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COMPARATIVE ANALYSIS OF RESPIRATORY DISEASES RELATED TO THE STRETCHING AND RAINING PERIODS IN THE STATE OF TOCANTINS

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ABSTRACT

Use of fire in forests in the state of Tocantins, especially in the dry season, initiates a series of respiratory diseases in adults and children with various levels of involvement that lead to hospital admission. The aim of this search was to collect relevant data on the prevalence of people under 10 and over 60 years old, affected by respiratory diseases in the State of Tocantins, making it possible to perform a comparison between the rainy and dry periods correlating fires as an aggravating factor and determinant in the increase of these respiratory conditions in the dry season, in what occurs the largest number of outbreaks, determining factor for this morbidity. This study aimed to examine the relationship between respiratory diseases during the rainy and dry season from October 2008 to September 2011 in the State of Tocantins. Therefore, to achieve the proposed objective it was used an exploratory and ecological methodology, with thematic maps constructed from a software called Terraview 4.0.0, data from the National Institute for Space Research (INPE), and the Department of Computer of the Unique Health System - DATASUS among them are the SIA/SUS, SIH/SUS, SINAN - NET. As a result, it was found that the lung problems distributed by sex between the months of study the largest percentage was in males with 57%, being females with 43%, relating to the larger number of cases of lung disorders distributed by range age in months studied, it was between 0 and 4 years old, being more pronounced between 1 and 4 years old. The cities that had high-level fires outbreaks coincided with cities that actually require intervention during the dry season were Tocantínia, Araguaçu and Taguatinga, but other cities who were nearby also had these needs for interventions such as the cities Miranorte and Duerê as well as other cities like Augustinópolis and Tocantinópolis that were nearby Araguatins (Sanitary Microregion of Araguatins n. 7) which showed a high level of fire outbreaks. Therefore, it is concluded that it is possible to propose intervention measures for certain micro-regions in order to reduce rates of respiratory diseases in the dry season promoting environmental education actions allied to health education, for this is essential the support of municipal, state and federal levels.

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INTRODUCTION

Burns are an aggravating factor in the emergence of respiratory diseases, since epidemiological studies have shown that the incidence of respiratory diseases, especially in the extreme ages, in childhood and in the third age, is very high, being more susceptible to diseases, becoming more fragile. Relevant to this, Rodrigues, Ignotti and Hacon (2013) carried out a study of the spatial distribution of burned outbreaks and hospitalizations due to respiratory diseases in the State of Rondônia, which found that the hospitalization rates reached

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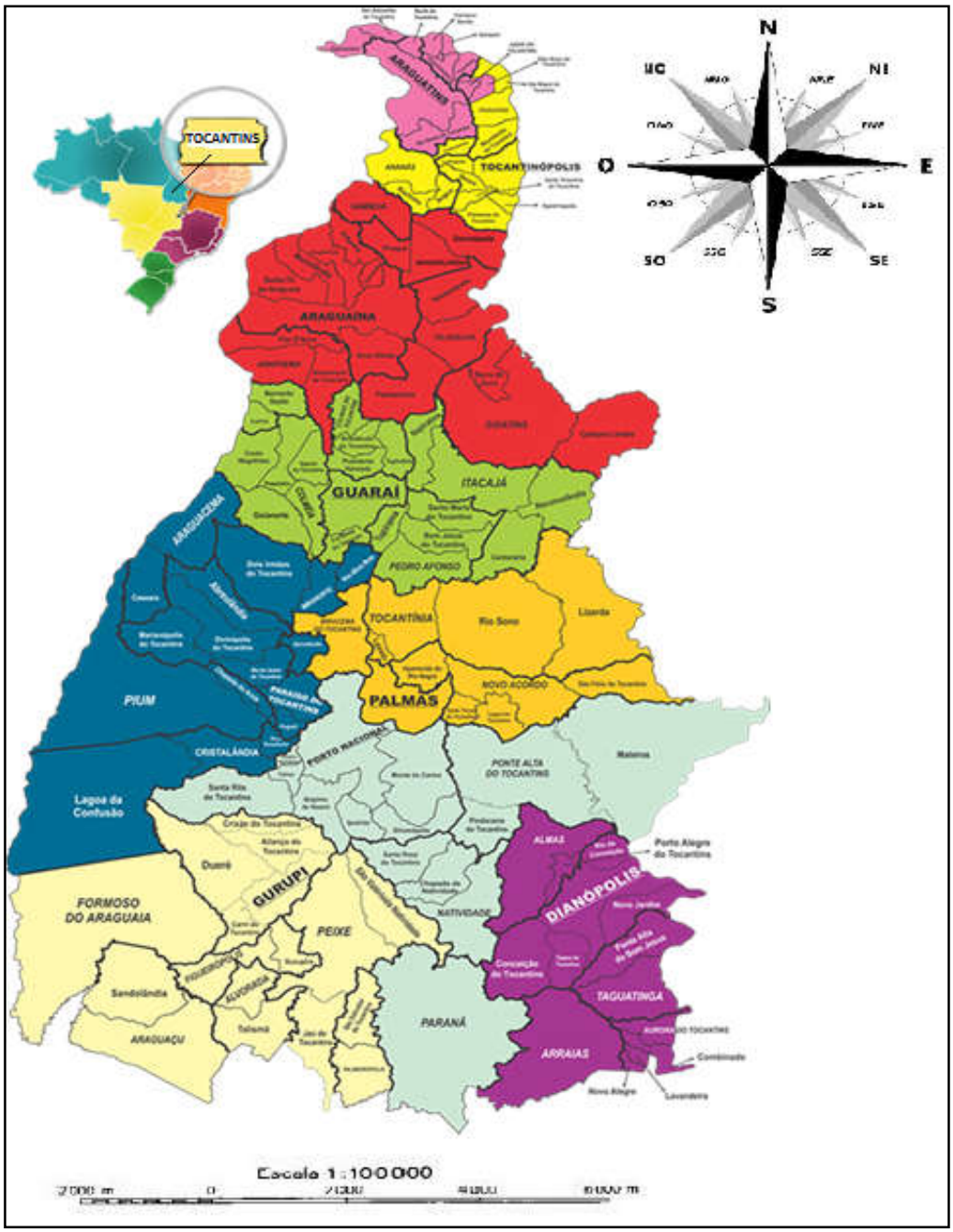
an annual average of 35,4 hospitalizations per 1.000 children in that state, from 2001 to 2010. The micro-region of Porto Velho had the lowest annual average (19,3%) of hospitalization rates for respiratory diseases in children under the age of five, in the same period, Cacoal had the highest average hospitalization rates, with 51,4%. In the State of Rondônia, there was a reduction in hospitalization rates due to respiratory diseases in children under 5 years of age, with a percentage of – 16,9% in the year 2001 to 2010 and a 12% increase from 2005 to 2010. In addition, all micro-regions in the state of Rondônia showed a reduction in the hospitalization rates established for the ten-year period. In the last five years, the reduction of hospitalization rates was observed only in the micro-regions of Porto Velho (-11,9%), Ji-Paraná (-17,4%) and Colorado D'Oeste (-29,9%). The micro-region of Ji-Paraná: -45,9% in ten years and -17,4% in five years presented a lower percentage when compared to the others. The same authors affirm that there was no difference between gross and established rates. In the year 2001 to 2010, the average number of outbreaks in the state of Rondônia was 8.762 outbreaks. The highest number of fires in the State was recorded in the micro-region of Porto Velho, averaging 3.174 outbreaks, followed by the Ariquemes microregion, with an average of 1.429 outbreaks. The Colorado-West microregion had the lowest number of outbreaks, with an average of 440 outbreaks. There was a reduction in the number of fires in the period mentioned above.

Rosa et al. (2008) analyzed the rate of hospital admissions due to respiratory diseases in children under 15 years of age in a municipality of the Brazilian Amazon showing high levels of environmental pollution. In 2005, the rate of hospitalizations for respiratory infections in children under 15 years of age was 70,1 / 1.000 children in the micro-region of Tangará da Serra. However, in the year 2000 to 2005, 12.777 hospitalizations of children were diagnosed in the city of Tangará da Serra, where 8.142 (63,7%) were due to respiratory diseases. During the dry season, from May to October, there was a 10% increase in hospitalizations for these diseases when compared to the rainy season, which corresponds from November to April. Therefore, the main causes of hospitalization were: pneumonia (90,7%) and respiratory failure (8,5%). In addition, hospitalization among children under 5 years of age for pneumonia was 4 times higher than expected for the municipality studied. Children under 12 months of age were more hospitalized, with an average increase of 32,4 hospitalizations per 1.000 children per year. The constant precipitation of particulate matter into the atmosphere occurs through the combustion of automotive vehicles, industrial smoke and biomass burning. Stationary sources and large fleets of vehicles are concentrated in metropolitan areas mainly in southeastern Brazil, while biomass burning occurs in greater extent and intensity in the Legal Amazon, located in the northern region of the country. According to the Brazilian inventory of carbon emissions, 74% of emissions occur through burning in the Amazon, in contrast to 23% of emissions from the energy sector (BRASIL, 2005). The State of Tocantins is within this reality contributing to the emission of pollutant particles into the atmosphere, since it is located in the North Region and in the Legal Amazon.

Considering that the state of Tocantins has an economy based on agriculture, there is a significant increase in the number of fires in order to prepare the land for the planting of grains, pastures and others. This method is incremented by landowners who understand that they have a low cost land preparation model. There is also the common sense that infers about a cultural practice of setting fire to the pastures for the preparation of the land. In rainy times there is also a considerable number of cases of diagnosed respiratory diseases, and this study aimed to perform a comparative analysis of the respiratory diseases related to the dry and rainy season in the State of Tocantins considering the burnings as an aggravating factor. The objective of this study was to analyze the relationship between respiratory diseases in the rainy season and in the dry season, when there is an increase in the number of anthropogenic (man - made - casually or disordered) fires. This analysis is due to the observation of the increase in the outbreaks of burns, which contributes to the increase of diseases of the respiratory system, being one of the major contributors to the appearance of these morbidities, favoring the increase of the index of hospitalizations and demand in hospital emergencies, burden on the state.

MATERIAL AND METHODS

This is an exploratory and ecological study. The indicated methodology studied the possible environmental aggressions of the rainy season and drought, with burnings as an aggravating factor in the impact on public health related to the occurrence of respiratory diseases in the State of Tocantins, the study population was of children under 10 years and older than 60 years of age. According to the health division, the state of Tocantins is divided into 9 microregions, as can be seen in figure 01: Araguatins (11 municipalities), Tocantinópolis (13 municipalities), Araguaína (20 municipalities), Guaraí (21 municipalities), Palmas), Paraiso do Tocantins (17 municipalities), Porto Nacional (15 municipalities), Gurupi (17 municipalities), Dianópolis (14 municipalities). Figure 6 shows the 139 municipalities of the State of Tocantins duly enumerated for better visualization and location. The State of Tocantins is situated in an area of geographic transition between the Amazon forest and the cerrado. It presents two types of vegetation: the Amazonian forest, that is, lowland and submontane, and the savannah (caatinga), which has a cerrado, cerradão, clean field, campo-cerrado and rock field. Its physiognomy has clearer and more open features, presenting many palm trees, inajá and babassu. The forest region is known as a tropical pluvial, with an average temperature of 25ºC. There are periods: rainy and drought, when burnings occur (IBGE, 2010). The Electronic Health Information System Archives of the SUS (SIHSUS) and the Outpatient Information System (SIASUS), Department of Informatics of the National Health System (DATASUS) were used, mainly electronic sources of the Ministry of Health. The technique of spatial information analysis was the analysis of areas using the IBGE census tracts for the State of Tocantins. Thus, all reported cases of respiratory diseases between 2008 and 2011 were analyzed and compared, as well as the variables and possible interactions with the environment in the 139 municipalities in the State of Tocantins. All age groups are relevant in the study, but there is a focus on those younger than 10 years and over 60 years of age, since they are citizens who have differentiated their immune responses. The study period comprised 3 years, based on the respective years of 2009 to 2011, seeking to observe the presence of respiratory diseases in all 139 municipalities of the State. If the periods defined as "rainy" and "drought" are respected, the census of the first period should be expanded so that there is effective coverage



Source: https://maps.google.com/maps. (2013).

Figure 1. Division of the State of Tocantins, according to sanitary microregions

of the first phase of the research, since the rainy season, if in the previous year, in the State. Therefore, the period was defined as October 2008 to September 2011.For the spatial statistical analysis, the TerraView software, version 4.0 0, obtained through the portal: http://www.dpi.inpe.br/ terralib, was used to obtain the Moran Global and Boxmap indices, which estimate the spatial correlation and the areas that need interventions, allowing the identification of subregions with occurrence of spatial dependence. These indices may range from - 1 to + 1; value with proximity to 1, that is; very similar to each other, as can be seen from the equation to calculate the global Moran index (LORENA, BERGAMASCHI and LEITE, 2011).

$$I^{(k)} = n \frac{\sum_{t=1}^{n} \sum_{f=1}^{n} w_{tf}^{(k)} (z_t - \bar{z})(z_f - \bar{z})}{(z_t - \bar{z})^2} \quad \text{.....(I)}$$

N = observation number
Wij = element in the neighborhood matrix for pair i and j
W = sum of matrix weights
zi and zj = deviations from the mean (zi-z), (zj-z)
z = average

This method was developed by the National Institute of Space Research - INPE, Geographic Information System - GIS, which provides cartographic data support established on the geoprocessing library, which consists of a simple viewer of geographic, matrix information, which are grids and images , as well as manipulates vector data, which are polygons, lines and points (INPE, 2012). We used the importation of the DATASUS, IBGE, SIASUS and SIHSUS banks to TerraView, where the data on respiratory diseases of the municipalities of Tocantins, a cartographic base, were registered, constituting a database of georeferenced documents.

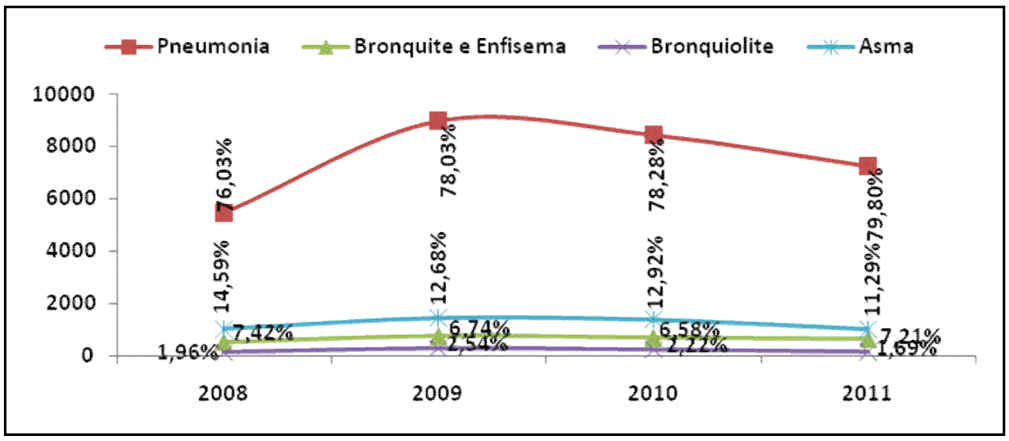


Figure 2. Pulmonary problems: pneumonia, bronchitis, emphysema, bronchiolitis and asthma, distributed per year, October 2008 to September 2011, Tocantins – Brazil

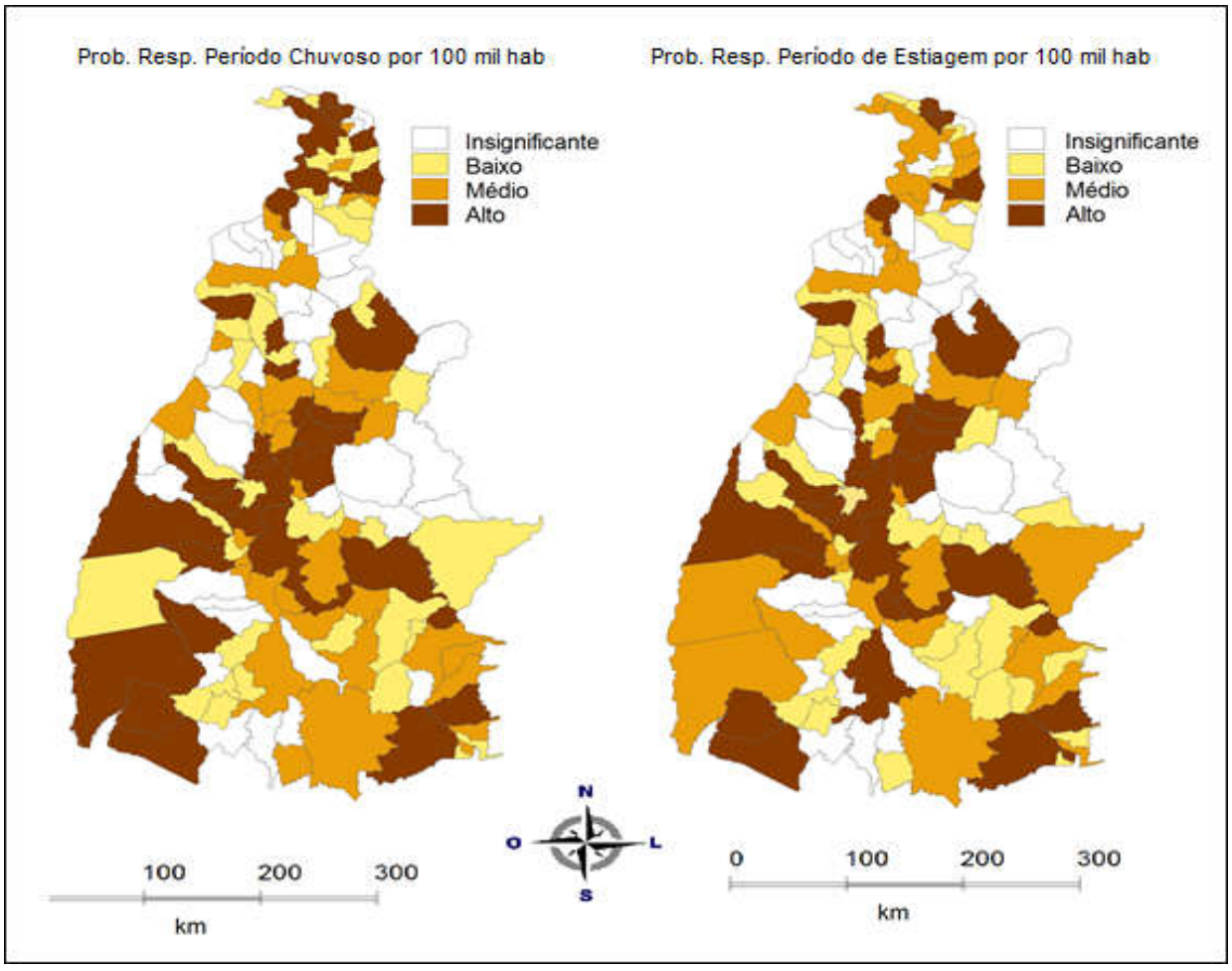


Figure 3. Maps of the distribution of lung diseases per 100,000 inhabitants, being A - rainy season, October to April and B - dry season, from May to September, between October 2008 and September 2011, Tocantins - Brazil

Thus, it was possible to identify the number of cases of respiratory diseases in the state of Tocantins, as well as their distribution in each municipality.

RESULTS

Figure 2 shows the pulmonary problems that occurred in the state of Tocantins, during the dry season, between May 2009 and September 2011. Pulmonary problems diagnosed in the State of Tocantins include: pneumonia, bronchitis, emphysema, bronchiolitis and asthma. In Figure 03, letter A, the data referring to respiratory problems in the rainy season are arranged, where the coefficient of detection ranged from 30.99 to 5.338.05. Still in Figure 03, letter B, data are available for respiratory diseases in the dry season, where the coefficient of detection ranged from 38.99 to 5165.18. It is highlighted in figure 3 that the rates were created in quantile, and all municipalities reported cases of hospitalization due to respiratory problems. The data presented in the white color as insignificant, had a variation of the coefficient of detection between 30.99 to 573.20 per 100 thousand inhabitants, yellow with low rates, 573.20 to 929.04, light brown with medium rates, 929.04 and 1570.43, dark brown with high rates, 1570.43 to 5338.05 per 100 thousand inhabitants. The rates reported as insignificant, the coefficient of detection ranged from 38.99 to 560.35, at low rates, 560.35 to 910.87, medium

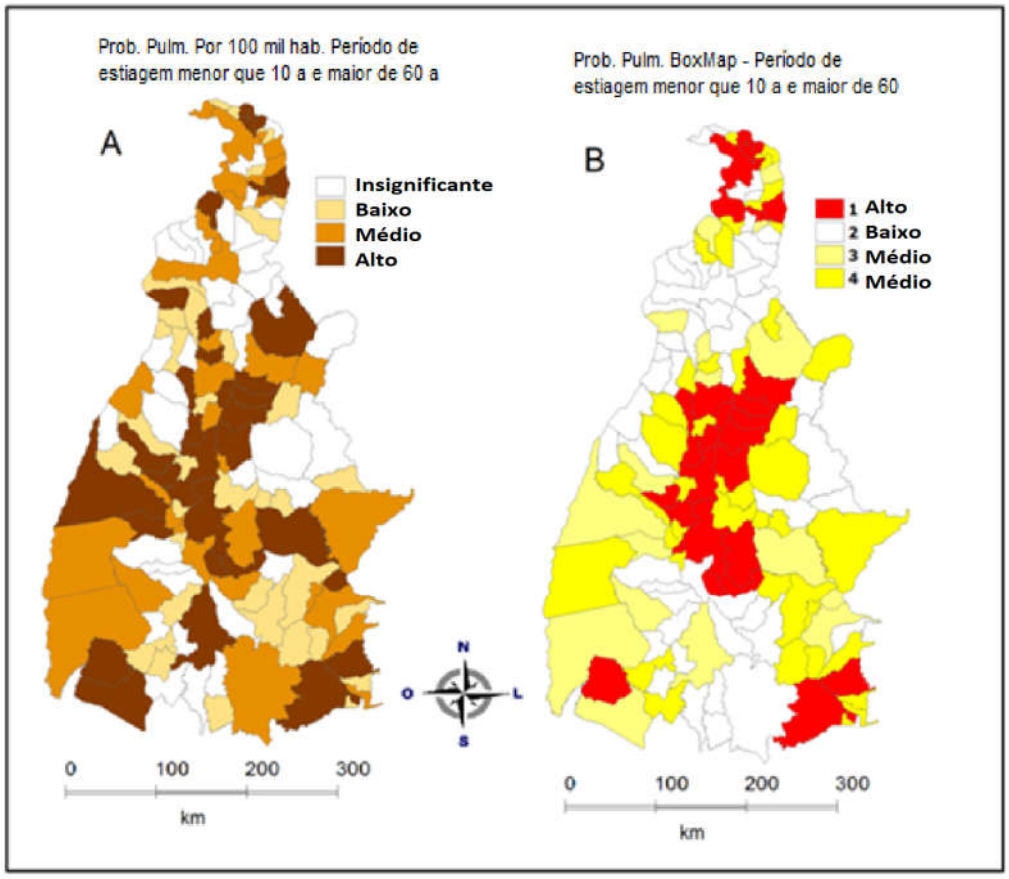


Figure 4. Maps of the distribution of lung diseases in children under 10 years of age and over 60 years of age, during the dry season between May 2009 and September 2011, A - per 100 thousand inhabitants, B - BoxMap, Tocantins – Brazil

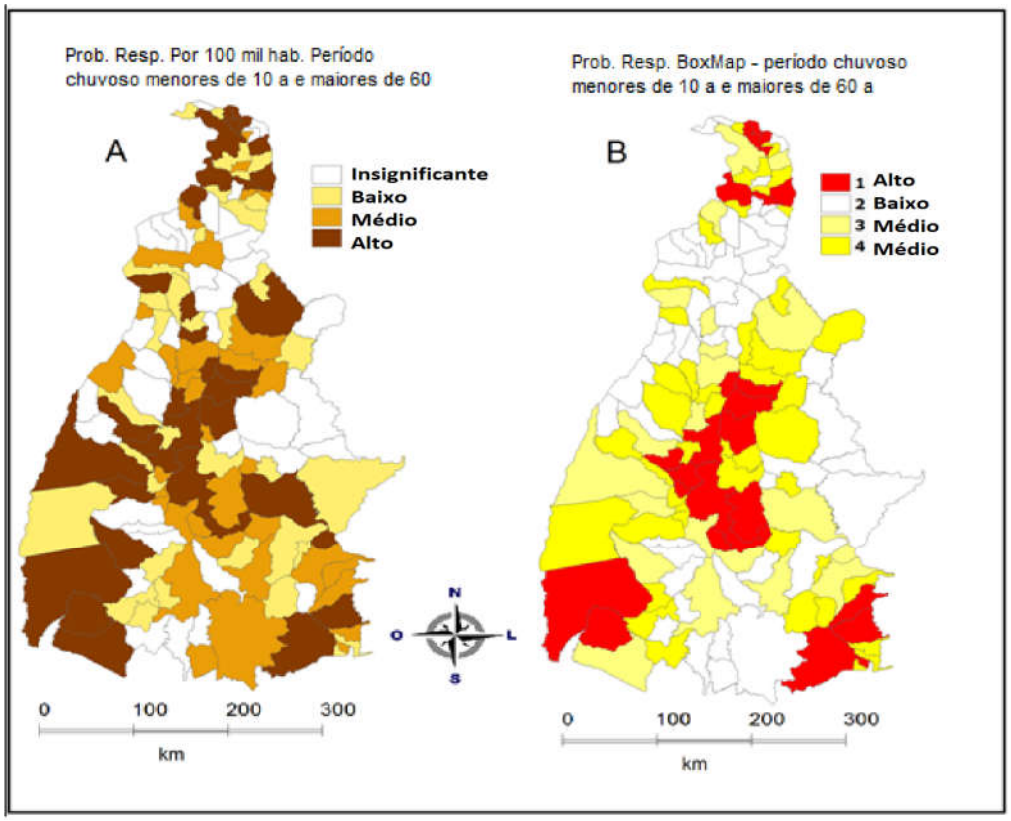


Figure 5. Maps of the distribution of pulmonary diseases, rainy season from October 2008 to September 2011, A- per 100 thousand inhabitants, B- BoxMap, Tocantins - Brazil

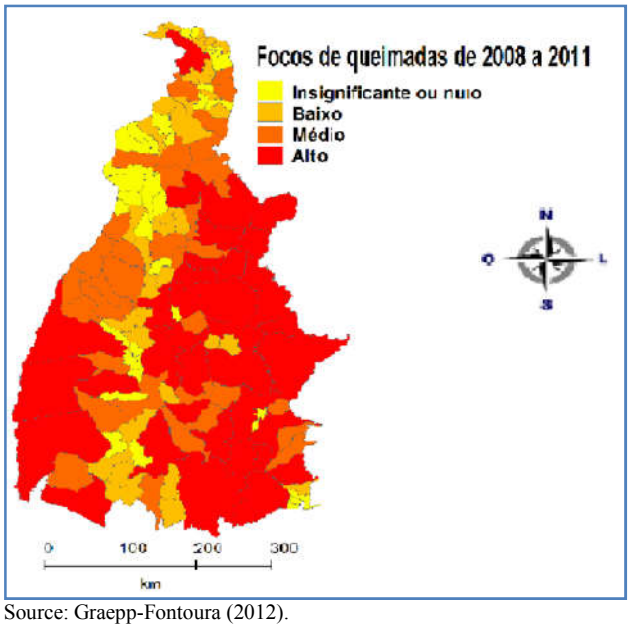
rates, 910.87 and 1.673.14 and high rates from 1,673.14 to 5,165 , 18 per 100 thousand inhabitants. The municipalities that presented the most respiratory problems in the rainy season, according to Figure 03, letter A, are dispersed by the state, highlighted in the darker color, with high rates. It can be seen in Figure 03, letter B, that the rates said to be insignificant, the coefficient of detection ranged from 38.99 to 560.35, at low rates, 560.35 to 910.87, medium rates, 910.87 and 1,673.14 and high rates 1,673.14 to 5,165.18 per 100

thousand inhabitants. The municipalities that presented the most respiratory problems during the dry season, are also dispersed by the state, arranged in dark brown color, with high rates. In Figure 4, letter A, the data referring to respiratory problems in the dry season in children less than 10 years and older than 60 years are set out. Figure 4, letter B, data are available for respiratory diseases in the dry season, in the age groups less than 10 years of age and over 60 years of age during the entire dry season that the survey covered. With regard to lung diseases in children younger than 10 years and older than 60 years, it is noted that the detection coefficient ranged from 38.99 to 5.165.18.

The rates were created in quantile, and all municipalities reported cases of hospitalization due to respiratory problems. The data presented in the color white as insignificant, had a variation of the detection coefficient between 38.99 to 560.35 per 100,000 inhabitants, yellow with low rates, 560.35 to 910.87, light brown with medium rates, 910.87 and 1673.14, dark brown with high rates, 1673.14 to 5165.18 per 100 thousand inhabitants. It can be seen in figure 4 that the municipalities in color red with value 1 are those that need intervention, since they have high values, the cities with white color of value 2 were those that had low values, that way they do not require interventions, already municipalities of light yellow color with value 3. and those of dark yellow color presented value 4, that way also do not require an immediate intervention. Figure 5 shows letter A (per 100,000 inhabitants) and letter B (Box map), data referring to respiratory problems in the rainy season, in the age groups less than 10 years and over 60 years in the rainy season that the research covered.

When analyzing the respiratory problems during the rainy season, it was possible to verify a detection coefficient between 30, 99 and 5,338.05. The rates were created in quantile, and all municipalities reported cases of hospitalization due to respiratory problems. The data presented in white color as insignificant, had a variation of the coefficient of detection between 30.99 to 573.20 per 100 thousand inhabitants, yellow with low rates, 573.20 to 929.04, light brown with medium rates, 929.04 and 1570.43, dark brown with high rates, 1570.43 to 5338.05 per 100 thousand inhabitants. The rates were created in quantile, with municipalities in color red 1, those that need intervention, because they have high values, the cities with a white color of value 2 were those that had low values, not requiring interventions, municipalities of light yellow color with value 3 and those of dark yellow with value 4 presented average values, in this way also they do not need an immediate intervention. Figure 6 is the representation of the total of fires that occurred between the years of 2008 and 2011, in the state of Tocantins.

When comparing the fires with the maps that approached the spatial correlation in the period of drought in the age groups less than 10 years and over 60 years of age, it was possible to visualize the municipalities that had the highest rates with spatial correlation in the maps A of the a period of drought based on the boxmap, corresponding to maps B which allows the exact location of the municipalities that need interventions in that particular location.



Source: Graepp-Fontoura (2012).

Figure 6. Map with the total of fires from 2008 to 2011

DISCUSSION

In view of the results of the present study, it is worth noting that there was a higher index of respiratory pathologies between April and May, with the transition months from rainy season to drought period. It was observed that the pathology with the highest index is pneumonia, after asthma, bronchitis and emphysema in the third place, and in the last place bronchiolitis. It is very noticeable that at the beginning of the rainy season there is an increase in the diagnosis of respiratory pathologies this can occur because some viruses present seasonal behavior. Both the fall and the high relative humidity of the air in the cyclical periods of drought / rain can imply damage to the respiratory tract of the individuals, especially to those that have some previous affection, such as a simple episode of cold (ROSA et al., 2008a). Corroborating with these findings, Thomazelli et al. (2007), points out that some viruses show a highly seasonal behavior, that is, they change more frequently in the cold season in areas of temperate climate and also in the rainy season in regions of tropical climate, such as in the legal Amazon. These viruses often cause respiratory diseases in children, especially the upper airways. However, the highest number of cases of pneumonia in 2009 was 8,988 cases in contrast to that of bronchiolitis, with the lowest percentage being only 141 cases in 2008, there is a very significant disparity comparing them during these stipulated periods.

In research already carried out in a macro-region of the Midwest, there were also significant cases of hospitalization for pneumonia and mainly emphysema and bronchitis, which partially corroborates the data obtained in the study, since both data from the surveys present results similar in relation to the classification by order of occurrences and respiratory pathologies specified. According to the list of morbidity of respiratory diseases, chronic obstructive pulmonary diseases (emphysema and bronchitis) are the main causes of hospitalizations in the elderly. Pneumonia is also an important cause of hospitalization in the Eastern Macroregion and Vale do Aço, since the hospitalization rate is high and has been oscillating over the years (DUTRA et al., 2010). The study also showed that the municipalities with the greatest

respiratory problems in the rainy season were: Araguaçu (Gurupi Sanitary Microregion No. 130), Taguatinga (Dianópolis Sanitary Micro-Region No. 129), Miranorte (Sanitary Micro-Region of Paraiso do Tocantins de No. 70) and Tocantínia (Sanitary Micro-Region of Palmas No. 73).

In relation to the spatial statistics in the rainy season, the Moran Global index, the significance was of I = 0.07 and the p-value of 0.08, showing that there was no significant spatial correlation between the municipalities. On the other hand, when evaluating the municipalities that presented the greatest number of respiratory problems during the dry season, it was evident that they are dispersed by the state: Miranorte (Palmeira Sanitary Microregion No. 70), Araguaçu (Microregion Sanitary of Gurupi No. 130), Taguatinga (Sanitary Micro-Region of Dianópolis No. 129), and Tocantínia (Sanitary Micro-Region of Palmas No. 73). When analyzing the significance of the spatial statistic in the dry season, the Moran Global index was I = 0.08 and the p-value was 0.05, showing that there was a spatial autocorrelation between the municipalities , with statistical significance, since the p-value less than 0.05 is significant. When analyzing the respiratory problems in the dry season in children under 10 years and over 60 years, it is important to note that when calculating the Moran Global index, to assess the significance, I = 0.039 and p-value of 0, 23, evidencing spatial autocorrelation, with no statistical significance. When correlating the two maps of respiratory problems in the drought period of Figure 4, the first one per 100,000 inhabitants and the other Boxmap, it was possible to detect that three municipalities (Miranorte, Tocantínia and Taguatinga) had the highest autocorrelation rates, proving the intervention of these three municipalities.

When comparing the two maps of figure 5, which deals with respiratory problems in the age group less than 10 years and greater than 60 years, it was found that two municipalities (Tocantínia and Taguatinga) that presented the highest rates of respiratory problems require intervention in the rainy season. However, it is not possible to discard the interventions of other municipalities that obtained high values and that presented respiratory problems in the rainy period that encompass the research, as some municipalities of the sanitary micro-regions of Araguatins and Tocantinópolis, among them are Carrasco Bonito (Sanitary Microregion of Araguatins de 4), Sampaio (Sanitary Microregion of Araguatins No. 5), Praia Norte (Araguatins Sanitary Microregion No. 8), Augustinopolis (Araguatins Sanitary Micro-region No. 6), Araguatins (Araguatins Sanitary Micro-Region No. 7), Axixá of Tocantins (Micro-Region of Araguatins No. 12), Nazaré (Tocantinópolis Sanitary Microregion No. 19), and Tocantinópolis (Tocantinópolis Sanitary Micro-region of No. 16), and these municipalities are in a nearby location. In the central part of the state there is also a cluster of municipalities that require intervention and they are significantly correlated within the results of the survey of both maps of Figure 5. It was also observed that the first four municipalities with the highest ranking rates were: Tocantínia (Palmeira Sanitary Micro-region No. 73), Tocantinópolis (Tocantinópolis Sanitary Micro-region No. 16), Taguatinga (Sanitary Micro-Region of Dianópolis de no. 129) and Augustinópolis (Micro-Region of Araguatins No. 6), which need intervention actions as well as the other municipalities that are highlighted in dark brown color. The spatial statistic, the Moran Global index, when evaluating the significance was of I = 0.16 and the p-value of 0.01, evidencing, therefore, that there was spatial autocorrelation, with statistical significance. In addition, it is important to note that acute and chronic respiratory diseases are an important cause of mortality (ROSA et al., 2008). In the world, children under 5 living in urban areas have 4 to 6 episodes of acute respiratory infection (ARI) per year; while in rural areas the frequency is 2 to 4 episodes per child / year, regardless of the level of development of the region (ROSA et al., 2008). With regard to fires, the study showed that municipalities with high-level fires, coincided with municipalities that really need intervention during the dry season, and these municipalities are: Tocantínia (Sanitary Micro-Region of Palmas, nº 73), Araguaçu (Sanitary Micro-region of No. Gurupi nº 130) and Taguatinga (Dianópolis Sanitary Micro-region No. 129), but other municipalities that were close to these also presented needs for interventions such as the municipalities of Miranorte (Sanitary Micro-region of Paraíso do Tocantins of nº 70) and Duerê (Sanitary Micro-region of Gurupi of nº 111). Other municipalities such as Augustinópolis (Micro-Region of Araguatins of No. 6) and Tocantinópolis (Tocantinópolis Sanitary Micro-region of No. 16), presented intervention needs, but there were no high rates of fires outbreaks, and this factor may be related to the municipality of Araguatins Microregion of Araguatins No. 7) that presented a high index of fires, being located near the two municipalities mentioned above. As can be seen, we can associate the high rates of burn outbreaks as a contributing factor to the finding of the municipalities that presented the most intervention needs related to diseases of the respiratory system.

Conclusion

It was possible to identify spatial patterns of the distribution of respiratory diseases in the dry and rainy season from October 2008 to September 2011, in the state of Tocantins. By means of thematic maps, high priority areas of intervention and density of rates were identified according to the municipalities. During the three years studied, it was possible to identify the highest rate of respiratory pathologies between April and May, with the transition months from rainy season to the dry season. Regarding lung problems in the rainy season from October 2008 to April 2011 in the State of Tocantins, it was possible to observe an increase in the month of December, with its highest peak in April, where the transition from the rainy period to the rainy season occurs drought. Regarding lung problems in the months of drought between May 2009 and September 2011 in the State of Tocantins, there was a decrease that began in May, with the highest peak, corresponding to the transition month between the rainy season. Thus, it is concluded that it is possible to propose intervention measures for certain microregions in order to reduce the rates of respiratory diseases in the dry season by promoting environmental education actions associated with health education, for this it is essential the support of the municipal spheres, state and federal.

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