, changing aspects related to supply, access and the procedures; the lower social and economic level also leads to fewer screening tests (Ribeiro & Nardocci, 2013).

From this, it was observed a positive association between HDI, Gini index and death from cervical cancer. According to these data, it can be inferred that the mortality rate from cervical cancer in some regions of Brazil can be influenced by these two social indicators. In this sense, it is necessary to articulate several public policies to improve these indicators and consequently reduce the mortality rate from cervical cancer.

Conclusion

The mortality rate from uterine cancer has a spatially diversified spatial distribution, most of the municipalities with high mortality rate are located in the North and Northeast regions. These regions need improvements for easier access, for possible early diagnosis of injuries and consequently the rapid referral to medium- and high-complexity services. The analysis of the study contributes to the epidemiological knowledge necessary for the strengthening and redirection of cervical cancer control policies, and with that, to establish better preventive strategies, diagnosis and early treatment of this type of neoplasia.

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