Original Article

Analysis of hospitalizations for respiratory diseases in Tangará da Serra, Brazil*

Análise das internações por doenças respiratórias em Tangará da Serra – Amazônia Brasileira

Antonia Maria Rosa[1], Eliane Ignotti[2], Sandra de Souza Hacon[3], Hermano Albuquerque de Castro[3]

Abstract

Objective: To analyze hospitalizations for respiratory diseases among children under 15 years of age in an area with high levels of environmental pollution. **Methods:** A cross-sectional study of hospitalizations due to respiratory diseases of patients residing in the city of Tangará da Serra, located in the state of Mato Grosso (Brazilian Amazon region), from 2000 to 2005. Data on hospital admissions were obtained from the Brazilian Unified Health Care System and from Brazilian Institute of Geography and Statistics population estimates. **Results:** In 2005, the rate of hospitalization for respiratory diseases among children under 15 years of age in the microregion of Tangará da Serra was 70.1/1,000 children. Between 2000 and 2005, there were 12,777 such admissions, of which 8,142 (63.7%) were for respiratory diseases. During the dry season (May to October), the rate of admissions for respiratory diseases was 10% higher than during the rainy season (November to April). The principal causes of admission included pneumonia (90.7%) and respiratory insufficiency (8.5%). Admissions of children under 5 years of age for pneumonia were 4 times the expected number for the city. Children under 12 months of age were the most frequently hospitalized, with an average increase of 32.4 admissions per 1,000 children per year. **Conclusions:** Tangará da Serra presented a high number of pediatric admissions for respiratory diseases. Therefore, it is logical to consider it a priority area for investigation and monitoring of the environmental risk factors for such diseases.

Keywords: Respiratory tract diseases; Pneumonia; Hospitalization; Climate; Air pollution/Brazil.

Resumo

Objetivo: Analisar as internações hospitalares por doenças respiratórias em menores de 15 anos de idade em uma área com elevados níveis de poluição ambiental. **Métodos:** Estudo transversal da morbidade hospitalar por doenças respiratórias de residentes no município de Tangará da Serra (MT) na Amazônia brasileira, no período de 2000 a 2005, através de dados de internações hospitalares do Sistema Único de Saúde brasileiro e de estimativas populacionais do Instituto Brasileiro de Geografia e Estatística. **Resultados:** Em 2005, a taxa de internações por doenças respiratórias em menores de 15 anos foi de 70,1/1.000 crianças na microrregião de Tangará da Serra. Entre 2000 a 2005 ocorreram, no município de Tangará da Serra, 12.777 internações de crianças, das quais 8.142 (63,7%) por doenças respiratórias. No período da seca (maio a outubro) houve 10% mais internações por doenças respiratórias que no período da chuva (novembro a abril). As principais causas de internação foram: pneumonias (90,7%) e insuficiência respiratória (8,5%). Em menores de 5 anos de idade, as internações por pneumonia foram mais de 4 vezes o esperado para o município. Os menores de 12 meses de idade foram mais frequentemente internados, com incremento médio de 32,4 internações por 1.000 crianças a cada ano. **Conclusões:** Tangará da Serra tem apresentado elevado número de internações por doenças respiratórias, portanto, é coerente considerá-lo como área prioritária para investigação e monitoramento dos fatores de risco ambientais para tais doenças.

Descritores: Doenças respiratórias; Pneumonia; Hospitalização; Clima; Poluição do ar/Brasil.

Introduction

Respiratory diseases, whether acute or chronic, are a major cause of morbidity and mortality. Worldwide, among children aged five years or less, those living in urban areas present 4 to 6 episodes of acute respiratory infection per year, compared with 2 to 4 episodes per year among those living in rural areas, regardless of the level of development of the region.[1]

* Study carried out at the *Universidade do Estado de Mato Grosso* – UNEMAT, State University of Mato Grosso – Cáceres, Brazil, and at the *Escola Nacional de Saúde Pública/Fundação Oswaldo Cruz* – ENSP/FIOCRUZ, National School of Public Health/Oswaldo Cruz Foundation – Rio de Janeiro, Brazil.
1. Professor and Coordinator of the *Estágio Regional Integrado da Universidade do Estado de Mato Grosso* – UNEMAT, Integrated Regional Internship of the State University of Mato Grosso – Cáceres, Brazil.
2. Professor in the Masters in Collective Health Program. *Universidade Federal do Mato Grosso* – UFMT, Federal University of Mato Grosso – Cuiabá, Brazil.
3. Professor in the Masters and Multidisciplinary Doctoral Program. *Escola Nacional de Saúde Pública/Fundação Oswaldo Cruz* – ENSP/FIOCRUZ, National School of Public Health/Oswaldo Cruz Foundation – Rio de Janeiro, Brazil.
Correspondence to: Antonia Maria Rosa. Av. Getúlio Vargas, 2335, Bairro Jardim Aida, CEP 78200-000, Cáceres, MT, Brasil.
Tel 55 65 9601-3465/55 65 3221-0504. Fax 55 65 3221-0500. E-mail: antonia-mr@unemat.br/antonia-mr@hotmail.com
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The majority of these cases are self-limiting upper respiratory tract infections. However, the cases that culminate in hospitalization, principally cases of pneumonia, most frequently occur in children living in developing countries.[2]

It is estimated that, among children under the age of 5 who live in such countries, the frequency of pneumonia is approximately 0.28 episodes per child-year. Between 7 and 13% of these episodes require hospitalization.[3] However, countries in the same region can present significant differences in terms of acute respiratory infection-related morbidity and mortality.[2]

In Brazil respiratory diseases are responsible for approximately 16% of all hospitalizations, 50% of those being due to pneumonia.[4] However, in more vulnerable groups, such as children, respiratory diseases are responsible for more than 50% of all hospitalizations.[5]

The prevalence of chronic forms of respiratory disease has also increased, in Brazil and in the world. In this group, we highlight asthma, the mean prevalence of which is 20% in Brazil,[6] higher than that reported for other Latin-American countries and one of the highest in the world. Between 5 and 10% of all cases of asthma are considered severe,[7] potentially requiring hospitalization.

Risk factors for hospitalization due to respiratory diseases include the following: exposure to environmental pollutants,[8-11] especially smoking[12]; close living quarters; deficit in nutritional status[13]; climatic seasonality[14]; incomplete immunization schedules[15]; poor socioeconomic conditions[16]; and exposure to biologic agents, such as pollen.[6] Such factors principally affect children under 5 years of age and adults over 65 years of age.

Exposure to environmental pollutants is a situation particularly problematic in some cities of the state of Mato Grosso, Brazil. A study carried out in the state capital of Cuiab showed the proportion of hospitalizations due to respiratory diseases is higher in the dry season, when the number of (sugar cane field) burn-offs in the region is greater.[14]

The city of Tangará da Serra, where the present study was conducted, is located in the trajectory of the dispersion of the pollutants generated both in neighboring countries and in the area of the arc of deforestation, in addition to having a growing area of cultivation of sugar cane to supply three processing plants in the region. The burning of sugar cane fields in the dry season is a practice that has increased the concentrations of gases and aerosol particles in the atmosphere of the region. In addition, the city is within the Amazon biome, with well-defined dry and rainy seasons.

Due to this relevant social and environmental scenario and to the perspectives for agribusiness growth for the region, the objective of this study was to analyze the hospitalizations due to respiratory diseases in patients below the age of 15 by age bracket, gender, and diagnosis, as well as to evaluate the climatic tendency and seasonality of these hospitalizations in the city of Tangará da Serra, Brazil.

Methods

Study design

This was a cross-sectional study of hospital morbidity due to respiratory diseases (chapter X of the tenth revision of the International Classification of Diseases-ICD-10-codes J00 to J99) of the residents in the city of Tangará da Serra, in the period of 2000 to 2005. We used the authorized hospital admissions database of the Brazilian Ministry of Health *Sistema Único de Saúde* (SUS, Unified Health Care System) Hospital Information System. Age-related population data were obtained from the Brazilian Institute of Geography and Statistics. For the year 2000, we considered the census; for the other years, we used the population estimates. Data on relative humidity were obtained from the Brazilian National Meteorological Institute,[17] but were available only for the years since 2003. We selected the paid non-elective authorized hospital admissions with short period of hospitalization (type 1) according to the year the hospitalization occurred and the place of residence of the patient. For value comparison, the table of values paid for procedures was provided by the Regional Health Department. For the purpose of this study, seasonality was defined as the dry season (May to October) and the rainy season (November to April). Individuals under the age of 15 were defined as those who were, at the time of hospitalization, at least 14 years, 11 months and 29 days of age.

Population and area of study

The city of Tangará da Serra is the treatment headquarters of the microregion of Tangará da Serra, which includes the cities of Barra do Bugres, Tangará da Serra, Nova Olímpia, Denise and Porto Estrela. The health services are composed of four private hospitals with a total of 180 beds. Two of those hospitals accept patients covered by SUS, together having 79 beds designated for SUS patients and 32 beds available either for patients covered by SUS or for those covered by private health insurance plans.[18] We chose to investigate children under 15 years of age due to the greater number of visits to health care facilities, as well as the greater vulnerability, seen in this age group.

Data analysis

We constructed rates of hospitalization due to respiratory diseases in patients under 15 years of age according to the microregions of the state of Mato Grosso, Brazil for the year of 2005. The proportion of hospitalizations per ICD-10 chapter per year was calculated based on the admissions of Tangará da Serra residents of all ages. Hospitalizations due to respiratory diseases were compared to hospitalizations due to pregnancy, delivery and puerperium since the latter is the principal cause of hospitalizations registered in Brazil.[19] Proportions and hospitalizations in patients under 15 years of age were calculated, as was the linear tendency of this rate. The mean of monthly admissions for this period was calculated and presented as a figure together with the mean air humidity in 2005. The variables selected for study were gender, age, month of hospitalization, year of hospitalization, ICD-10 chapters, groups of causes and evolution. The neonatal period was excluded from the analyses or analyzed separately, in function of the importance of the component attention to prenatal care and delivery for the morbidity and mortality of this age group. The software TabWin (http://www.datasus.gov.br) was used for conversion and analysis of the data obtained from the *Departamento de Informação e Informática do* SUS (DATASUS, Information Technology Department of the SUS). The study was approved by the Ethics in Research Committee of the Federal University of Mato Grosso Julio Muller University Hospital on January 24, 2007.

Results

In the year 2005, the rate of hospitalization due to respiratory diseases in patients under the age of 15 was higher in the microregion of Tangará da Serra (70.1/1,000 children) than in any other region in the state of Mato Grosso, followed by the microregion of Canarana (64.6/1,000 children; Figure 1). When grouped into quartiles, 75% of the microregions of the state presented rates lower than 54.1/1,000 children.

During the six-year study period, the number of SUS-sponsored hospitalizations among residents of the city of Tangará da Serra was 29,619, of which 10,662 (36%) were due to respiratory diseases.

Respiratory diseases constituted the leading cause of hospitalization during the study period, accounting for 10 to 50% more hospitalizations than did pregnancy, delivery and puerperium. The proportion of admissions due to respiratory diseases varied from 33.2% (in 2002) to 41% (in 2004), followed by that of admissions due to pregnancy,

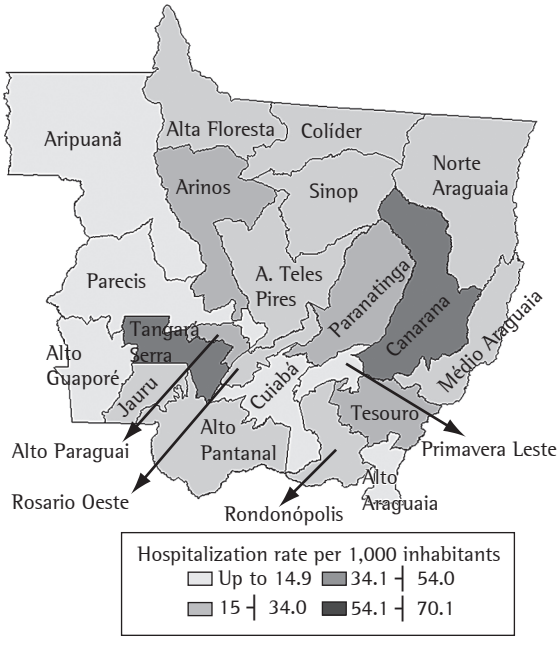

Figure 1 - Rate of hospitalization due to respiratory diseases in patients under 15 years of age according to microregion of residence. State of Mato Grosso, Brazil, 2005. Source: Brazilian Ministry of Health/Information Technology Department of the Unified Health Care System. Hospitalizations during neonatal period were excluded.

delivery and puerperium, which varied from 18.3% (in 2002) to 22.3% (in 2004).

In patients under 15 years of age, all-cause hospital admissions accounted for 12,777 hospitalizations, of which 8,142 (63.7%) were due to respiratory diseases. When the neonatal period was excluded, all-cause hospital admissions accounted for 11,713 hospitalizations, 7,733 (66%) of which were due to respiratory diseases. Of the 7,733 patients admitted, 4,275 (52.3%) were male and 3,458 (44.7%) were female.

Among the 8,142 children hospitalized due to respiratory diseases in the period, 15 died. Of those 15, 11 (73.3%) were female and 4 (26.7%) male, the in-hospital mortality rate being 1.8/1,000 hospitalizations or 0.9/1,000 hospitalizations if the neonatal period is excluded.

The rate of hospitalization due to respiratory diseases in patients under 15 years of age presented a mean estimated increase of 2.6/1,000 children per year. In patients under 12 months of age, however, the mean estimated increase was 32.4/1,000 children per year. This age group presented the highest rates of hospitalization due to respiratory disease during the period studied (Figure 2).

In patients aged 15 years of less, hospitalization due to diseases of the upper respiratory tract accounted for 1.5% of all hospitalizations due to respiratory diseases, whereas that due to diseases of the lower tract accounted for 98.5%, the majority due to acute conditions, which accounted for 99.5% of the hospitalizations due to diseases of the lower respiratory tract.

Pneumonia was the leading cause of hospitalization (90.7%), followed by respiratory insufficiency, which accounted for 8.5% of the hospitalizations. However, chronic respiratory diseases, such as asthma, severe acute asthma and bronchiectasis, accounted for 0.5% of the hospitalizations.

The number of hospitalizations due to pneumonia in patients under the age of 5 during the study period was more than four times higher than that expected for the city (Table 1).

Excluding the neonatal period, boys presented a mean rate of hospitalization due to respiratory diseases of 63.6/1,000 children in 2000 and 72.7/1,000 children in 2005, which was 20% higher than that found for girls. Among girls, this rate increased from 47.4/1,000 children in 2000 to 76.3/1,000 children in 2003.

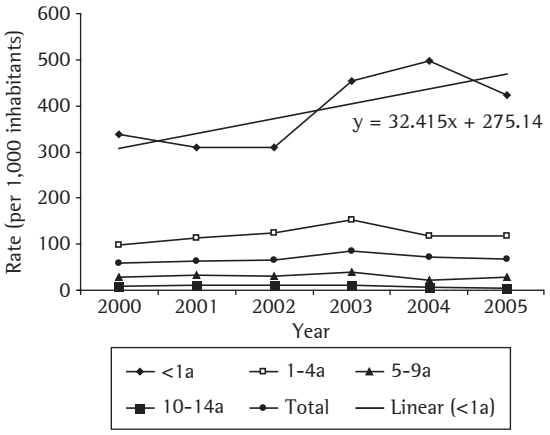

Figure 2 - Rate of hospitalization according to age. Tangará da Serra, Brazil, 2000 to 2005. Source: Brazilian Ministry of Health/Information Technology Department of the Unified Health Care System/Hospital Information Service.

The number of hospitalizations due to respiratory diseases was lower in the months of December, January and February. There was an increase in the number of hospitalization due to respiratory diseases in the month of March and in the months of intense drought (July, August and September), whereas the number of hospitalizations due to diseases described in other ICD-10 chapters presented less pronounced variations throughout the year (Figure 3a).

The mean number of hospitalizations due to respiratory diseases was 10% higher in the dry season than in the rainy season. We highlight the year 2001, in which the number of hospitalizations due to respiratory diseases was 50% higher in the dry season than in the rainy season (Table 2).

Analyzing the monthly mean of aggregated hospitalizations from 2003 to 2005 and the monthly mean relative humidity in 2005, we observed that hospitalizations peaked in August, when the relative humidity is lowest (Figure 3b). In this period, the mean monthly temperature presented slight variation (between 21.8 and 25.4 °C).

Discussion

The DATASUS records of hospitalizations for the state of Mato Grosso, for the Central-West region and for Brazil as a whole show that most paid authorized hospital admissions are those due to pregnancy, delivery and puerperium.[4,19] In the city of Tangará da Serra, however, hospitalizations due

Table 1 - Distribution of expected and observed cases of pneumonia in patients under 5 years of age. Tangará da Serra, Brazil, 2000 to 2005.

Year of hospitalization	Population under 5 years of age	Expected cases of pneumonia in the community	Expected cases of hospitalization due to pneumonia[b]	Observed cases of hospitalization due to pneumonia[b]
2000	5,870	1,643.6	213.6	703
2001	6,079	1,702.0	221.3	814
2002	6,253	1,750.8	227.6	872
2003	6,430	1,800.4	234.0	1,257
2004	6,607	1,850.0	240.5	1,227
2005	7,009	1,962.5	255.0	1,145

Source: Brazilian Ministry of Health/Information Technology Department of the Unified Health Care System/Hospital Information Service. [a]Calculated according to the estimation method proposed by Rudan et al.[3] - 0.28 episodes of pneumonia/year in children under 5 years of age. [b]Calculated according to the estimation method proposed by Rudan et al.[3] - it was considered that approximately 13% of the episodes of pneumonia/year in children under 5 years of age evolve to hospitalization.

to respiratory diseases accounted for the greatest proportion of hospitalizations in the study period.

Our data are in accordance with those in the literature regarding age bracket, the highest rates of hospitalization due to respiratory diseases being observed in children up to 12 months of age. It is known that the risk of acquiring acute respiratory infection is not different for children under 12 months of age and for those aged 12 months to 4 years; however, the risk of hospitalization is higher among the former, possibly due to greater vulnerability.[20]

In the neonatal period, in-hospital mortality due to respiratory diseases was higher, as was the prevalence of the many risk factors for morbidity and mortality. The component of attention in the pre-natal, delivery and puerperium periods must be taken into consideration in in-hospital mortality.[21]

We observed that boys were more frequently hospitalized due to respiratory diseases than were girls. One report in the literature showed that males present a 1.5 times higher risk of hospitalization due to respiratory diseases than do females.[22] Among other factors, anatomical differences and greater exposure to risk factors are the suggested explanations.

In the present study, as well as in other studies, hospitalization due to acute respiratory infection

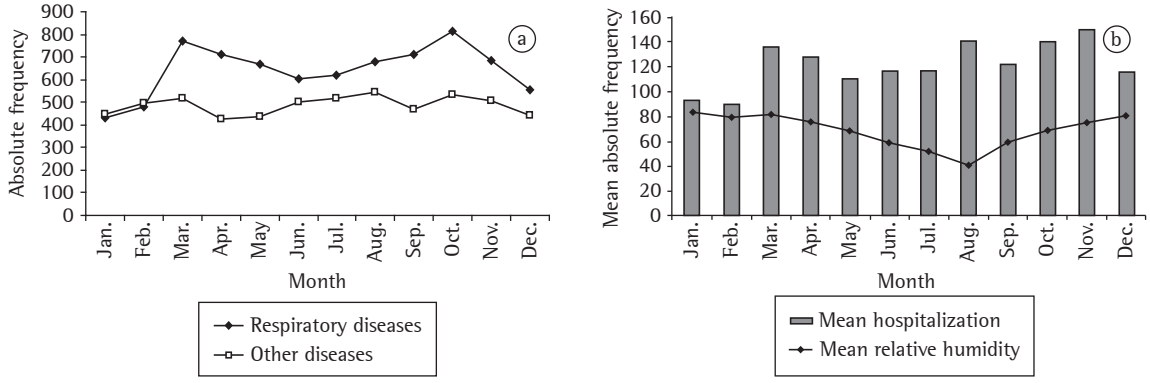

Figure 3 - Distribution of the hospitalizations due to respiratory diseases and other diseases according to the month of hospitalization from 2000 to 2005 (a) and the mean of hospitalizations due to respiratory diseases in the period of 2003 to 2005 compared to mean relative humidity in 2005 (b), excluding the neonatal period, in patients under 15 years of age. Tangará da Serra, Brazil.Source: Hospital Information Service/Information Technology Department of the Unified Health Care System.

Table 2 - Ratio of the hospitalization due to respiratory diseases according to the dry and rainy season[a], excluding the neonatal period in patients under 15 years of age. Tangará da Serra, Brazil, 2000 to 2005.

Year of hospitalization	Dry season	Rainy season	Ratio
2000	541	459	1.2
2001	675	451	1.5
2002	635	593	1.1
2003	813	815	1.0
2004	785	587	1.3
2005	645	734	0.9
Total	4094	3639	1.1

Source: Hospital Information Service/Information Technology Department of the Unified Health Care System, 2006. [a]Dry season: May to October; rainy season: November to April.

was found to be more common than was hospitalization due to other causes.[1-3] However, in the present study, the number of cases of pneumonia were higher than that estimated for the city according to the method proposed by Rudan et al.,[3] with a minimal but constant increase in the rates of such admissions in patients under 15 years of age over the study period.

The high proportions of hospitalization due to pneumonia can be a result of alterations in the mechanisms of remuneration for the procedures during the period: the value of the remuneration for the hospitalization due to pneumonia presented an increase of 124.8% since 2002, reaching a final value higher than the remuneration for hospitalization due to asthma, which increased by 51.9%.

In cases of acute respiratory insufficiency, the influence of the mechanisms of remuneration cannot be ruled out; the final value of the remuneration for hospitalizations due to respiratory insufficiency was below that paid for those due to pneumonia, albeit higher that those paid for asthma.

It is of note that the various types of pneumonia are on the list of conditions responsive to outpatient care; properly treated in the primary care service, they should not evolve to requiring hospitalization.[23] However, the limited coverage provided by the Family Health Program in the city prior to 2005 might have contributed to the elevated proportions of hospitalizations due to respiratory diseases: only 15.5% of the population, according to the data from the DATASUS Primary Health Care Database.

Regarding hospitalizations due to asthma, we found the opposite of what was observed for hospitalizations due to pneumonia: considering the mean prevalence of asthma in Brazil,[6] in addition to the proportion of these cases which might require hospitalization,[7] there seems to be underreporting of the cases of this disease.

It is known that profiles of upper or lower respiratory tract infection, especially viral infection, can lead to asthma exacerbation.[7,24,25] However, it seems that even in cases in which the individual presents asthma symptoms, the most common cause of hospitalization is pneumonia.

In addition, there is difficulty in the clinical diagnosis of asthma,[7] as well as prejudice and resistance from the parents in accepting the fact that the child has the disease. These factors, in conjunction or in isolation, can lead to underreporting of asthma and can influence the way in which health clinic staffs organize patient care protocols.

Although there were differences among months in terms of the number of hospitalizations, we found operational seasonality accompanying the significant drops in the months of December, January and February, all of which are vacation months for health professionals, especially physicians.

At the end of February and the beginning of March, the health professionals return from vacation, which might have been responsible for the peak observed in March. However, this is also when children return to schools and day care centers. Therefore, the March peak might be attributable to the fact that children with low immunity come into contact with classmates carrying microorganisms brought from various nuclear families,[26] influenced by close living quarters,[13] which can be an aggravating factor in the dissemination of infections.

Hospitalizations due to respiratory disease also tend to increase in July. It is known that months of extreme drought represent risk of irritation of the respiratory system and exacerbation of the chronic diseases, due to the lower relative humidity and greater concentrations of air pollutants.

The high relative humidity at the end of September can promote the growth of fungi in the household environment, which could explain the peak observed in October, since these microorganisms are significant allergens, especially in predisposed individuals, and are associated with asthma.[7]

An increase in emergency room visits due to asthma in the rainy months has been reported in the literature. However, similar to what was observed in the present study, the proportion of hospitalizations due to asthma has been shown to be greater in the dry season.[27]

A study carried out in the city of Piracicaba, Brazil showed that an increase in the levels of air pollution resulted in a 21.4% increase in the number of hospitalizations in children under the age of 13.[9] However, the studies carried out to date refer to respiratory disease in the scenario of exposure to pollution in urban centers that are more industrialized, with greater population density and larger vehicle fleets, where climatic seasonality polarized in two seasons is not observed in such a pronounced form, characteristics differing from those found in Tangará da Serra. It remains in question whether this association would be similar in an Amazon region with typical cycles of drought and rain, which modify the levels of pollution and, possibly, the interaction of the latter with human health.

Pollutants generated from biomass burning, especially from the burning of sugar cane, the principal crop of the region, are composed of ultrafine particles which can remain suspended in the air for longer periods and can reach deeper portions of the respiratory tract, having adverse effects on health and increasing the number of hospitalizations due to respiratory diseases.[9]

In addition to the increased air pollution in the dry season, there can be a reduction in the dispersion of pollutants due to the geographical barriers of the city, which is surrounded by the Chapada dos Parecis and Serra Tapirapuã, factors which possibly contribute to the increase of hospitalizations observed in this period.

Analyzing the hospitalizations by season, we observed that the proportion of hospitalizations was greater in the dry season for all previous years, except 2003, as well as for the aggregated period. Although the proportion of hospitalizations was greater in the rainy season for 2005, this was an isolated finding.

Anthropogenic factors such as the economic activity in the city and the region, public policies for air quality control and incorporating technologies or not in the productive process are relevant factors for a better understanding of the local health scenario.[28]

In the view of these facts, the city meets the Brazilian Ministry of Health Air Surveillance Program criteria for inclusion as an Area of Interest for Atmospheric Environmental Impacts on Health. Therefore, it is considered important to establish a local sentinel clinic.

It should be borne in mind that the studied population refers to the portion of the residents in the city who are treated by the SUS. In addition, those who evolved to hospitalization represent more severe cases of the disease. However, the public health care system accounts for the majority of the hospitalizations in Brazil.[29] The reliability of data on hospital morbidity has steadily increased,[30] being easily available online, with little lag time.

We can conclude that the microregion and the city of Tangara da Serra both presented the highest proportions of hospitalization due to respiratory diseases in the state of Mato Grosso. Therefore, it is coherent to consider it a priority area for investigation and monitoring of the risk factors for human health, especially environmental risks.

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